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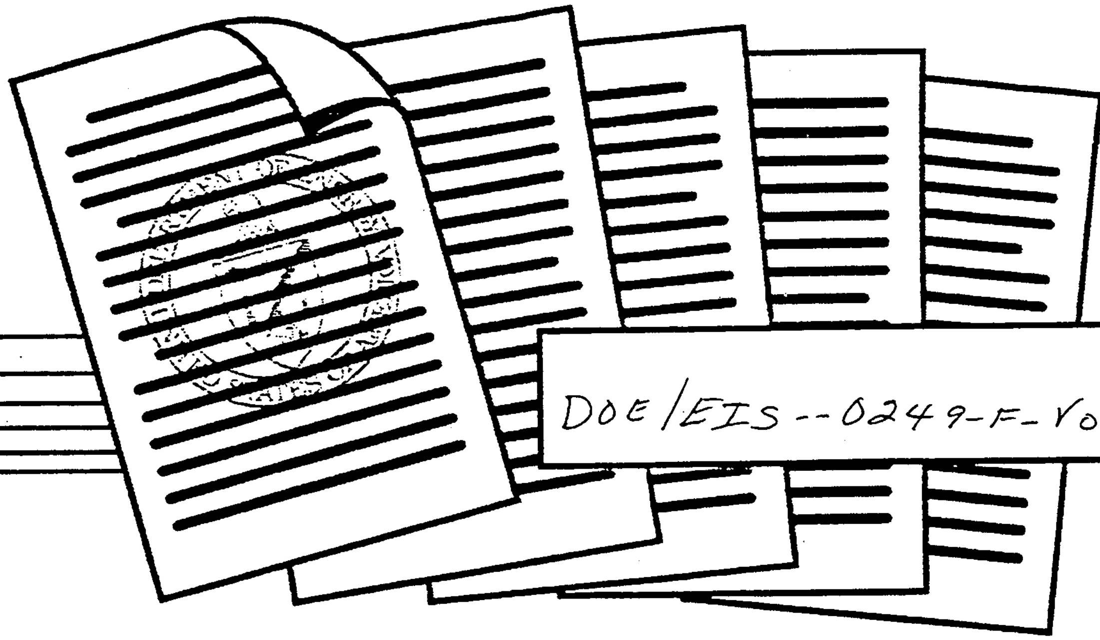

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Medical Isotopes Production Project: Molybdenum-99 and Related Isotopes

Environmental Impact Statement

Volume I

U.S. Department of Energy
Office of Nuclear Energy,
Science and Technology
Washington, D.C.

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Medical Isotopes Production Project: Molybdenum-99 and Related Isotopes: Environmental Impact Statement, Volume I

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ABSTRACT:

This Environmental Impact Statement (EIS) provides environmental and technical information concerning the U.S. Department of Energy's (DOE) proposal to establish a domestic source to produce molybdenum-99 (Mo-99) and related medical isotopes (iodine-131, xenon-133 and iodine-125). Mo-99, a radioactive isotope of the element molybdenum, decays to form metastable technetium-99 (Tc-99m), a radioactive isotope used thousands of times daily in medical diagnostic procedures in the U.S. Currently, all Mo-99 used in the U.S. is obtained from a single Canadian source. DOE is pursuing the Medical Isotopes Production Project in order to ensure that a reliable supply of Mo-99 is available to the U.S. medical community. Under DOE's preferred alternative, the Chemistry and Metallurgy Research Facility at the Los Alamos National Laboratory (LANL) and the Annular Core Research Reactor and Hot Cell Facility at Sandia National Laboratories/New Mexico (SNL/NM) would be used for production of the medical isotopes.

In addition to the preferred alternative, three other reasonable alternatives and a no action alternative are analyzed in detail. The sites for the three reasonable alternatives are LANL, Oak Ridge National Laboratory (ORNL), and Idaho National Engineering Laboratory (INEL). The analyses in this EIS indicate no significant difference in the potential environmental impacts among the alternatives. Each of the alternatives would use essentially the same technology for the production of the medical isotopes. Minor differences in environmental impacts among alternatives relate to the extent of activity necessary to modify and restart (as necessary) existing reactors and hot cell facilities at each of the sites, the quantities of low-level radioactive waste generated, how such waste would be managed, and the length of time needed for initial and full production capacity.

DOE issued a Draft EIS on December 22, 1995, and held a formal public comment period on the draft through February 9, 1996. During the comment period, two public hearings were held at or near each of the four alternative locations. Comments received and DOE's responses to those comments are found in the second volume of this EIS. The Final EIS contains change bars in the left-hand margin, reflecting DOE's consideration of the public comments.

Department of Energy
Washington, DC 20585

Dear Reader:

This is your copy of the *Final Environmental Impact Statement (EIS) for the Medical Isotopes Production Project (MIPP): Molybdenum-99 and Related Isotopes.* The Final EIS analyzes the environmental impacts of the Department of Energy proposal to establish a domestic source to produce molybdenum-99 and related medical isotopes. In this review, the Department identified four reasonable alternatives for accomplishing the proposed action. The Department's preferred alternative is to use existing facilities at Sandia National Laboratories/New Mexico and Los Alamos National Laboratory with appropriate modifications.

The Final EIS is a two-volume document. Volume I contains a discussion of the purpose of and need for the proposed action, alternatives for accomplishing the proposed action, a description of the affected environment surrounding each reasonable alternative, an analysis of the potential environmental impacts associated with each alternative, and a discussion of the regulatory framework applicable to the proposed project. Volume II contains the public's comments on the Draft EIS and the Department's responses to those comments.

For additional copies of this document, please contact Mr. Wade Carroll, MIPP EIS Document Manager, Office of Nuclear Energy, Science and Technology, NE-70, U.S. Department of Energy, 19901 Germantown Road, Germantown, Maryland 20874-1290, telephone (301) 903-7731, facsimile (301) 903-5434.

The Department's decision on the proposed Medical Isotopes Production Project will be made after this EIS has been publicly available for at least 30 days. Thank you for your interest in this proposed project.

Sincerely,

Terry R. Dash, Director
Office of Nuclear Energy,
Science and Technology

Summary

The U.S. Department of Energy (DOE) proposes to establish, as soon as practicable (in about 1 to 3 years), a domestic capability to produce a continuous supply of molybdenum-99 (Mo-99) and related medical isotopes for the U.S. medical community. The purpose of the proposed action is to ensure a reliable domestic supply of Mo-99, an important medical isotope, for the near term of 5 to 10 years.

The DOE has evaluated the following alternatives:

- No Action
- Annular Core Research Reactor: Sandia National Laboratories/New Mexico and Chemistry and Metallurgy Research Facility: Los Alamos National Laboratory-Preferred Alternative
- Omega West Reactor/Chemistry and Metallurgy Research Facility: Los Alamos National Laboratory
- Oak Ridge Research Reactor/Radioisotope Development Laboratory: Oak Ridge National Laboratory
- Power Burst Facility/Test Area North: Idaho National Engineering Laboratory.

Purpose and Need for Action

Over the last four decades, DOE and its predecessor agencies have produced and distributed certain isotopes for medical and industrial applications through DOE's national laboratories. In 1990, Congress established the Isotope Production and Distribution Program to consolidate all existing DOE isotope production activities under one program. Among other activities, this program has responsibility for ensuring that the U.S. health care community has access to a reliable supply of Mo-99.

What is molybdenum-99? Mo-99 is a radioactive isotope of the element molybdenum. Mo-99 is produced by splitting (fissioning) uranium-235 or by otherwise modifying the nucleus of a stable isotope. Mo-99 decays to form metastable technetium-99 (Tc-99m), a radioactive isotope that has broad applications in the area of medical diagnostic procedures. Tc-99m is the most widely used medical radioisotope in the U.S. According to a study prepared for the U.S. House of Representatives Subcommittee on Energy and Environment in February 1995 by members of a group called the Senior Scientists and Engineers, it was estimated that a total of approximately 38,000 diagnostic procedures involving radioactive isotopes are performed each day in the U.S. Most of these procedures use Tc-99m.

By chemically attaching Tc-99m to different carrier agents, the isotope can be concentrated in specific parts of the body, such as the lungs, liver, heart, brain, and skeletal system, to help identify medical conditions in these areas that could otherwise be identified only through invasive surgery.

Both of these isotopes are very short-lived. Mo-99 and Tc-99m have half lives (the time in which the quantity of the isotope is reduced by 50 percent) of 66 hours and 6 hours, respectively. Therefore, production and distribution must be maintained on an essentially continuous basis with rapid processing and delivery.

How is molybdenum-99 produced? Either an accelerator, a solution-fueled nuclear reactor, or a solid-fueled nuclear reactor can be used to produce Mo-99. However, the most efficient way to produce Mo-99 is through the fissioning of uranium-235 in a nuclear reactor. Two processes currently have U.S. Food and Drug Administration (FDA) approval in the U.S. The first is used by Nordion International, a Canadian firm, and the second is the Cintichem process (named for the Cintichem corporation) to which DOE now owns the exclusive rights. Both of these processes involve the fissioning of uranium-235 within highly enriched uranium targets inserted into a solid-fueled reactor.

Who has produced molybdenum-99 in the U.S.? Development of the Mo-99/Tc-99m generator occurred at the Brookhaven National Laboratory in New York in the 1950s. The Atomic Energy Commission produced and supplied Mo-99 from its reactors at Oak Ridge National Laboratory, Tennessee, and Brookhaven National Laboratory, New York, until 1966 when it discontinued this service in deference to commercial sources which began producing Mo-99 in the U.S. Production of Mo-99 was initiated in 1966 by Union Carbide Nuclear Corporation. From 1970 until 1989, Mo-99 was produced privately in the U.S. by the Cintichem Corporation, using a company-owned nuclear reactor located at Tuxedo, New York. During that period, Cintichem supplied approximately half of the Mo-99 used in the U.S. In 1989, Cintichem decided to shut down and decommission the reactor. Since then, no Mo-99 provided to the U.S. medical community has been produced in the U.S.

What is the current U.S. source for molybdenum-99? Since the Cintichem reactor shut down, the U.S. medical community has been dependent entirely on Nordion International in Canada for Mo-99. Nordion supplies 100% of the U.S. demand and approximately 85% of the world demand for Mo-99. Nordion receives their bulk Mo-99 from a single nuclear reactor (the National Research Universal reactor) operated by Atomic Energy of Canada Limited at the Chalk River site approximately 100 miles northwest of Ottawa, Canada.

How is the U.S. vulnerable to interruption of Mo-99 supply? The Canadian reactor was commissioned in 1957. The Atomic Energy of Canada Limited plans to shut down the reactor in the year 2000. Nordion International and Atomic Energy of Canada Limited are exploring the possibility of constructing two new reactors and one new Mo-99 separation facility that could produce Mo-99 using an improved process. Plans for the new project continue to be discussed, but the official announcement to construct these facilities has not been made. If two reactors are built that can act as backup for each other, reliable and sufficient backup production capability is expected to exist. If only one reactor is built, the risk of relying on a single source remains. To complete construction and commissioning of just one of these reactors and the required separation facility would take an estimated 36 months. By the end of commissioning, Nordion expects to have their new Mo-99 production process approved by the FDA. Completion of the construction and commissioning of the second reactor would take an estimated additional 12 months. Therefore, the earliest that Nordion could be expected to supply Mo-99 from a new reactor is mid-1999. Full-scale Mo-99 production would probably require at least an additional several months for each of the reactors. Until a backup production facility capable of providing 100% of the U.S. demand for Mo-99 is established, the U.S. will continue to be vulnerable to an interruption in the supply of this important isotope.

Are there other sources of molybdenum-99? Other Mo-99 production sources exist, located primarily in Europe. These sources potentially could increase their production rates in the event of a shut down of the Canadian reactor. Mo-99 could then be shipped to Nordion for final processing and shipment to radiopharmaceutical companies. However, due to the short half lives of Mo-99 and Tc-99m, the increased time required to ship Mo-99 from Europe would reduce the effective quantity of Mo-99 that could be supplied to the U.S. In any case, the European sources could supply only a portion of the U.S. demand. Accordingly, if the Canadian production source were to become unavailable, the supply of Mo-99 available to the U.S. would be substantially reduced or eliminated.

What is DOE's proposed action? DOE proposes to establish, as soon as practicable, a domestic capability to produce a continuous supply of Mo-99 and related medical isotopes for the U.S. medical community. The purpose of the proposed action is to ensure a reliable domestic supply of Mo-99, an important medical isotope. The near-term goal (over the next 5 to 10 years) would be to provide a backup capability for Mo-99 used in the U.S. by establishing a baseline production level of 10 to 30% of the current U.S. demand. This goal would include the capability to increase production to supply 100% of the U.S. demand, should the Canadian source become unavailable.

Because it is essential to establish a backup capacity as soon as possible, DOE proposes to use an FDA-approved Mo-99 production process. Specifically, DOE proposes to modify an existing research reactor and hot cells to produce and process Mo-99 and related medical isotopes. The Mo-99 would be packaged in Type B accident-resistant packaging for shipment by commercial air carriers to the U.S. radiopharmaceutical companies. Passenger aircraft could be used in accordance with the U.S. Department of Transportation regulation 49 CFR 175. The U.S. radiopharmaceutical companies would repackage the Mo-99 in Tc-99m generators from which the medical facilities would extract the Tc-99m. The U.S. radiopharmaceutical companies and their locations are as follows:

Company	**Location**
DuPont-Merck	Boston, Massachusetts
Amersham Mediphysics	Chicago, Illinois
Mallinckrodt Medical	St. Louis, Missouri

The DOE may choose to ship the Mo-99 product from the selected site to Nordion in Canada in lieu of shipping the product directly to the radiopharmaceutical companies. The product would then be inserted into the Nordion process stream so that final product testing and distribution activities would be conducted by Nordion.

What are the related medical isotopes? The related medical isotopes that would be produced are iodine-125, iodine-131, and xenon-133. Iodine-125 and iodine-131 are used in the treatment of thyroid conditions, such as Graves disease. Xenon-133 is used in the diagnosis of lung maladies.

Iodine-131 and xenon-133, like Mo-99, are produced during the fission of uranium-235. These isotopes would be produced during the Mo-99 production process. Iodine-125 would be produced using a separate process. These isotopes could be produced under each of the Mo-99 production alternatives analyzed in detail in this EIS.

What has DOE recently done regarding molybdenum-99? In 1990, after Cintichem ceased production of Mo-99, the U.S. medical community and U.S. radiopharmaceutical industry asked DOE to plan for reestablishing a domestic production capability. The financial uncertainties involved in constructing a new nuclear reactor or operating an existing reactor to produce Mo-99 have thus far kept private companies from establishing a domestic Mo-99 production capability.

After an extensive review of government-owned operating reactors and facilities in 1991, the Omega West Reactor and the Chemistry and Metallurgy Research Facility at Los Alamos National Laboratory, New Mexico, were proposed as the preferred alternative for the U.S. production of Mo-99. However, in December of 1992, a leak was found in an underground coolant line of the Omega West Reactor. Subsequently, DOE identified the Annular Core Research Reactor at Sandia National Laboratories, New Mexico, and the Chemistry and Metallurgy Research Facility at Los Alamos National Laboratory as the preferred facilities for the production of Mo-99.

In 1994, DOE prepared an Environmental Assessment of Medical Isotope Production at Sandia National Laboratories, New Mexico, and Los Alamos National Laboratory. This predecisional draft was provided to the state of New Mexico and the public for comment in February of 1995. Based on the Environmental Assessment and on public comments received, DOE decided to prepare an environmental impact statement.

Changes from the Draft to the Final EIS

The Department released the Draft EIS for public comment in December 1995. The availability of the Draft EIS was announced by the Department in the December 22, 1995, issue of the *Federal Register* (60 FR 66542-66543). The public had a 49-day public comment period, which ended on February 9, 1996. Eight public hearings were held to give the public an opportunity to provide oral comments on the

Draft EIS. The hearings were held in Idaho Falls, Idaho on January 17, 1996; Oak Ridge, Tennessee on nuary 25, 1996; Albuquerque, New Mexico on January 30, 1996; and Los Alamos, New Mexico on ebruary 1, 1996. Two hearings were held at each location.

A total of 61 individuals and organizations provided oral comments at the public hearings. In addition, the Department received 101 letters and written statements. Comments received on the Draft EIS were considered in preparing the Final EIS. Changes to the Draft EIS, either in response to public comment or to correct technical information, are denoted by a change bar in the margin. All comments received, along with the Department's responses to those comments, are reproduced in the Comment Response Document (Volume II of this EIS). Comments that resulted in notable changes to the EIS addressed the following topics:

- **Need for the Project** - Some commentors questioned why the Department has proposed to produce Mo-99 when other Mo-99 production initiatives (such as Nordion's plan to build the Maple I and II reactors) are planned or are underway. The Department further investigated these other Mo-99 production initiatives and, to reflect their current status, updated Sections 2.0 and 3.2.

- **The Preferred Alternative** - Multiple commentors questioned the viability of and the rationale for identifying the Annular Core Research Reactor at Sandia National Laboratories/New Mexico as the preferred alternative. Section 3.3.1.1 was revised to provide further insight into the Department's rationale for identifying the preferred alternative.

- **Cost of Alternatives** - Several commentors noted that the cost of the preferred alternative was not lowest among the four reasonable alternatives, and that the estimated cost for the Idaho and Oak Ridge alternatives should be further investigated. The EIS Team worked with the respective sites to develop additional cost data, and Section 5.22 has been revised to include this new data and to clarify the bases for the cost estimates.

- **Privatization of Mo-99 Production Facility** - Several commentors requested that the Department clarify its intent regarding the future privatization of any Mo-99 production capability that it may decide to establish. Section 2.0 has been revised to clarify the privatization discussion and to include a brief discussion of the Moly-99 project's relationship to the Department's National Isotope Strategy.

- **Shipment of Mo-99 to Nordion** - Organizations associated with the radiopharmaceutical industry commented that the Department should consider shipping Mo-99 to Nordion for final processing, quality assurance testing, and distribution. While shipment of Mo-99 to Nordion was included as a shipment option in the Draft EIS, the Summary, Section 5.11, and Appendix B of the Final EIS were modified to present this option more clearly.

- **Water Use** - Several organizations from New Mexico and other individual commentors questioned the wisdom of selecting Sandia National Laboratories/New Mexico as the preferred site, given recent reports that increased water use in the Albuquerque area could result in shortages and could even cause the city to sink (due to draining of the aquifer). Section 5.16 was revised to clarify and put into perspective the amount of water that would be used in the proposed project.

- **Required Modifications at the Power Burst Facility** - In response to comments from Idaho-based commentors, Section 3.3.4.9 was revised to clarify the modifications required to produce Mo-99 in the Power Burst Facility. These include modifications to the reactor central cavity, removal of transient control rods, and installation of coolant flow balance valves.

- **Site Descriptions** - Several commentors provided comments regarding the descriptions of the affected environment around the four sites under consideration. Chapter 4 was revised as appropriate to incorporate these comments.

- **Editorial Changes** - Multiple editorial changes were made to the EIS as a result of internal review and public comments.

Alternatives

What are the requirements for a molybdenum-99 production facility? In order to produce sufficient supplies of Mo-99 to meet 100% of the U.S. medical community demand, certain technical criteria must be met. For example, to minimize the current window of vulnerability, a reasonable alternative must be either an operating facility or one capable of operating in the near term. The production method used must allow the generation facility the capability to provide a quantity of approximately 3000 6-day curies per week to the radiopharmaceutical companies to satisfy 100% of the U.S. demand for Mo-99. (A 6-day curie is defined as the amount of product, in curies, remaining 6 days after the product is delivered to the radiopharmaceutical company.) Due to the need to maintain essentially continuous production, the facility's periodic scheduled maintenance outages must be reliably accomplished in no longer than 6 days. The facility operation must use an FDA-approved process for Mo-99 production. Finally, the facility must be able to package and transport irradiated targets to a separation facility that can chemically process the product.

What does a molybdenum-99 separation facility need? Certain technical criteria must be met for the facility to chemically process, separate, and purify Mo-99. Specifically, the facility must have enough shielded and sealed rooms (commonly known as hot cells) to support reliable Mo-99 separation (including separation and environmental control equipment, remote handling equipment, and a room for quality control). The facility must have adequate ventilation systems (separate zones, differential pressures, and filters) to handle any hazardous gases produced in either the production or separation process. Due to the short half-life of Mo-99, the facility must be located in a place where timely packaging and shipment of the Mo-99 product from the facility will assure that purity and curie concentration requirements are met (10,000 curies of Mo-99 per gram of product upon delivery to the customer). The separation facility must be able to use an FDA-pproved process for Mo-99 extraction. It must also be able to manage the radioactive waste that is generated during the processing.

How were the reasonable alternatives identified? A number of facilities were evaluated against the preliminary technical screening criteria for Mo-99 generation and processing. The alternatives considered for initial screening included each of the alternatives identified in the Notice of Availability for this environmental impact statement, as well as additional alternatives that had the potential to fulfill the Mo-99 production requirements. This preliminary screening provided the reasonable alternatives to be analyzed.

Which alternatives are evaluated in detail in the Environmental Impact Statement? The DOE evaluated the following reasonable alternatives:

- No Action
- Annular Core Research Reactor: Sandia National Laboratories/New Mexico and Chemistry and Metallurgy Research Facility: Los Alamos National Laboratory-Preferred Alternative
- Omega West Reactor/Chemistry and Metallurgy Research Facility: Los Alamos National Laboratory
- Oak Ridge Research Reactor/Radioisotope Development Laboratory: Oak Ridge National Laboratory
- Power Burst Facility/Test Area North: Idaho National Engineering Laboratory.

What are the implications of the No Action alternative? Under this alternative, DOE would not establish a production capability for Mo-99 and related medical isotopes. The current U.S. demand for Mo-99 requires a weekly supply of approximately 3000 6-day curies of Mo-99. All Mo-99 sold in the U.S. is currently produced in Canada. Under the No Action alternative, the U.S. medical community would continue to rely on this source of supply. The Canadian reactor is nearly 40 years old and, although an aggressive maintenance program continues to keep the reactor operating, no plans have been made to continue operation beyond the year 2000. Under the No Action alternative, the following issues remain unresolved:

- The diagnostic procedure using Tc-99m, the daughter product of Mo-99, is the procedure of choice for the medical community. Without a reliable supply of Mo-99, invasive surgery may be the only alternative in many cases.

- The current reliance on a single source of Mo-99 creates the potential for the interruption of the Mo-99 supply.

- Sufficient replacement capacity cannot currently be established quickly in an emergency. A significant amount of planning time and resources is necessary to establish a Mo-99 production capability.

- The near-term production capacity in Europe is not sufficient to contribute significantly to the U.S. demand for an extended period of time.

- Reliable and sufficient backup capability (foreign or domestic) is not guaranteed in the foreseeable future.

Additionally, the financial risks for a private sector company to establish Mo-99 production are sufficiently high that, in the next several years, no domestic private sector company is expected to undertake Mo-99 production at a capacity sufficient to supply 100% of U.S. demand. Even assuming that a company accepts the risks, the estimated time to production precludes this option from consideration for near-term production.

If no action is taken by DOE to provide a domestic Mo-99 production capability, the U.S. medical community will continue to rely on the current Canadian source for Mo-99. Such a dependence will carry with it substantial risks for the foreseeable future. However, if the private sector company in Canada undertakes and completes construction of two reactors, sufficient backup production capability is expected to exist.

What would DOE do to minimize the U.S. vulnerability to interruption of Mo-99 supply? DOE would produce Mo-99 using the Cintichem process. As shown in Figure S-1, Mo-99 is produced using a stainless steel tube which is coated on the inside with highly enriched uranium (called a *target*). The target is irradiated in a small research size nuclear reactor for about a week. Each of the alternative reactors would initiate operations using existing fuel. Three of the alternatives (Annual Core Research Reactor, Omega West Reactor, and Oak Ridge Research Reactor) would initially use highly enriched uranium fuel.

The Power Burst Facility would use low enriched uranium fuel. All of the alternatives using highly enriched uranium would transition to the use of low enriched uranium fuel as the fuel is expended (expected to take between 1 to 7 years at 100% production). The conversion from highly enriched uranium to low enriched uranium for the three alternatives discussed would be a relatively simple and inexpensive undertaking. The irradiated target is transported to a shielded facility (hot cell). There the target is opened and the interior coating (that now contains Mo-99) is dissolved, removed, and processed. When the Mo-99 reaches a certain level of purity, it is packaged in a U.S. Department of Transportation-approved cask and shipped on commercial air carriers (a practice consistent with current isotope transportation modes) to radiopharmaceutical companies. A simplified production process is outlined in Figure S-1. Facilities that could be used in the production of Mo-99 by alternative are as follows.

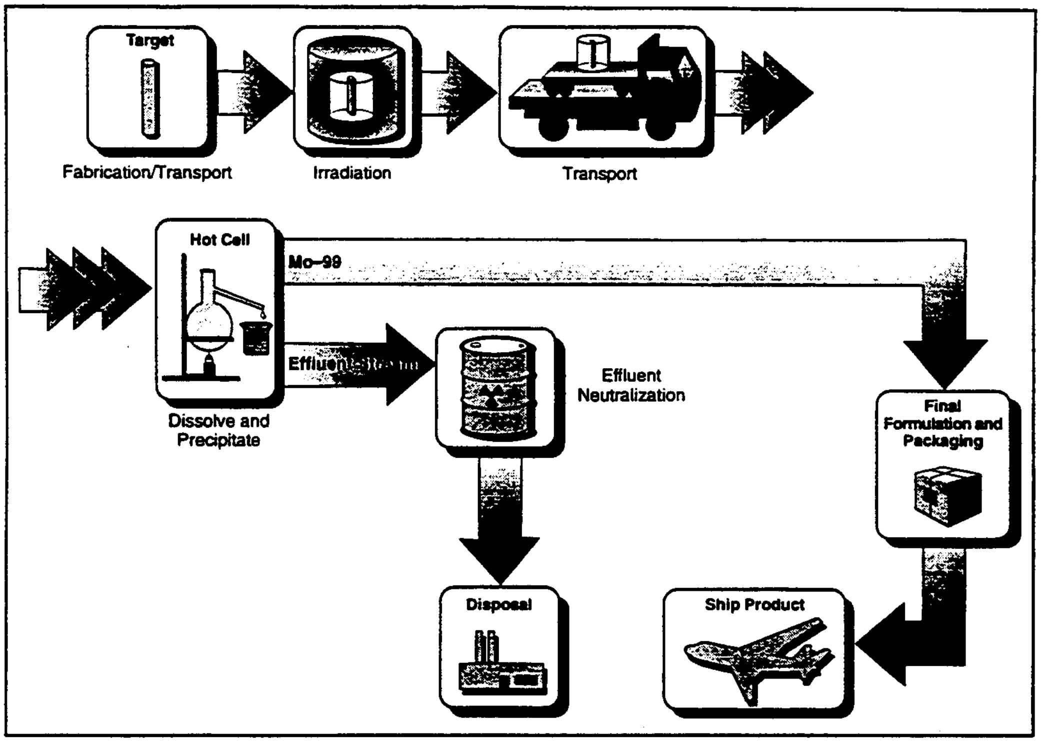

Figure S-1. Molybdenum-99 Production Process

nnular Core Research Reactor: Sandia National Laboratories/New Mexico and Chemistry and Metallurgy Research Facility: Los Alamos National Laboratory

The Annular Core Research Reactor was identified as the preferred Mo-99 production alternative because it is a currently operating reactor, which would allow the shortest time to initial production and would reduce both cost and schedule uncertainties associated with producing Mo-99 and related medical isotopes. Targets would be fabricated at the LANL Chemistry and Metallurgy Research facility (preferred) or at SNL/NM. The targets would be irradiated in the Annular Core Research Reactor. The irradiated targets would be processed in the SNL/NM Hot Cell Facility to produce Mo-99 and related medical radioisotopes. Low-level radioactive wastes would be shipped to the Nevada Test Site for disposal.

Omega West Reactor/Chemistry and Metallurgy Research Facility: Los Alamos National Laboratory

The Chemistry and Metallurgy Research facility would be used for fabricating the targets and processing the targets to recover the Mo-99 and related isotopes. The targets would be irradiated in the Omega West Reactor, which would be repaired and restarted for this project. Low-level radioactive wastes would be disposed onsite at LANL.

Oak Ridge Research Reactor/Radioisotope Development Laboratory: Oak Ridge National Laboratory

The targets would be irradiated in the Oak Ridge Research Reactor which would be restarted for this project. The Radioisotope Development Laboratory would be used for fabricating the targets and processing the targets to recover Mo-99 and related isotopes. Low-level radioactive wastes would be shipped to the Nevada Test Site for disposal.

Power Burst Facility/Test Area North: Idaho National Engineering Laboratory

Targets would be fabricated at the INEL Test Area North, the Experimental Test Reactor Critical Facility annex, or the lower floor of the Materials Test Reactor building. The targets would then be shipped for irradiation to the Power Burst Facility, which is currently in standby and would need to be restarted. Targets would undergo processing either at hot cells at the Test Area North or in new hot cells constructed in a suitable location adjacent to the Power Burst Facility. Low-level radioactive wastes would be disposed onsite.

Which alternatives did not meet the screening criteria? Alternatives that did not meet the technical screening criteria were eliminated from further consideration. These alternatives, and a brief description of the reasons for their dismissal, are listed in Table S-1.

Table S-1. Alternatives Considered, But Dismissed

Alternative	Reason for Dismissal
INEL - Advanced Test Reactor	Operating characteristics, current mission
NIST Reactor/AFRRI Hot Cells	Current mission, unavailability, target contamination
One or More TRIGA Reactors	Hot cell availability, transportation, scheduling
ORNL - High Flux Isotope Reactor	Operating characteristics, current mission
ORNL - Bulk Shielding Reactor	Operating characteristics
Hanford - Fast Flux Test Facility	Facility size (too large), lack of other compatible missions, operating characteristics
Accelerator Facilities	Production capabilities
University Reactors	Individual production capabilities, lack of hot cells, conflicting missions, operational history
University of Missouri, Missouri Research Reactor Center	Mo-99 delivery capability, transportation problems, lack of hot cells, conflicting missions
Isotopes USA	Does not meet near-term goals; no advantage offered for near-term development of Mo-99 production
Babcock & Wilcox Medical Isotope Production Reactor	Does not meet near-term goals for Mo-99 production
Thermo Technology Ventures, Inc.	Does not meet near-term goals for Mo-99 production

Affected Environment

The EIS describes the environment that could be impacted by the proposed activities. The environments described are those surrounding the facilities at Sandia National Laboratories, New Mexico; Los Alamos National Laboratory, New Mexico; Oak Ridge National Laboratory, Tennessee; and Idaho National Engineering Laboratory, Idaho. No new major construction activities would be required under any of the reasonable alternatives. The facilities necessary to accomplish the proposed action exist at each of the alternative sites and would be available with minor modifications. Facility modifications identified as necessary to accomplish the proposed action are, for the most part, internal to the existing facilities. Consequently, the description of the affected environment emphasizes only those areas that are of most interest with respect to environmental consequences.

Environmental Consequences

What are the environmental consequences of the No Action alternative? The No Action alternative would not result in any additional environmental consequences. However, the consequences of the No Action alternative would be an increased risk to the U.S. health care community and its consumers. If the sole Canadian source of Mo-99 became unavailable for an extended time, cost of some diagnostic procedures and medical risk to patients would likely increase.

What are the environmental consequences of the reasonable alternatives? The analyses in this EIS indicate no significant difference in the environmental impacts among the alternatives. Each of the reasonable alternatives would use the same technology for the production of Mo-99 and related medical isotopes. Minor differences among the alternatives relate primarily to the type and status of the existing facilities, the modifications required to prepare the facilities for production, and amounts of low-level waste generated and how those wastes would be managed.

Under normal operating conditions, radiological doses to members of the public, involved and uninvolved workers from target fabrication and irradiation, product processing and transport for each of the alternatives would be well within regulatory limits established to protect human health. Each alternative would involve the use of an existing, small research reactor (10 MW thermal or less). The probability of credible accidents is low and the consequences of those accidents are small and would be similar for each site. The risk of latent cancer fatality would be very small under any of the alternatives.

Waste generated during the isotope production process would consist primarily of low-level radioactive waste. Each of the alternative sites has sufficient waste management capability either onsite or through existing arrangements with other DOE sites to dispose of low-level waste generated by the proposed activity. The quantities of spent nuclear fuel generated would be at most a few kilograms per year during production at rates sufficient to supply 100% of the U.S. demand. All alternative sites have adequate capabilities for storage of spent fuel for up to 5 years at a production rate sufficient to supply 100% of the U.S. demand. Community impacts resulting from project employment requirements are anticipated to be minimal. Impacts to cultural, ecological, and other natural environmental features would be negligible for any of the alternatives.

Table S-2 presents a comparison of the major environmental consequences of 100% production for reasonable alternatives analyzed in this EIS based on the analyses contained in Section 5.

Table S-2. Summary of Environmental Consequences and Comparison of Alternatives at 100% Production

Consequence Category	Unit of Measure	Alternatives			
		SNL/NM-ACRR LANL-CMR	**LANL OWR/CMR**	**ORNL ORRR/RDL**	**INEL PBF/TAN**
Air Quality					
Dose from Radionuclide Emissions to Air (normal operations)					
Offsite Maximally Exposed Individual	mrem/yr				
Target Irradiation		0.00017	0.15	0.004	0.0013
Target Processing		0.17	0.0042	0.31	0.13
Population within 80 km (50 mi)	person-rem/yr				
Target Irradiation		0.023	0.63	0.41	0.011
Target Processing		13	0.032	15	1.2
Risk of Latent Fatal Cancer(a)		0.007	0.0003	0.008	0.0006
Transportation					
Incident Free Transport (Annual Shipments of Targets, Products, and Waste)					
Radiological Dose	person-rem/yr				
Crew		24	23	23	23
Public		52	52	26	53
Risk of Latent Fatal Cancer[a]					
Crew		0.01	0.01	0.01	0.01
Public		0.03	0.03	0.01	0.03
Transportation Accidents (Ground and Air)					
Collective Public Risk from Accidents Involving Radioactive Materials:					
Risk of Latent Fatal Cancer[a]		2×10^{-5}	2×10^{-5}	1×10^{-5}	2×10^{-5}
Vehicle Accident Fatalities		0.01	0.01	0.02	0.01

Table S-2. (contd)

Consequence Category	Unit of Measure	Alternatives: SNL/NM-ACRR LANL-CMR	LANL OWR/CMR	ORNL ORRR/RDL	INEL PBF/TAN
Highest Consequence Facility Accidents					
Target Irradiation		Multiple Fuel Element Rupture	Fuel Melt	Fuel Melt	Fuel Melt
Accident Frequency	events per year	5×10^{-5}	10^{-6} to 10^{-4}	10^{-6} to 10^{-4}	10^{-6} to 10^{-4}
Dose to Offsite Maximally Exposed Individual	rem				
Inhalation/External[b]		0.076	0.48	0.037	0.099
All Pathways[b]		0.20	5.7	0.42	1.6
Dose to Population within 80 km (50 mi)	person-rem				
Inhalation/External[b]		150-2300	91 - 930	750 - 1400	20 - 170
All Pathways[b]		151-2350	91 - 940	5400 - 11000	900 - 7300
Latent Fatal Cancers (if accident occurs)		≤1	<1	<1 - 6	<1 - 4
Risk of Latent Fatal Cancer[a]		4×10^{-6} to 6×10^{-6}	5×10^{-6}	7×10^{-6} to 3×10^{-4}	9×10^{-7} to 4×10^{-5}
Resource Use - Operations					
Water	1000 m^3/yr	40	120	120	120
Electricity	MWh/yr	400	500	500	500
Materials - Target Fabrication					
Highly Enriched (93%) Uranium	kg/yr	4-36[c]	3[c]	3-26[c]	3-26[c]
Stainless Steel	tonnes/yr	0.50	0.36	0.36	0.36
Reactor Fuel					
Kilograms of Uranium Used in Fuel	kg U/yr	16	32	32	32
Spent Fuel Produced	elements/yr	57	29	22	17
SNF Storage Capacity	elements	300-1000[d]	1091	984	786
Operational Wastes					
Low-level Radioactive Liquid	m^3/yr	7.3[e]	5.2[e]	5.2[e]	5.2
Low-level Radioactive Solid	m^3/yr	49	17.6	68	80

Table S-2. (contd)

Consequence Category	Unit of Measure	Alternatives: SNL/NM-ACRR LANL-CMR	LANL OWR/CMR	ORNL ORRR/RDL	INEL PBF/TAN
Socioeconomics					
Primary Employment					
Construction/modifications	worker-years	92	92	113	97
Routine operations	workers	59	45	62	59
Cost					
Construction/modifications	million dollars	19.6	19.6	21.0[f]	17.2[f]
Routine operations (per year)	million dollars	12.8	11.0	9.6[f]	8.4[f]

(a) Radiological risk from normal operations or accidents is calculated as the latent cancer fatalities that might result if a radiological exposure occurred, multiplied by the estimated frequency of the event. The risk for normal operation assumes a frequency of 1.0 (that is, the exposure is assumed to occur), whereas the risk for accidents is estimated using the combined frequency of the accident and the assumed atmospheric conditions (if applicable) for a particular accident scenario. Where the risk of latent fatal cancer is less than 1, no cancers would be expected to result from a year of operation.
(b) Accident consequences are conservative estimates that assume no protective actions are taken for offsite members of the public. The *Inhalation/External* pathway results correspond to a hypothetical release during a season when no agricultural products for human or animal consumption are growing. The *All Pathways* results correspond to a hypothetical release just before harvest, thereby maximizing the potential consequences of ingesting contaminated food. Neither analysis assumes protective action, such as evacuation, sheltering, or interdiction of contaminated food products, for the public.
(c) Minimum values assume 90% recovery of highly enriched uranium after isotope extraction. Uranium recovery would occur at LANL, and could be implemented at other sites. However, the consequence analyses presented in Section 5 do not assume uranium recovery at sites other than LANL. Unrecovered highly enriched uranium would go into the waste stream and is included in the waste volume presented for sites other than LANL.
(d) 300 is current capability; 1000 is potential capability (cost not included).
(e) Liquid waste volumes are before solidification. Liquid wastes would be solidified at indicated sites prior to disposal.
(f) As explained in Section 5.22, the cost estimates for ORNL and INEL are expected to contain greater uncertainties than those presented for SNL/NM and LANL.

ACRR - Annular Core Research Reactor
CMR - Chemistry and Metallurgy Research Facility
ORRR - Oak Ridge Research Reactor
OWR - Omega West Reactor
PBF - Power Burst Facility
RDL - Radioisotope Development Laboratory
TAN - Test Area North

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Acronyms and Abbreviations

ac	acre
ACRR	Annular Core Research Reactor (SNL/NM)
AECL	Atomic Energy of Canada Ltd.
AFRRI	Armed Forces Radiobiology Research Institute
AGS	Alternating Gradient Synchrontron
AIA	Albuquerque International Airport
AL	Alabama
ALARA	as low as reasonably achievable
ANC	Aerojet Nuclear Company
ANL	Argonne National Laboratory
ANMS	Advanced Nuclear and Medical Systems
ANL-W	Argonne National Laboratory-West
ANSI	American National Standards Institute
AQCR	Air Quality Control Region
AR	Arkansas
ARA	Auxiliary Reactor Area
BLIP	Brookhaven LINAC Isotope Producer
BLM	Bureau of Land Management
BNCT	Boron Neutron Capture Therapy
BNL	Brookhaven National Laboratory
BSR	Bulk Shielding Reactor (ORNL)
CAA	Clean Air Act
CAP-88	Clean Air Act Assessment Package-1988
CEQ	Council on Environmental Quality
CFA	Central Facilities Area
cfm	cubic feet per minute
CFR	Code of Federal Regulations
Ci	curies
cm	centimeter
CMR	Chemistry and Metallurgy Research (LANL)
CNEL	Community Noise Equivalent Level
COE	U.S. Army Corps of Engineers
D&D	decontamination and decommissioning
dB	decibel
dB(A)	A-weighted decibel
DCG	Derived Concentration Guide
DMF	Drug Master File
DOC	U.S. Department of Commerce
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy

DOI	U.S. Department of Interior
DOT	U.S. Department of Transportation
EA	Environmental Assessment
EBR-1	Experimental Breeder Reactor-1
EDE	Effective Dose Equivalent
EPA	U.S. Environmental Protection Agency
FDA	Food and Drug Administration
FDP	Flourinel Dissolution Process
FEIS	final environmental impact statement
FFTF	Fast Flux Test Facility
FONSI	Finding of No Significant Impact
FR	federal register
FREC	fuel-ringed external cavities
ft	foot/feet
FTE	full-time equivalent
FWHM	full width at half maximum
g	gram/grams
GA	Georgia
gal	gallon/gallons
GB	glovebox
GeV	giga (billion) electron volts
GIF	Gamma Irradiation Facility
GOCO	government-owned contractor-operated
h	hour
ha	hectare
^{3}H	tritium
HCF	Hot Cell Facility
HEPA	high efficiency particulate air
HEU	highly enriched uranium
HFR	High Flux Reactor
I	iodine
IBTC	Idaho Brain Tumor Center
ICRP	International Commission on Radiological Protection
ICPP	Idaho Chemical Processing Plant
IDHW	Idaho Department of Health and Welfare
IFSF	Irradiated Fuel Storage Facility
IL	Illinois
in.	inch/inches
INEL	Idaho National Engineering Laboratory
IPC	Idaho Power Company
IRE	Institute National des Radio-elements

KAFB	Kirtland Air Force Base
kg	kilogram
km	kilometer/kilometers
km^2	square kilometers
kmph	kilometers per hour
kV	kilovolt
kW	kilowatt
KY	Kentucky
L	liter
LAMPF	Los Alamos Meson Physics Facility
LANL	Los Alamos National Laboratory
LATA	Los Alamos Technical Associates
LCF	latent cancer fatality
Ldn	day-night sound level
Leq	equivalent sound level
LEU	low-enriched uranium
LINAC	linear accelerator
LLNL	Lawrence Livermore National Laboratory
LLW	low-level waste
m	meter/meters
m^2	square meters
m^3	cubic meters
Ma	million years
mA	milliamperes
mCi	millicuries
MED	Manhattan Engineering District
MEI	maximally exposed individual
MESODIF	mesoscale diffusion (meteorological technique)
MeV	million electron volts
mi	mile/miles
mi^2	square miles
min	minute/minutes
MIPP	Medical Isotope Production Project
MIPR	Medical Isotope Production Reactor
MIPC	Medical Isotope Production Center
ml	milliliter
mm	millimeter
MMES	Martin Marietta Energy Systems
MMI	Modified Mercalli Intensity
Mo	molybdenum
MO	Missouri
mph	miles per hour
mR	milliroentgen
mrem	millirem

MS	Mississippi
MSA	Metropolitan Statistical Area
mSv	millisieverts
MV	megavolt
MVa	megavolts-amperes
mW	milliwatts
MW	megawatt
MWh	megawatt hour
MWt	megawatt thermal
nCi	nanocuries
NC	North Carolina
NCRP	National Council of Radiation Protection
NDT	non-destructive testing
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NIST	National Institute of Standards and Technology
NMAC	New Mexico Air Code
NMDGF	New Mexico Department of Game and Fish
NOAA	National Oceanographic and Atmospheric Administration
NOI	notice of intent
NPDES	National Pollutant Discharge Elimination System
NRC	Nuclear Regulatory Commission
NRF	Naval Reactors Facility
NRU	National Research Universal (reactor)
NTS	Nevada Test Site
ORNL	Oak Ridge National Laboratory
ORR	Oak Ridge Reservation
ORRR	Oak Ridge Research Reactor (ORNL)
OSHA	Occupational Safety and Health Administration
OWR	Omega West Reactor (LANL)
PAM	perimeter air monitor
person-rem	unit collective population dose
PBF	Power Burst Facility (INEL)
PEIS	Programmatic Environmental Impact Statement
RAL	Remote Analytic Laboratory (ORNL)
RAM	regional air monitor
RCRA	Resource Conservation and Recovery Act
RDL	Radioisotope Development Laboratory (ORR)
REIS	Regional Economic Information System
RERTR	Reduced Enrichment for Research and Test Reactors
RIMS	Regional Input-Output Modeling System
ROD	Record of Decision

ROI	region of influence
RWMC	Radioactive Waste Management Complex (INEL)
SAR	Safety Analysis Report
SC	South Carolina
SNL/NM	Sandia National Laboratories/New Mexico
SNF PEIS	Spent Nuclear Fuel Programmatic Environmental Impact Statement
SPR	Sandia Pulsed Reactor
SPERT	Special Power Excursion Reactor Test
SPUR	Sandia Pulse Reactor
SRS	Savannah River Site
Sv	sievert
TA	technical area (LANL only)
TAN	Test Area North (INEL)
Tc	technetium
TEDE	total effective dose equivalent
TFBA	Thermal Fuels Behavior Program
TI	Transportation Index
TLD	Thermoluminescent Dosimetry
TN	Tennessee
TRA	Test Reactor Area (INEL)
TRIGA	Training, Research, Isotope Production, General Atomics (reactor)
TSP	total suspended particulates
TSR	technical safety requirements
TVA	Tennessee Valley Authority
TVV	Thermo Technology Ventures
U	uranium
UBC	Uniform Building Code
USAF	U.S. Air Force
USC	United States Code
USDA-SCS	U.S. Department of Agriculture, Soil Conservation Service
USFWS	U.S. Fish and Wildlife Service
VA	Virginia
WERF	Waste Experimental Reduction Facility (INEL)
WIPP	Waste Isolation Pilot Plant
wk	week
yr	year
yd	yard/yards
yd^2	square yards
yd^3	cubic yards

Units of Measure

The principal units of measurement used in this EIS are SI units, an abbreviation for Système Internationale d'Unités, a metric system, accepted by the International Organization of Standardization as the legal standard at a meeting in Elsinore, Denmark, in 1966. In this system, most units are made up of combinations of six basic units, of which length in meters, mass in kilograms, and time in seconds are of importance in this EIS.

In this EIS, values given in SI units are followed by values shown as common units in parentheses.

Units of Measure

Symbol	Name
Temperature:	
°C	degrees Centigrade
°F	degrees Fahrenheit
Time:	
d	day
h	hour
[illegible]	week
[illegible]	year
Rate:	
kmph	kilometers per hour
mph	miles per hour
ft^3/h	cubic feet per hour
Volume:	
cm^3	cubic centimeter
ft^3	cubic feet
gal	gallon
L	liter
m^3	cubic meter
ppm	parts per million
yd^3	cubic yard
Sound:	
dB(A)	A-weighted decibel
Ldn	day-night sound level
Leq	equivalent sound level

Symbol	Name
Length:	
cm	centimeter (1×10^{-2} m)
ft	foot
in.	inch
km	kilometer (1×10^{3} m)
m	meter
mi	mile
mm	millimeter (1×10^{-3} m)
µm	micrometer (1×10^{-6} m)
Area:	
ac	acre
ft^2	square foot
km^2	square kilometer
mi^2	square mile
Energy:	
kV	kilovolt
kW	kilowatt
MeV	million electron volts
MV	megavolt
MW	megawatt
MWt	megawatt thermal
Rate:	
gpm	gallons per minute

Nomenclature

Units of Radioactivity

	Radioactivity
Symbol	**Name**
Ci	curie
mCi	millicurie (1 x 10^{-3} Ci)
µCi	microcurie (1 x 10^{-6} Ci)
nCi	nanocurie (1 x 10^{-9} Ci)
pCi	picocurie (1 x 10^{-12} Ci)
aCi	attocurie (1 x 10^{-18} Ci)
Bq	becquerel

Units of Radiation Dose

	Radiation Dose
Symbol	**Name**
mrad	millirad (1 x 10^{-3} rad)
mrem	millirem (1 x 10^{-3} rem)
Sv	sievert
µSv	microsievert (1 x 10^{-6} Sv)
R	roentgen
mR	milliroentgen (1 x 10^{-3} R)
µR	microroentgen (1 x 10^{-6} R)
1 Sv	100 rem

Numerical (Scientific or Exponential) Notation

Numbers that are very small or very large are often expressed in scientific or exponential notation as a matter of convenience. For example, the number 0.000034 may be expressed as 3.4 x 10^{-5} or 3.4E-05 and 65,000 may be expressed as 6.5 x 10^{4} or 6.5E+04. Multiples or submultiples of the basic units are also used. A partial list of multiples and submultiples follows:

Name	Symbol	Value Multiplied by:		
atto	a	0.000000000000000001	or 1 x 10^{-18}	or 1E-18
pico	p	0.000000000001	or 1 x 10^{-12}	or 1E-12
nano	n	0.000000001	or 1 x 10^{-9}	or 1E-09
micro	µ	0.000001	or 1 x 10^{-6}	or 1E-06
milli	m	0.001	or 1 x 10^{-3}	or 1E-03
kilo	k	1,000	or 1 x 10^{3}	or 1E+03
mega	M	1,000,000	or 1 x 10^{6}	or 1E+06
giga	G	1,000,000,000	or 1 x 10^{9}	or 1E+09
tera	T	1,000,000,000,000	or 1 x 10^{12}	or 1E+12

The following symbols are occasionally used in conjunction with numerical expressions:

less than

≤less than or equal to

>greater than

≥greater than or equal to

In this EIS, numerical values that are less than 0.001 or greater than 9999 are generally expressed in exponential notation.

Conversion Table

Base Unit	Multiply By	To Obtain	Base Unit	Multiply By	To Obtain
in.	2.54	cm	cm	0.394	in.
ft	0.305	m	m	3.28	ft
mi	1.61	km	km	0.621	mi
lb	0.454	kg	kg	2.205	lb
gal	3.785	L	L	0.264	gal
ft^2	0.093	m^2	m^2	10.76	ft^2
mi^2	2.59	km^2	km^2	0.386	mi^2
ft^3	0.028	m^3	m^3	35.3	ft^3
nCi	1000	pCi	pCi	0.001	nCi
pCi/L	10^{-9}	µCi/mL	µCi/mL	10^{9}	pCi/L
pCi/m^3	10^{-12}	Ci/m^3	Ci/m^3	10^{12}	pCi/m^3
pCi/m^3	10^{-15}	mCi/cm^3	mCi/cm^3	10^{15}	pCi/m^3
mCi/km^2	1.0	nCi/m^2	nCi/m^2	1.0	mCi/km^2
becquerel	2.7×10^{-11}	curie	curie	3.7×10^{10}	becquerel
gray	100	rad	rad	0.01	gray
sievert	100	rem	rem	0.01	sievert
ppb	0.001	ppm	ppm	1000	ppb
°F	(°F - 32) ÷ 9/5	°C	°C	(°C x 9/5) + 32	°F
g	0.035	oz	oz	28.349	g

Element and Chemical Nomenclature

Symbol	Constituent
Ba	barium
CO	carbon monoxide
H	hydrogen
I	iodine
Mo	molybdenum
Na	sodium
NO_2	nitrogen dioxide
O	oxygen
SO_2	sulfur dioxide
Tc	technetium
U	uranium
Xe	xenon

Radionuclide Nomenclature [a,b]

Symbol	Radionuclide	Half-Life	Symbol	Radionuclide	Half-Life
Am-241	americium-241	432 yr	Pr-144m	praseodymium-144m	7.2 min
Ar-41	argon-41	1.8 h	Pu-238	plutonium-238	87.7 yr
Ba-137m	barium-137m	2.6 min	Pu-239	plutonium-239	2.4×10^4 yr
Ba-140	barium-140	12.75 d	Pu-240	plutonium-240	6.5×10^3 yr
Br-83	bromine-83	2.4 h	Rh-103m	rhodium-103m	56.12 min
Ce-141	cerium-141	32.5 d	Rh-106	rhodium-106	29.9 sec
Ce-144	cerium-144	284 d	Ru-103	ruthenium-103	39.3 d
Cs-137	cesium-137	30 yr	Ru-106	ruthenium-106	368 d
H-3	tritium	12.3 yr	Sm-147	samarium-147	1.06×10^{11} yr
I-125	iodine-125	59.4 d	Sr-89	strontium-89	50.5 d
I-129	iodine-129	1.6×10^7 yr	Sr-90	strontium-90	29.1 yr
I-131	iodine-131	8 d	Tc-99	technetium-99	2.1×10^5 yr
I-132	iodine-132	2.28 h	Tc-99m	metastable technetium-99	6.0 h
I-133	iodine-133	20.8 h	Te-127	tellurium-127	9.4 h
I-134	iodine-134	52.6 min	Te-127m	tellurium-127m	109 d
I-135	iodine-135	6.57 h	Te-129	tellurium-129	1.16 h
Kr-83m	krypton-83m	1.86 h	Te-129m	tellurium-129m	33.6 d
Kr-85	krypton-85	10.7 yr	Te-132	tellurium-132	3.26 d
Kr-85m	krypton-85m	4.48 h	U-234	uranium-234	2.4×10^5 yr
Kr-87	krypton-87	1.27 h	U-235	uranium-235	7×10^8 yr
Kr-88	krypton-88	2.84 h	Xe-125	xenon-125	17.1 h
La-140	lanthanum-140	1.678 d	Xe-131m	xenon-131m	11.9 d
Mo-99	molybdenum-99	2.747 d	Xe-133	xenon-133	5.2 d
Nb-95	niobium-95	35 d	Xe-133m	xenon-133m	2.19 d
Nb-95m	niobium-95m	3.61 d	Xe-135	xenon-135	9.1 h
Nd-147	neodymium-147	10.98 d	Xe-135m	xenon-135m	15.3 min
Pm-147	promethium-147	2.6 y	Xe-138	xenon-138	14.1 min
Pr-143	praseodymium-143	13.57 d	Y-90	yttrium-90	2.67 d
Pr-144	praseodymium-144	17.28 min	Y-91	yttrium-91	58.5 d

(a) From *CRC Handbook of Chemistry and Physics*. 74th edition. ed. David R. Lide, CRC Press, Boca Raton, Florida 1993.

(b) Isomers are indicated by the addition of an *m*.

1.0 Introduction

The U.S. Department of Energy (DOE) proposes to establish a domestic source for and to produce molybdenum-99 (Mo-99) and related medical isotopes, including iodine-131, xenon-133, and iodine-125. DOE proposed this project to ensure a reliable supply to the U.S. medical community of the metastable isotope technetium-99 (Tc-99m), which is produced from Mo-99. This Final Environmental Impact Statement (EIS) analyzes the environmental impacts of alternatives to accomplish the proposed action.

On February 7, 1995, DOE issued an environmental assessment (EA) for public comment on the proposed action to produce Mo-99 and related medical isotopes using the Chemistry and Metallurgy Research Facility at Los Alamos National Laboratory (LANL) and the Annular Core Research Reactor at Sandia National Laboratories/New Mexico (SNL/NM). The public review and comment period on the EA ended on May 1, 1995. Based on the EA and comments received, DOE decided to prepare a Draft EIS.

1.1 Organization

- **Section 1 - Introduction**: Medical Isotopes Production Project (MIPP) background and the environmental analysis process.
- **Section 2 - Purpose of and Need for Action**: reasons why DOE needs to take action at this time.
- **Section 3 - Alternatives**: includes a summary and comparison of expected environmental impacts for each alternative.
- **Section 4 - Affected Environment**: aspects of the human and physical environment that might be affected.
- **Section 5 - Environmental Consequences**: analysis of the impacts on the affected human and physical elements of the environment.
- **Section 6 - Regulatory Framework**: environmental regulations that could apply to the proposed project.
- **Section 7 - Glossary of Terms**: terms used in this EIS are defined.
- **Section 8 - List of Preparers and Contributors**: persons who contributed to the preparation of this EIS.

- **Section 9 - Bibliography**: all documents used in the preparation of this EIS. Each of those listed is publicly available.

- **Appendix A - Molybdenum-99**: discussion of the Mo-99 production process.

- **Appendix B - Analysis of Transportation Impacts**: detailed description of the impacts of transportation of medical isotopes and associated wastes.

- **Appendix C - Input to the GENII Calculations for All Alternatives**: description of the various input data for wind, population, and food production for each site.

- **Appendix D - Climatology and Meteorology**: description of characteristics of climate for each of the proposed sites.

1.2 Alternatives Analyzed

This EIS evaluates the reasonable alternatives that would meet the purpose and need for agency action and identifies alternatives that were considered but eliminated from detailed study, and briefly discusses the reasons for their elimination. In addition, a No Action alternative, as required by the Council on Environmental Quality regulations for compliance with the National Environmental Policy Act (NEPA), is presented as a basis for comparison.

Alternatives evaluated in detail are

- **No Action** - Under this alternative, DOE would not establish a production source for Mo-99.

- **Annular Core Research Reactor - Sandia National Laboratories/New Mexico (SNL/NM), Albuquerque, New Mexico (DOE's preferred alternative) and the Chemistry and Metallurgy Research Facility - Los Alamos National Laboratory, Los Alamos, New Mexico.** Wing 9 of the Los Alamos National Laboratory (LANL) Chemistry and Metallurgy Research building or a building within an existing facility at SNL/NM would be used to fabricate targets. The operating Annular Core Research Reactor and supporting facilities at SNL/NM would be used to produce Mo-99 and related isotopes. Low-level radioactive wastes would be disposed of at the Nevada Test Site.

- **Omega West Reactor/Chemistry and Metallurgy Research Facility - Los Alamos National Laboratory (LANL)**, Los Alamos, New Mexico. All process steps would be carried out onsite at LANL. Wing 9 of the Chemistry and Metallurgy Research building would be used for fabricating the targets and recovering Mo-99 in the hot cells. The target irradiation would occur in the Omega West Reactor, which would be repaired and restarted for this purpose. Low-level radioactive wastes would be disposed of onsite at LANL.

- **Oak Ridge Research Reactor/Radioisotope Development Laboratory - Oak Ridge National Laboratory (ORNL)**, Oak Ridge, Tennessee. The Radioisotope Development Laboratory would be customized and dedicated for target fabrication and Mo-99 processing. Mo-99 would be produced by irradiating targets using the Oak Ridge Research Reactor, which would be restarted and redesignated as the Medical Isotope Production Center. Low-level radioactive wastes would be disposed of at the Nevada Test Site.

- **Power Burst Facility/Test Area North - Idaho National Engineering Laboratory (INEL)**, Idaho Falls, Idaho. All process steps would be carried out onsite at INEL. Targets would be fabricated at INEL at the Test Area North in a building similar to the Experimental Test Reactor Critical Facility annex or the lower floor of the Materials Test Reactor building. The targets would be shipped for irradiation to the Power Burst Facility, which would be restarted for this purpose. The Mo-99 would be extracted from the irradiated targets, either in existing hot cells at the Test Area North or at new hot cells constructed for this purpose. Low-level radioactive wastes would be disposed of onsite at INEL.

1.3 Laws and Regulations

This EIS was prepared pursuant to the National Environmental Policy Act of 1969 (NEPA) (42 U.S.C. 4321 et seq.), the Presidents's Council on Environmental Quality NEPA regulations (40 CFR Parts 1500-1508), and the DOE NEPA regulations (10 CFR Part 1021).

4 Public Participation, Outreach, and Changes from the Draft EIS

1.4.1 Public Participation and Outreach

The Department of Energy has provided multiple opportunities for public involvement in the EIS development and review process for the proposed Medical Isotopes Production Project. The decision to prepare an EIS for the proposed project was in part based on public comments received on an earlier environmental assessment. The environmental assessment was prepared to analyze the potential impacts of a proposal to produce medical isotopes using facilities at Los Alamos National Laboratory and at Sandia National Laboratories/New Mexico. The DOE initiated this EIS with the desire of assuring stakeholders and interested parties of the limited environmental impacts of the proposed project.

On July 6, 1995, DOE issued a notice of intent in the *Federal Register* (60 FR 35191-35195) which announced that DOE would prepare an EIS for the proposed Medical Isotopes Production Project. The notice of intent also provided the schedule for the public scoping meetings for the EIS. Additional public notice of the proposed project and the schedule for the public scoping meetings was provided through the placement of advertisements in local newspapers in the communities with alternative facilities under consideration. Local public notices were placed in the following newspapers.

New Mexico:	Albuquerque Journal New Mexican Rio Grande Sun El Hispano News	Albuquerque Tribune Journal North Los Alamos Monitor
Idaho:	Idaho Falls Post Register Times News Daily News	Idaho State Journal Idaho Statesman
Tennessee:	Roane County Newspaper	Knoxville News Sentinel

DOE also issued a press release on July 6, 1995, regarding the notice of intent. The press release was provided to general and minority market newspapers near the alternative facilities and to media outlets nationwide. Commentors from the earlier environmental assessment process were notified by mail of the DOE effort to begin preparing an EIS.

Eight EIS scoping meetings were conducted in four communities near alternative sites -- two each in Idaho Falls, Idaho (July 24, 1995); Oak Ridge, Tennessee (July 26, 1995); Albuquerque, New Mexico (July 31, 1995); and Los Alamos, New Mexico (August 1, 1995).

The scoping meetings were conducted by a neutral moderator and the format of the meetings included: 1) informational presentations on the purpose and need for the production of the medical isotopes, the proposed alternatives for the production process, medical applications for the isotopes, initial considerations for potential environmental impacts and the NEPA process; 2) a question and answer period in which EIS project representatives responded to project-related questions from the public; and 3) a public comment session during which members of the public offered formal comments on issues they deemed appropriate for review in the scope of the EIS. All the proceedings of the scoping meetings were recorded by a court reporter and transcribed for public record. An informational poster session complemented the scoping meetings. Informational materials, including documents and references, and a brochure on the proposed project were disseminated at the scoping meetings.

The DOE accepted scoping comments both orally and in writing at the public meetings. Written comments were also accepted by mail. The public comment period for the scoping of the EIS concluded on August 7, 1995.

DOE public reading rooms and selected public libraries in communities near sites considered in the EIS were provided EIS documents, reference materials, copies of public notices, written public comments, and the transcripts of the scoping meetings. These reading rooms and libraries include:

DOE Headquarters
Freedom of Information
'eading Room 1E-190
Forrestal Building
100 Independence Ave., S.W.
Washington, D.C. 20595
(202) 586-6020

Los Alamos National Laboratory
Community Reading Room
1450 Central Ave., Suite 101
Los Alamos, New Mexico 87544

Oak Ridge Operations Office
Public Reading Room, 112
55 Jefferson Circle
Oak Ridge, Tennessee 37831
(615) 241-4780

Nuclear Reactor Laboratory
Massachusetts Institute of Technology
138 Albany Street
Cambridge, Massachusetts 02139

National Atomic Museum
Building 20358
Wyoming Blvd.
Kirtland AFB, New Mexico 87185

Idaho Operations Office
Idaho Public Reading Room
1776 Science Center Drive
Idaho Falls, Idaho 83402
(208) 526-0271

Library
Georgia Institute of Technology
Atlanta, Georgia 30332-0900

Research Reactor Facility, Room 229
Research Park
University of Missouri-Columbia
Columbia, Missouri 65211

Rhode Island Nuclear Science Center
South Ferry Road
Narragansett, Rhode Island 02882

Oral comments were presented by 26 people at the scoping meetings, three of whom also submitted written comments, and 19 written comments were submitted by people who did not offer oral comments. A total of 234 comments were identified among nine comment categories. The comments came from a broad range of sources including individuals, citizen organizations, and state and local governments.

The comments received during the scoping phase were considered in the development of the *Medical Isotopes Production Project: Molybdenum-99 and Related Isotopes Environmental Impact Statement Implementation Plan* issued in September 1995. The Implementation Plan reports the results of the environmental impact statement scoping process, and provided guidance for the preparation of the Draft EIS. A notice of availability of the implementation plan was published in the *Federal Register* on October 30, 1995 (60 FR 55249), and the release of the Implementation Plan was announced through a DOE News Brief. The Implementation Plan was distributed to interested parties through a DOE mailing to individuals, organizations, Indian Tribal governments, and local, state and federal agencies. The mailing was assembled, in part, from the lists of parties who registered at the scoping meetings, commented during the earlier environmental assessment process or had otherwise contacted DOE concerning the proposed project.

On December 22, 1995, DOE published a notice of availability in the *Federal Register* (60 FR 66542-66543) for the *Medical Isotopes Production Project: Molybdenum-99 and Related Isotopes Draft Environmental Impact Statement* (DOE/EIS-0249D). During the week prior to the formal release of the document, DOE mailed copies of the Draft EIS to stakeholders and interested parties. In addition to the *Federal Register* notice (which also provided the public hearing schedule for comments on the Draft EIS), DOE provided public notice through a December 21, 1995, press release and the placement of informational advertisements in local newspapers, as previously done with regard to the scoping meetings. The issuance was also announced through the Internet on DOE's home page.

Copies of the Draft EIS were provided to the DOE public reading rooms and the selected public libraries listed above.

The period for public comment on the Draft EIS was December 22, 1995 through February 9, 1996. Due to the holiday season being observed during the comment period, DOE extended the comment period to 49 days.

Eight public hearings were conducted to receive comments on the Draft EIS, two each in Idaho Falls, Idaho (January 17, 1996); Oak Ridge, Tennessee (January 25, 1996); Albuquerque, New Mexico (January 30, 1996); and Los Alamos, New Mexico (February 1, 1996). The public hearings were conducted by a neutral moderator and the format of the meetings included: 1) informational presentations on the content of the Draft EIS, medical applications for the isotopes, and the NEPA process; 2) a question and answer session in which EIS project representatives responded to project-related questions from the public; and 3) a public comment session during which members of the public offered formal comments on the Draft EIS.

Concurrent to the formal proceedings, "quiet rooms" with tape recorders were made available for individuals wishing to offer comments privately or without waiting for the completion of agenda items in the hearing session. All the proceedings of the public hearings were recorded by a court reporter and transcribed for public record, along with taped comments from the quiet rooms. An updated informational poster session complemented the public hearings. Informational materials, including documents and references, and an updated brochure on the proposed project were disseminated at the public hearings.

The public comment period on the Draft EIS resulted in oral comments from 61 people at the public hearings, and 96 individuals and organizations submitted a total of 101 comment letters and written statements. A total of about 750 comments were identified. The comments came from a broad range of sources including individuals, citizen organizations, and state and local government agencies. Copies of the comment letters and hearing transcripts were provided to the public libraries and reading rooms listed above. Comments received on the Draft EIS were considered in preparing the Final EIS. Changes to the Draft EIS, either in response to public comment or to correct technical information, are denoted by a change bar in the margin.

In addition to the opportunities for involvement by the general public, DOE representatives engaged in a series of small group meetings with stakeholders known to be interested in the project. The purpose of the small group meetings was to offer more detailed information on the proposed project and to receive more personal characterizations of the public's interests than what might generally be portrayed in written word or in front of a larger audience. The small group meetings were informal in nature. The views expressed by the participants were not entered into the formal comment record, as other mechanisms for official comment (public hearings and written comments) were available to all. Nevertheless, points of discussion raised in the small group meetings were considered by DOE for incorporation in the EIS process where appropriate.

DOE issued a Draft EIS on December 22, 1995, and held a formal public comment period on the draft through February 9, 1996. Two public hearings were held at or near each of the four alternative locations during the comment period. Comments received and DOE's responses to those comments are found in the second volume of this EIS.

1.4.2 Changes from the Draft EIS

Changes to the Draft EIS, either in response to public comment or to correct technical information, are denoted by a change bar in the margin. All comments received, along with the Department's responses to those comments, are reproduced in the Comment Response Document (Volume II of this EIS). Comments that resulted in notable changes to the EIS addressed the following topics:

- **Need for the Project** - Some commentors questioned why the Department has proposed to produce Mo-99 when other Mo-99 production initiatives (such as Nordion's plan to build the Maple I and II reactors) are planned or are underway. The Department further investigated these other Mo-99 production initiatives and, to reflect their current status, updated Sections 2.0 and 3.2.

- **The Preferred Alternative** - Multiple commentors questioned the viability of and the rationale for identifying Annular Core Research Reactor at Sandia National Laboratories/New Mexico as the preferred alternative. Section 3.3.1.1 was revised to provide further insight into the Department's rationale for identifying the preferred alternative.

- **Cost of Alternatives** - Several commentors noted that the cost of the preferred alternative was not lowest among the four reasonable alternatives, and that the estimated cost for the Idaho and Oak Ridge alternatives should be further investigated. The EIS Team worked with the respective sites to develop additional cost data, and Section 5.22 has been revised to include this new data and to clarify the bases for the cost estimates.

- **Privatization of Mo-99 Production Facility** - Several commentors requested that the Department clarify its intent regarding the future privatization of any Mo-99 production capability that it may decide to establish. Section 2.0 has been revised to clarify the privatization discussion and to include a brief discussion of the Moly-99 project's relationship to the Department's National Isotope Strategy.

- **Shipment of Mo-99 to Nordion** - Organizations associated with the radiopharmaceutical industry commented that the Department should consider shipping Mo-99 to Nordion for final processing, quality assurance testing, and distribution. While shipment of Mo-99 to Nordion was included as a shipment option in the Draft EIS, the Summary, Section 5.11, and Appendix B of the Final EIS were modified to present this option more clearly.

- **Water Use** - Several organizations from New Mexico and other individual commentors questioned the wisdom of selecting Sandia as the preferred site, given recent reports that increased water use in the Albuquerque area could result in shortages and could even cause the city to sink (due to draining of the aquifer). Section 5.16 was revised to clarify and put into perspective the amount of water that would be used in the proposed project.

- **Required Modifications at the Power Burst Facility** - In response to comments from Idaho-based commentors, Section 3.3.4.9 was revised to clarify the modifications required to produce Mo-99 in the Power Burst Facility. These include modifications to the reactor central cavity, removal of transient control rods, and installation of coolant flow balance valves.

- **Site Descriptions** - Several commentors provided comments regarding the descriptions of the affected environment around the four sites under consideration. Chapter 4 was revised as appropriate to incorporate these comments.

- **Editorial Changes** - Multiple editorial changes were made to the EIS as a result of internal review and public comments.

1.5 Next Steps

After considering the comments received, DOE revised the EIS, as appropriate, and issued this Final EIS. The FEIS will be distributed in a manner similar to that of the Draft EIS, and will be sent to all parties who commented on the Draft EIS.

Following completion of the FEIS (but at least 30 days after the notice of availability of the FEIS is published in the *Federal Register* by the U.S. Environmental Protection Agency), DOE will issue a Record of Decision. The Record of Decision will specify which alternative (or alternatives) is environmentally preferable. In addition to the environmental impacts analyzed in this FEIS, the decision will be based on cost, programmatic, policy, national need, and other considerations.

If mitigation measures, monitoring, or other conditions are adopted as part of DOE's decision, they will be summarized in the Record of Decision, as applicable, and included in a mitigation action plan. The Record of Decision and mitigation action plan, if needed, will be placed in each alternative site's public reading room and will be available to interested parties upon request.

1.6 Relationship of the MIPP-EIS to Other DOE NEPA Documents

NEPA documents that have either been prepared, or are in preparation by DOE, for activities related to the proposed action include:

- *Programmatic EIS for Waste Management* evaluates the DOE complex-wide long-term waste management policies and practices. The notice of availability for the Draft EIS was published on September 22, 1995. Any waste generated by Mo-99 production would be managed consistent with the Record of Decision from DOE's complex-wide Programmatic Environmental Impact Statement (PEIS) for waste management.

- *Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Restoration and Waste Management Programs Final Environmental Impact Statement* evaluates the management of DOE-owned spent nuclear fuel. The Record of Decision was published in the *Federal Register* on June 1, 1995. The small quantity of spent nuclear fuel generated from use of a reactor in the production of Mo-99 would be managed in accordance with the Spent Nuclear Fuel-Programmatic Environmental Impact Statement (SNF PEIS) Record of Decision.

- *Los Alamos National Laboratory Site Wide Environmental Impact Statement* will analyze the cumulative impacts of operations and planned activities foreseen at LANL within the next 5 to 10 years (notice of intent published on May 12, 1995, 60 FR 25697). The preferred alternative and one additional alternative considered in this MIPP-EIS would involve the use of facilities at LANL. The preferred alternative proposes to use the Chemistry and Metallurgy Research Facility to fabricate the targets. Another alternative examined in this MIPP-EIS considers the use of the Omega West Reactor (for irradiation of targets) and of the Chemistry and Metallurgy Research Facility (for target fabrication and processing).

- *Draft Environmental Impact Statement for the Nevada Test Site and Other Offsite Test Locations Within the State of Nevada* will analyze the cumulative impacts of operations and planned activities foreseen at the Nevada Test Site. The Draft EIS was issued for public review in January 1996. Low-level waste from Mo-99 production is included as part of the impact analysis in the sitewide Nevada Test Site EIS.

- *Draft Environmental Assessment for Sandia National Laboratories/New Mexico Offsite Transportation of Low-Level Radioactive Waste* will evaluate the shipment of existing inventories of low-level waste accumulated at SNL/NM and new low-level waste projected to be generated at SNL/NM.

Low-level radioactive waste, generated by the production of Mo-99 at SNL/NM and analyzed in the MIPP-EIS, will be included in the projected quantities identified in the proposed EA.

- *Environmental Assessment for the Chemistry and Metallurgy Research (CMR) Building Upgrades at Los Alamos National Laboratory* was prepared to evaluate safety upgrades to the facility. The purpose of the upgrades is to reduce risk, enhance the safety margin, and provide for the continued safe, reliable, and effective use of the facility in support of Laboratory missions. The Department is reviewing comments received during the public comment period and expects to decide if the Environmental Assessment supports a finding of no significant impact in 1996. The Chemistry and Metallurgy Research Facility is being considered for use in both the preferred alternative (to be used for target fabrication activities) and the LANL Omega West Reactor alternative (target fabrication and processing). The medical isotopes project activities at the Chemistry and Metallurgy Research Facility would proceed independently of the building upgrades.

2.0 Purpose and Need for Action

For more than 40 years, the U.S. Department of Energy (DOE) and its predecessor agencies have produced and distributed isotopes for medical and industrial applications through DOE's national laboratories. In 1990, Congress established the Isotope Production and Distribution Program to consolidate all existing DOE isotope production activities under one program.

Among other activities, the DOE Isotope Production and Distribution Program has responsibility for ensuring that the U.S. health care community has access to a reliable supply of molybdenum-99 (Mo-99). Mo-99 is a short-lived radioactive isotope of molybdenum. In just a few days after its production, Mo-99 decays to form metastable technetium-99 (Tc-99m), the most widely used medical radioisotope in the U.S.

Tc-99m has broad nuclear medicine applications in the areas of diagnostic procedures and medical laboratory tests. According to a report issued to the U.S. House of Representatives Subcommittee on Energy and Environment, a total of approximately 38,000 diagnostic procedures involving radioactive isotopes are performed each day in the United States. Most of these procedures use Tc-99m. By chemically attaching the Tc-99m to a selected carrier agent, it is possible to direct the isotope to a specific area of concern, such as the bones, brain, heart, kidneys, liver, lungs, and thyroid gland. From its target location in the body, Tc-99m emits gamma radiation that is received by gamma camera imaging equipment. The images created provide physicians with detailed information about conditions and functions in the body that could otherwise be obtained only by performing invasive exploratory surgery. Tc-99m-based radiopharmaceuticals help provide an assessment of organ function and detection of tumor metastases in the dy.

Tc-99m is the isotope of choice for most diagnostic procedures because its short physical half-life (6 h) minimizes the radiation dose received by the patient, because the characteristics of its radioactive emissions allow for quick and accurate diagnosis of certain abnormal conditions in the body (as well as verification of corrective actions) and because it can be combined with many different carriers to concentrate in different parts of the body. No other isotope has been found to offer a better combination of short half-life, optimum energy for gamma imaging, low patient dose, and versatility.

The short half-lives of Mo-99 and Tc-99m (66 h and 6 h, respectively) make these isotopes highly perishable. In order to provide a reliable supply for medical use, it is critical that production and distribution be maintained essentially on a continuous basis.

The Atomic Energy Act of 1954 authorized the Atomic Energy Commission to produce and make available radioisotopes for medical and scientific purposes. From the mid-1950s through 1966, the Atomic Energy Commission supplied Mo-99 produced at the Oak Ridge Research Reactor in Tennessee and in reactors at the Brookhaven National Laboratory in New York. The Atomic Energy Commission withdrew from Mo-99 production when commercial production was initiated in the U.S. by Union Carbide Nuclear

Corporation at a small reactor in Tuxedo, New York. From 1970 to 1989, Cintichem, Inc. produced Mo-99 at the Tuxedo, New York, reactor and provided approximately half of the Tc-99m used in the U.S. In 1989, Cintichem decided to shut down and decommission its reactor.

In November 1991, DOE purchased the Cintichem technology and equipment for $750,000, with an agreement to pay Cintichem a 4% royalty on the first 5 years of sales of Mo-99 and other isotopes produced by use of the Cintichem process. In addition, DOE agreed to accept the spent nuclear fuel from the Cintichem reactor. Subsequently, the Cintichem reactor was decommissioned and the spent nuclear fuel was transported to the DOE's Savannah River Site for storage.

The loss of the Mo-99 production capability at Cintichem left the U.S. totally reliant upon a single foreign source, Nordion International, located near Ottawa, Canada. Nordion receives bulk Mo-99 from Atomic Energy of Canada Ltd. (AECL). Nordion presently produces essentially all of the Mo-99 sold in the U.S., and an estimated 85% of the Mo-99 sold worldwide. The remaining 15% is produced by a variety of sources, most of which are located in Europe.

Prior to 1993, AECL operated two reactors that were available for the production of Mo-99. In 1993, one of the two Canadian reactors was permanently shut down, leaving only the second reactor operating. Any shutdown or extended outage of this nearly 40-year-old reactor could jeopardize the U.S. supply of Mo-99. In April 1995, this reactor suffered an unplanned shutdown for four days. European sources were able to increase their production temporarily to cover the European demand usually supplied by Nordion, and Nordion had sufficient product in process to meet the U.S. demand during this period. However, because Mo-99 has such a short half-life, making long-distance shipping difficult, and because European sources did not have sufficient capacity to meet both U.S. and European needs, shortages would likely have occurred in the U.S. if the Canadian reactor had remained out of service.

Although Mo-99 can be produced by different processes, such as target irradiation in a reactor or in an accelerator, only the Cintichem process and the proprietary process used by Nordion have been approved by the U.S. Food and Drug Administration (FDA) for Mo-99 sold in the U.S. Both processes use Mo-99 produced in a reactor. The Nordion process results in substantially greater quantities of liquid radioactive waste and mixed waste than the Cintichem process. Waste generated by the Cintichem process is primarily solid waste, which is much easier to manage and dispose. In both processes, the Mo-99 is shipped by air to radiopharmaceutical manufacturers, where the product is packaged as Mo-99/Tc-99m generators, so that Tc-99m can be extracted for use at the medical facilities. The Cintichem process can also be used to produce certain other radioisotopes (iodine-131 and xenon-133) that have medical applications. Iodine-125 was also produced by Cintichem through irradiation of xenon-124.

DOE proposes to establish, as soon as practicable, a domestic capability to produce a continuous supply of Mo-99 and related medical isotopes for the U.S. medical community. The purpose of the proposed action is to ensure a reliable domestic supply of Mo-99, an important medical isotope. The near-term goal (over the next 5 to 10 years) is to provide a backup capability to production in Canada by supplying a baseline production level of 10 to 30% of the current U.S. demand for Mo-99. This goal would include the capability to supply 100% of the U.S. demand, should the Canadian source become unavailable. Because of the potential for Mo-99 shortages, it is essential to establish a backup capacity as soon as practicable. If ıd when private industry can ensure a reliable supply of Mo-99, the Department will reassess its need to maintain a Mo-99 production capability.

The U.S. medical community uses about 60% of the worldwide supply of Mo-99/Tc-99m, yet has no current domestic production source for these isotopes. Because the worldwide medical radioisotope market is influenced by forces other than narrow market forces, full cost recovery of investment is often not feasible. In addition to market vagaries, the uncertainties and liabilities associated with licensing, constructing, and operating a nuclear reactor have prevented, and will likely continue to prevent, private companies in the U.S. from developing a domestic source of Mo-99 to replace the Cintichem reactor. Nordion intends to build two modern 10-MW reactors in Canada, as replacements for the existing reactor.[a] However, until these reactors are built, a window of vulnerability will exist for the U.S. medical community. DOE commissioned a study entitled an *Independent Assessment of the DOE Plan to Establish a United States Production Source for Molybdenum-99*, conducted by Integrated Resources Group, Inc., and JUPITER Corporation, dated September 30, 1994, which concluded "there is a critical need for a stable supply of Mo-99 in the United States" (Savoie and Singh 1994).

Although Mo-99 production sources in Europe could increase their production rates in the event of a shutdown of the Canadian reactor, Savoie and Singh 1994 found that "[while the European sources] do offer some potential for the near-term [supply of Mo-99]...European capacity can only supply a portion of the U.S. demand."

If the Canadian production source were to become unavailable, the supply of Mo-99 available to the .S. would be substantially reduced or eliminated. A shortage of Mo-99 would limit the diagnoses of thousands of medical patients in the U.S. each day. A reduction in Mo-99 supply could also result in a cost increase to patients for diagnostic procedures that involve Tc-99m.

Because the U.S. medical community has been without a reliable backup supply of Mo-99 since the shutdown of one of the Canadian reactors in 1993, DOE is addressing the critical need to provide such a backup. In Senate Report No. 103-291 accompanying the Energy and Water Development Appropriations Act, 1995, the Committee on Appropriations stated the

> "United States is fully dependent for 100% of the supply of Mo-99 and Tc-99m, both important to nuclear medicine, on sources in Canada which produces (sic) these isotopes in aging facilities. Of particular concern is the lack, since 1990, of a domestic source of Mo-99, an isotope used to produce

(a) Nordion communication to Nuclear Medicine Professionals on November 10, 1995. Nordion International, Inc., 447 March Road, Kanata, Ontario, Canada.

Tc-99m which is used in approximately 36,000 medical diagnoses per day. The committee notes that the Department is taking steps to...produce Mo-99 and related medical isotopes to ensure that there are no inadequacies of supply for domestic use. The committee supports this effort and wishes to be kept informed as the Department progresses."

The need for a domestic production source for Mo-99 has been echoed by the U.S. medical and scientific communities. Response to a statement in a December 1994 report by the Institute of Medicine Committee on Biomedical Isotopes stating the short term Mo-99 supply situation is "no longer precarious" has been particularly strong. In a February 1995 report, Senior Scientists and Engineers stated "in our only disagreement with that distinguished [Institute of Medicine] committee, we believe that their report is over optimistic on the Mo-99 situation, now and future...," and that "the Mo-99 problem...must be [solved] if the U.S. is to have a reliable supply of its most important non-military isotope." Also, the *Position Statement on Isotope Availability* issued by the Society of Nuclear Medicine and the American College of Nuclear Physicians in May 1995 stated, "it is particularly urgent that the U.S. Government work to establish a reliable uninterrupted supply of Mo-99, as the source of Tc-99m, the main radioactive isotope used in diagnostic Nuclear Medicine."

For the reasons previously stated, and as recommended by Savoie and Singh (1994), DOE proposes to "move immediately to narrow this [short-term] window of risk," regarding the domestic supply of Mo-99. DOE's long-term goal (beyond 5 to 10 years) is that production of Mo-99 in the U.S. should be conducted by the private sector. DOE is not addressing the long-term in this environmental impact statement. DOE does, however, encourage the development of private sources in the U.S. for long-term production of Mo-99. The Department could then withdraw from markets that are reliably supplied.

If DOE proceeds with the near term production of Mo-99 and related medical isotopes using government facilities and equipment, the Department would eventually explore the possibility of private sector participation consistent with the U.S. Department of Energy National Isotope Strategy (DOE 1994a). The Department would consider the potential sale or lease of certain of its facilities to private sector entities if, by such action, isotope production and delivery would be enhanced. The Department's objectives would be to encourage the private sector to play a greater role in isotope supply and to decrease the Government's cost and involvement. Any environmental reviews and actions related to future private sector involvement would be performed as required by law.

3.0 Alternatives

The U.S. Department of Energy (DOE) proposes to establish, as soon as practicable (in about 1 to 3 years), a domestic capability to produce a continuous supply of molybdenum-99 (Mo-99) and related medical isotopes for the U.S. medical community. The purpose of the proposed action is to ensure a reliable domestic supply of Mo-99, an important medical isotope. This section describes the alternatives that were considered for the production of Mo-99 and related medical isotopes.

3.1 Approach to Determine the Reasonable Alternatives

To determine the reasonable alternatives, DOE identified specific technical criteria necessary to satisfy the purpose of, and need for, the proposed action. These criteria were used to evaluate alternative facilities for both Mo-99 production and separation.

3.1.1 Molybdenum-99 Production Facility Needs

- Facility must be operating or capable of operating in the near term.
- Production method must allow the separation facility to provide approximately 3000 6-day curies (Ci) per week to the radiopharmaceutical houses to satisfy the U.S. demand for Mo-99. A 6-day curie is the amount of activity remaining after a given product has been allowed 6 days to decay.
- Facility must have the handling capability to support removal of the product from the facility.
- Periodic scheduled maintenance outages must be reliably accomplished in ≤ 6 days.
- Facility operation must be capable of using a U.S. Food and Drug Administration (FDA)-approved process for Mo-99 production.
- Facility must be able to package and transport the production facility product, if required, to a facility that can chemically process the product.

3.1.2 Molybdenum-99 Separation Facility Needs

- Facility must be capable of providing shielded and sealed rooms sufficient to support reliable Mo-99 production (including separation and environmental control equipment, remote handling equipment, and a room for a quality control facility).

- Facility must be capable of providing adequate ventilation systems to manage any hazardous gases produced or released during the separation process (separate zones, differential pressures, and filters).

- Facility must be located so that timely packaging and shipment of the Mo-99 product from the facility will ensure that the activity and purity requirements of the product are maintained (10,000 Ci Mo-99 per gram of product upon delivery to the customer).

- Facility must be able to manage the radioactive waste that is generated during the separation.

- Facility must be able to employ an FDA-approved process for Mo-99 separation.

- Facility must be capable of reliably separating commercially desirable ancillary radioactive isotopes (7 days/week) consistent with an FDA-approved Mo-99 separation process.

Either an accelerator, a solution-fueled nuclear reactor, or a solid-fueled nuclear reactor could be used to produce Mo-99. However, the technology necessary to produce Mo-99 in an accelerator or in a solution-fueled reactor is not sufficiently developed to satisfy the production criteria listed. Therefore, the reasonable alternatives described in this section all involve the use of a solid-fueled reactor as the Mo-99 production facility.

Two processes are approved by the FDA for the production and separation of Mo-99 sold in the U.S., both of which involve use of a solid-fueled reactor. They are the Cintichem process and the process used by Nordion International in Canada. Only one of the alternatives considered, the University of Missouri Research Reactor, would use the Nordion process. This alternative was not considered reasonable because it could not satisfy the production and separation facility criteria listed. All of the reasonable alternatives would use the Cintichem process.

The Cintichem process involves four steps (see Figure 3-1). The first step is target fabrication. In this step highly enriched uranium, 93% enriched in the fissile isotope uranium-235, is coated on the inside of a stainless steel tube. The tube is then sealed at each end. This step is conducted remotely inside a controlled-atmosphere facility, such as a glove box. (The Department of Energy has issued a "sources sought" notice to determine if there are companies interested in target fabrication [CBD 1995]. Responses to the request would be evaluated prior to a determination of whether to proceed with a procurement regarding privatization of target fabrication, and National Environmental Policy Act [NEPA] documentation would be prepared as appropriate.)

The second step is target irradiation in the Mo-99 production facility (a solid-fueled reactor). A target is usually irradiated in a reactor for about a week, and then is removed for processing.

The third step is target processing in the Mo-99 separation facility. In this step, the irradiated target is placed into a heavily shielded facility known as a hot cell. The top of the target is punctured, the gases inside the target are removed, and a chemical solution is poured into the target. This chemical solution

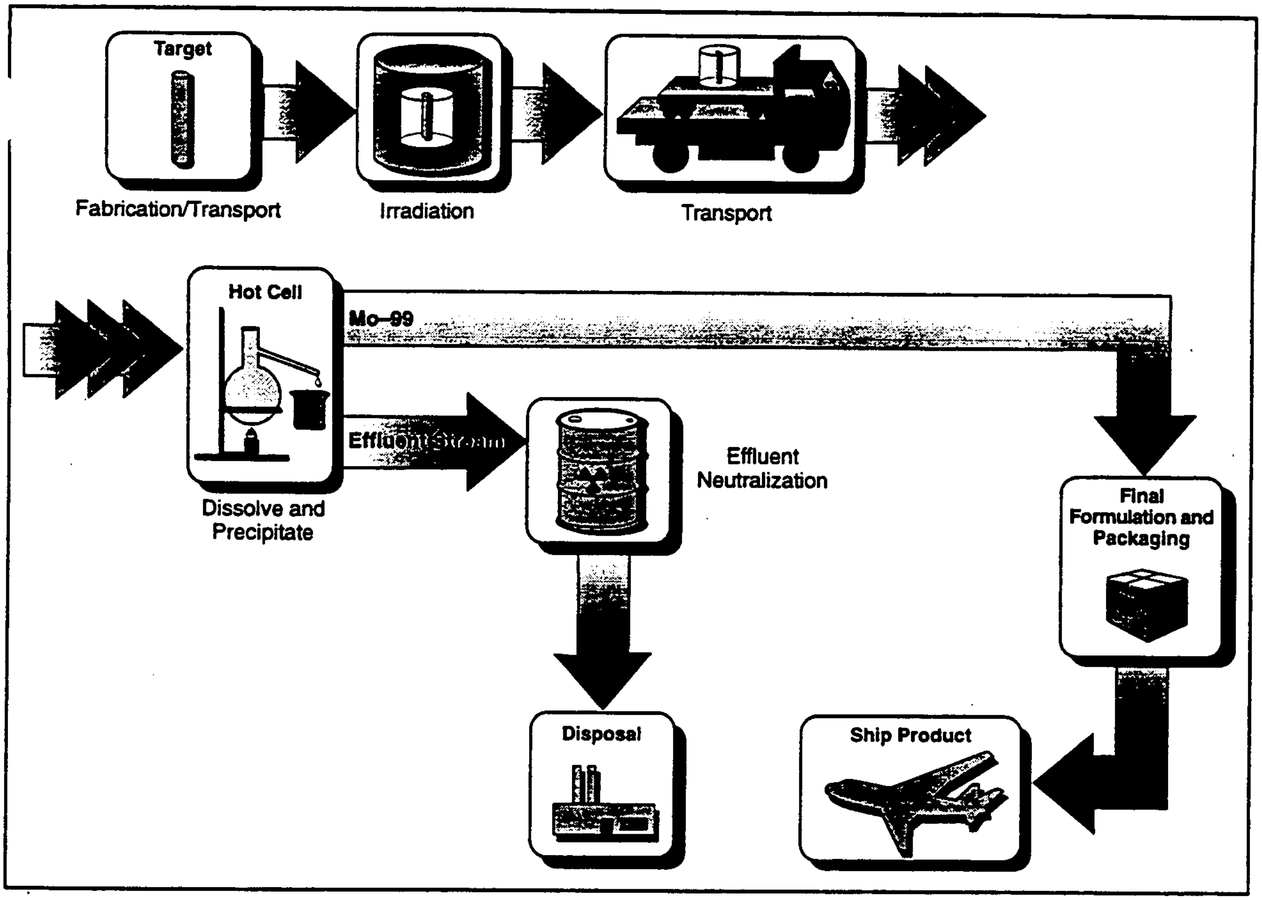

Figure 3-1. Molybdenum-99 Production Process

dissolves the highly enriched uranium coating from the inside of the target. The chemical solution is then filtered to remove the molybdenum, which is packaged for shipment to the radiopharmaceutical companies. A more detailed description of this step is provided in Appendix A.

Waste stream management is the fourth step. Materials used in the separation of the Mo-99 product become waste during the processing. The Idaho National Engineering Laboratory (INEL) and Los Alamos National Laboratory (LANL) are capable of handling, processing, and storing, entirely onsite, the waste generated from Mo-99 production. Sandia National Laboratories/New Mexico (SNL/NM) and Oak Ridge National Laboratory (ORNL) would ship waste generated from Mo-99 production to the Nevada Test Site, which historically has been the site for disposal of low-level waste.

The DOE intends to produce a baseline quantity of Mo-99 (about 10% to 30% of U.S. demand) to maintain the capability to respond to shortages in domestic Mo-99 supply. Because the DOE intends to produce Mo-99 even when the Canadian source is supplying Mo-99, periods may occur when DOE is unable to sell the Mo-99 it produces. In this case, the unsold Mo-99 would be disposed of as low-level radioactive waste at the same disposal site as other low-level wastes generated during Mo-99 production.

Two additional medical isotopes produced from fission, xenon-133 and iodine-131, can be separated from the waste streams of the Mo-99 process. Xenon-133 is used in the diagnosis of lung maladies; iodine-131 is used in the diagnosis and treatment of thyroid conditions, such as Graves disease. The Drug Master Files for these isotopes are structured for an initial extraction from the waste stream of a Mo-99 production process. Separate hot cell facilities, or at least several additional process stations within hot cells, would be required to perform these separations as concomitant operations with the Mo-99 process.

The DOE has given LANL the task of reproducing and refining the Cintichem target fabrication process. This initiative is currently being conducted in the Chemistry and Metallurgy Research Wing 9 Facility. A proof of process scale production facility has been completed. Associated quality assurance and quality control equipment and procedures are also being developed. These procedures and methods are used to ensure that completed targets would not leak during irradiation, the inner wall uranium coating would be uniform, and the appropriate amount of material had been plated on the target inner wall. This work, when completed (about 1 month after the Record of Decision for this FEIS), could be reproduced at most sites as a turn-key process.

LANL has also been tasked by the DOE to assist SNL/NM in the development of the Cintichem separation chemistry process, which would be applicable at all reasonable alternative sites. This initiative is currently ongoing at LANL and SNL/NM.

Iodine-125, an isotope used in radio-immunoassay activities, can also be produced at the facility selected for Mo-99 production. The iodine-125 process requires a separate target irradiation. The iodine-125 isotope can be made through irradiation of xenon-124. Production of this isotope requires separate irradiation locations in the reactor or the reactor shield. It would also require separate hot cell facilities in which to conduct the chemical separation and purification processes.

The focus of the proposed project is the production of Mo-99. Iodine-125, iodine-131, and xenon-133 could be produced at any of the sites to offset the costs of Mo-99 production, but are in less demand by the medical community than Mo-99. Therefore, the focus of the discussion in the remainder of this section is on the production of Mo-99.

3.2 No Action Alternative

3.2.1 Description of the Alternative

Under this alternative, DOE would not establish a U.S. production source for Mo-99. The U.S. would continue to rely on Nordion International, a Canadian firm, to supply its Mo-99 needs. Potential changes to the currently existing conditions include the construction of new Mo-99 production reactor(s) and a new separation facility in Canada, FDA approval of other foreign Mo-99 production processes, and ommercialization of alternative Mo-99/Tc-99m production technologies.

3.2.2 Impacts of the No Action Alternative

The current demand for metastable technetium-99m (Tc-99m) in the U.S. requires a weekly supply of approximately 3000 6-day Ci of Mo-99. Currently, the entire U.S. supply of Mo-99 is produced in Canada by Nordion International, using a single reactor, the National Research Universal (NRU) reactor. Under the no action alternative, the U.S. medical community would continue to rely on this source of supply.

The current supply of Mo-99 from Canada would be interrupted if the NRU reactor experienced a mechanical failure or were shut down for any reason. The NRU reactor must operate continuously for 12 or 13 days of each 15-day operating period in order to maintain a continuous supply of Mo-99. Down time is normally required for maintenance, repairs, and target replacement. This operating schedule has been maintained for many years to meet the U.S. and Canadian demands for Mo-99, and to ship Mo-99 to numerous other foreign countries.

An interruption of the continuous supply of Mo-99 from Canada would have serious impacts on the practice of diagnostic nuclear medicine in the U.S. More than 90% of all diagnostic imaging procedures rely on Mo-99 generator-supplied Tc-99m. These procedures involve medical tests for renal (kidney) function, bone scans for cancer and other abnormalities, liver and bile duct function, heart disease and defects, brain cancer, blood flow in stroke patients, and diagnoses for a variety of other health conditions. The discontinuation of physicians' ability to perform such necessary diagnostic tests would seriously ındermine their ability to diagnose and treat many different diseases. For many of these tests, there is no alternative method of analysis. About 36,000 patients could be affected for each day of interrupted supply.

If the NRU reactor is shut down, it might not be restarted. The reactor was commissioned in 1957 and, although an aggressive maintenance program is in place to keep it operating, no plans exist to continue operation beyond the year 2000 because of the reactor's age and the isotope separation waste storage capacity. Any major problem at the reactor requiring significant time and resources to repair would likely result in a permanent shutdown, terminating this source of supply.

Nordion International Inc. and Atomic Energy of Canada Ltd. (AECL) (the Crown corporation that operates the NRU reactor) began planning and construction of (initially one and now two) new isotope production reactors (Maple I and Maple II) to replace the NRU reactor for Mo-99 production. These facilities would use a Mo-99 production and separation process similar to the Cintichem process to reduce the amounts of radioactive waste generated. However, AECL decided to halt construction of the Maple reactor complex and processing facility in 1993 after a legal and financing dispute with Nordion and its parent company, MDS Health Group Ltd., of Canada. MDS Health Group Ltd. subsequently filed a breach of contract lawsuit against AECL, and the two sides agreed to arbitration hearings to resolve the dispute (Rojas-Burke 1995). The dispute has been mostly resolved, but Nordion has not yet made a formal announcement to resume construction due to a disagreement with the Canadian government regarding the tax treatment of the new reactors. The announcement to resume construction was previously anticipated in the first quarter of 1995 (Savoie and Singh 1994).

The sale in the U.S. of Mo-99 produced at the Maple reactor complex cannot begin until the facility is completed, licensed, and approved by the U.S. FDA for supply to U.S. pharmaceutical companies. Although Nordion currently plans to build two reactors, they may at some time decide to construct only one of the two proposed reactors. If only one reactor is built, the sole-source of supply issue would remain for nuclear medicine physicians in the U.S. The Nordion and AECL estimate of the time required to complete the necessary environmental and construction permitting, to construct and commission one of the reactors, and to construct the radiochemical separation facility is about three years. Construction and commissioning of the second reactor, if pursued, would proceed simultaneously and would be completed about one year after the first unit. Full-scale Mo-99 production and sale in the U.S. would probably require an additional several months at each of the reactors.

Nordion estimates the cost to construct the two new reactors and the new processing facility at $140 million. To finance the construction of the new reactors and hot cell, Nordion has announced that they intend to raise the price of Mo-99 by about 40%.

Nordion has established a European subsidiary by acquiring the radiopharmaceutical department of Institute National des Radio-elements (IRE) in Fleurus, Belgium, but the IRE (fully-owned by the Belgian federal government) remains the owner of Mo-99 production. IRE and Nordion have signed a mutual Mo-99 backup agreement to avoid a complete shortage of Mo-99 in case of an unscheduled shutdown of the Canadian NRU reactor. However, Mo-99 from the Belgian source has never been sold in the U.S. The contractual backup arrangement is currently written for IRE to supply Nordion the excess capacity of its facility for 8 weeks.

The IRE has produced medical and industrial isotopes since 1972. Its primary source for medical isotopes is the BR2 reactor at Mol, Belgium. The IRE currently uses a collaboration of four different reactors to ensure a stable supply. They are the BR2, the High Flux Reactor (HFR) at Petten, the Netherlands, OSIRIS at Saclay, France, and SILOE at Grenoble, France. IRE's processing of Mo-99 is centralized in Fleurus. The IRE runs at a normal base level of 1200 6-day Ci per week, has a capacity of 2000 6-day Ci per week, and can produce approximately 3000 6-day Ci per week on a short-term basis. In this case, approximately 1800 6-day Ci could be produced to supply the U.S. for 8 weeks under the backup arrangement with Nordion (Savoie and Singh 1994). This quantity (1800 6-day Ci) is only 60% of the current U.S. demand.

It is unlikely, however, that Nordion's backup arrangement with IRE could immediately respond to a U.S. shortage of Mo-99. Use of the IRE source would depend on IRE's ability to obtain FDA approval. The IRE submitted a Drug Master File to the FDA in 1991, and Mo-99 samples were sent to the U.S. radiopharmaceutical companies (DuPont-Merck, Amersham Mediphysics, and Mallinckrodt Medical) so that they could support IRE's request for FDA approval. However, the FDA approval process on the submittal has proceeded slowly because IRE has no established U.S. customers. IRE has informed DOE that IRE has a sufficient number of certified transport casks to ship the Mo-99 material from Europe 'irectly to the U.S. pharmaceutical companies.

Mallinckrodt Medical, a U.S. radiopharmaceutical company, is currently working with the HFR at Petten in the Netherlands to secure a backup supply for its European needs. The HFR is owned by the Joint Research Center of the European Community and is operated by the Netherlands Energy Research Foundation. It is a multipurpose reactor, previously used about 15% of the time for production of radioisotopes.

Mallinckrodt would use the HFR to produce Mo-99 and recently completed an upgrade of a radiochemistry processing facility at Petten to process the Mo-99. In August, 1995, Mallinckrodt received a license from the Dutch nuclear regulatory authority to produce medical isotopes at the Petten facility. Mallinckrodt has worked since that time to secure approvals from the U.S. FDA for Mo-99 generators for sale in the U.S. The Petten facility expects to receive back-up Mo-99 from reactors in France and, perhaps, Poland. The Mallinckrodt process uses clad plate uranium-235 sections as targets, similar to the Nordion process.

Mallinckrodt expects to begin Mo-99 production at Petten for European customers in 1996, and for U.S. operations upon FDA approval. Mallinckrodt expects to be able to supply about 30% of the world market, but will not supply Mo-99 to other pharmaceutical companies. It does not intend to compete with Nordion, which is expected to supply the remaining 70% of demand. While production at the Petten HFR could be increased beyond European needs, it would not be expected to meet the U.S. demand in the event of an interruption in supply at Nordion.

Molybdenum-99 is produced in a number of other countries. These include reactor production facilities in Australia, Indonesia, Japan, Peru, Argentina, Russia, China, and South Africa. For the most part, these represent small, government-run production facilities, and the Mo-99 is produced for local use rather than international export. It is not expected that any of these foreign sources could meet a significant portion of the U.S. demand for Mo-99/Tc-99m generators. The production capabilities are generally small and sporadically run. The foreign governments are reluctant to try to meet U.S. FDA requirements for export to the U.S., which are viewed as unreasonably costly and lengthy to pursue. International politics and transportation deficiencies also have major roles in limiting the ability of foreign producers to supply Mo-99 to the U.S.

The Atomic Energy Corporation of South Africa has expanded its Mo-99 production capacity at its Safari-1 research reactor to 1000 curies per week and has commissioned a new radiochemical process line at its facility near Pretoria (Nucleonics Week, 1996). The product has not been approved by the U.S. FDA for sale in the U.S.

Thermo Technology Ventures, Inc., a U.S. company, is investigating a concept for direct production of Tc-99m using small particle accelerators (see Section 3.4.3.3). If successful, Thermo Technology Ventures may be able to supply a significant quantity of Tc-99m to the U.S. medical community by late 1999.

If DOE selects the no action alternative and does not establish a domestic supply of Mo-99, neither the government nor private industry could effectively respond to the U.S. Mo-99 needs if the Canadian source becomes unavailable. Because the production process for Mo-99 requires a properly trained staff, a technically viable reactor or accelerator, and substantial hot cells, a production source cannot quickly be established. A significant amount of planning, time, and resources is necessary to establish such capability. Schedules for establishing a production source for the four analyzed alternatives are listed in Table 3.2 at the end of this section. Budget figures for establishing a production source are listed in Section 5.3. These figures do not include sunk costs or continued operational costs.

3.3 Alternatives to Accomplish the Proposed Action

3.3.1 Annular Core Research Reactor: Sandia National Laboratories/ New Mexico and the Chemistry and Metallurgy Research Facility: Los Alamos National Laboratory Alternative--Preferred Alternative

The SNL/NM is located in Albuquerque, New Mexico, as a tenant on the Kirtland Air Force Base. The SNL/NM is a multiprogram laboratory operated for DOE by the Lockheed-Martin Corporation with facilities located in Albuquerque, New Mexico, and Livermore, California. The SNL/NM is a research and development facility and conducts programs in nuclear reactor safety, nuclear safeguards, energy research, and microelectronics. The SNL/NM has not been called upon to produce and market radioisotopes in the past. This type of mission would be new to the SNL/NM facilities.

This alternative would involve the use of existing DOE facilities at SNL/NM and LANL to produce Mo-99. The following sections describe the activities included as part of this alternative. The locations of SNL/NM and LANL are shown on Figure 3-2.

3.3.1.1 Description of the Alternative

Under this alternative, highly enriched uranium targets would be fabricated at the LANL Chemistry and Metallurgy Research Facility and then shipped to Technical Area V at SNL/NM. The targets would be irradiated in the SNL/NM Annular Core Research Reactor, removed and then processed to produce medical radioisotopes in the SNL/NM Hot Cell Facility adjacent to the Annular Core Research Reactor. The medical radioisotopes would be shipped to radiopharmaceutical companies via the Albuquerque International Airport. Low-level wastes would be shipped to the Nevada Test Site for disposal under an existing agreement.

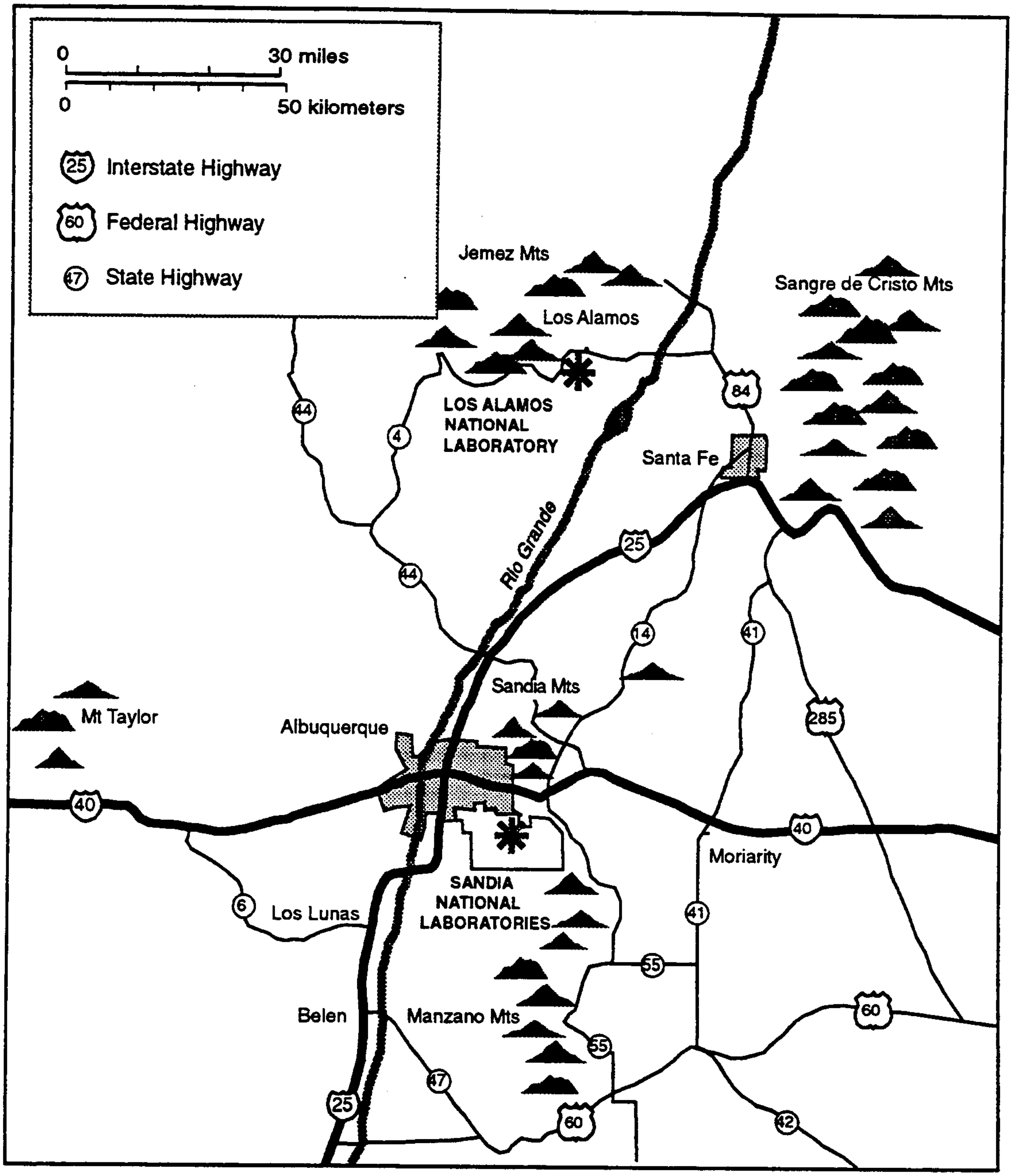

Figure 3-2. Location of Los Alamos National Laboratory and Sandia National Laboratories

An overview of the proposed program is depicted in Figure 3-3.

The Annular Core Research Reactor/Hot Cell facility combination is the preferred alternative for target irradiation and processing because of the relatively short time required to begin initial production. The ability to produce even a small amount of Mo-99 in a short period of time is important in that FDA approval of DOE-produced Mo-99 could be obtained earlier and, if an Mo-99 shortage were to occur in the near future, DOE would be able to supply at least a fraction of the U.S. demand. The following factors also contributed to the identification of the Annular Core Research Reactor/Hot Cell Facility as the preferred alternative.

- The reactor and hot cell are currently operable, and the reactor has current safety documentation (e.g., Safety Analysis Report and Technical Safety Requirements). These factors would help reduce cost and schedule uncertainties associated with producing Mo-99. Because DOE is proposing to respond to a near term window of vulnerability in Mo-99 supply, it is important to keep uncertainties (especially schedule uncertainties) to a minimum.

- The reactor is not in use at this time, and is only expected to be needed to support defense programs in the event of a national emergency.

Under the preferred alternative, the Chemistry and Metallurgy Research Facility is the preferred target fabrication facility. This facility is in the locale of the preferred reactor and the staff are familiar with the target fabrication process. The facility also has the capability of extracting uranium from the waste streams, greatly reducing the quantity of highly enriched uranium necessary for target production. This facility was used to develop significant enhancements to the Cintichem target fabrication process; thus, the process currently exists at this facility in a prototype system.

3.3.1.2 Existing Facilities

Existing facilities at LANL and SNL/NM that would be used in the production of Mo-99 include the Chemistry and Metallurgy Research Facility at LANL (target fabrication); the Annular Core Research Reactor at SNL/NM (to irradiate Mo-99 production targets), and the SNL/NM Hot Cell Facility (processing).

In its current configuration, the Hot Cell Facility would only be able to conduct limited processing activities. A new cell would be constructed within the Hot Cell Facility to enable steady state production of greater than 10% and up to 100% of the U.S. demand for Mo-99.

3.3.1.3 Target Fabrication

Target Fabrication at LANL. Target fabrication would be performed inside glove boxes that are vented through high efficiency particulate air (HEPA) filters to the stacks in the Chemistry and Metallurgy Research Facility, Wing 9. Each target would be constructed of number 304 stainless steel tubing,

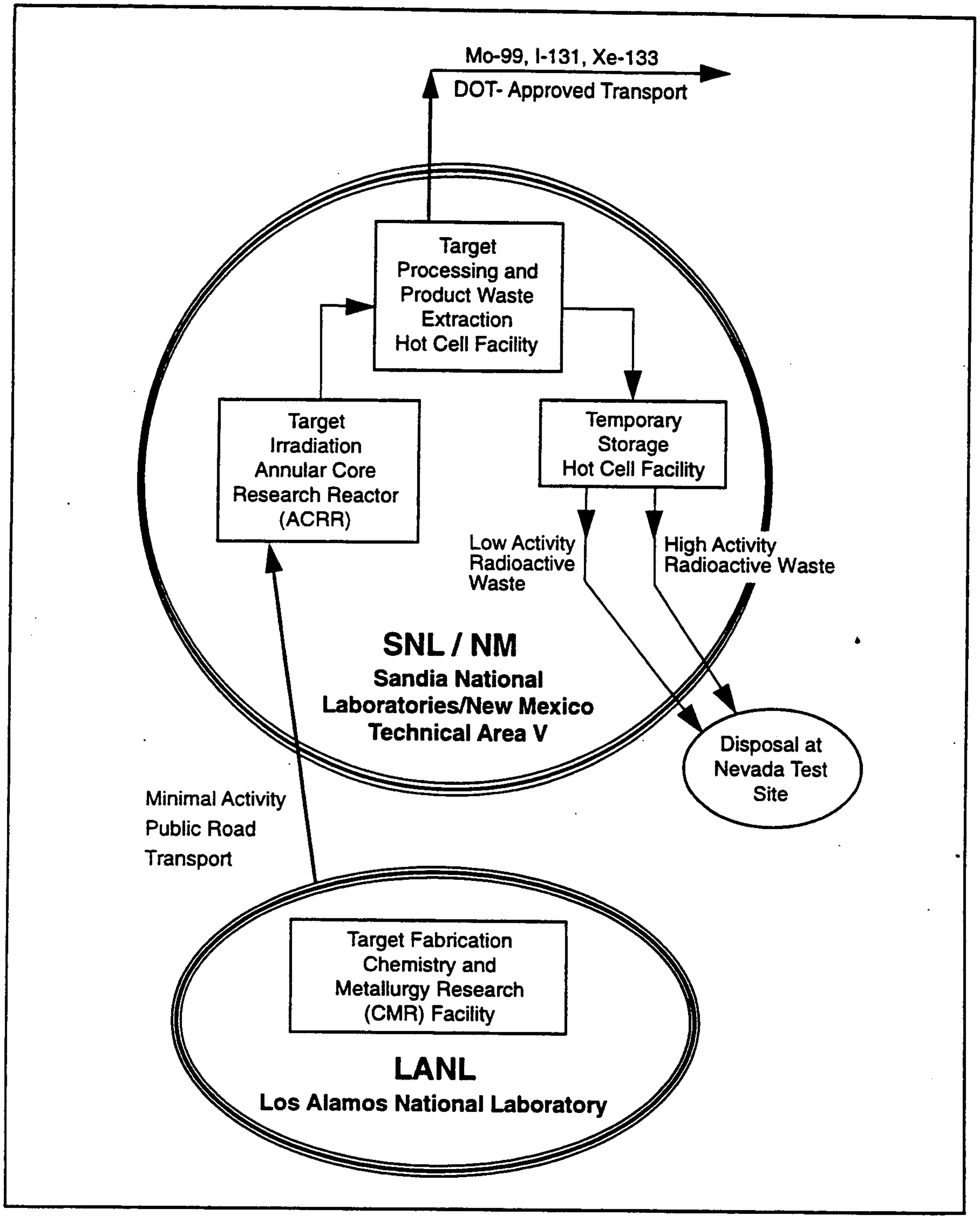

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Figure 3-3. Sandia National Laboratories/Los Alamos Laboratory Isotope Production Process approximately 51 cm (20 in.) long and 3 cm (1.25 in.) in outer diameter with a wall thickness of 0.09 cm (0.035 in.) (see Figure 3-4). Caps would be welded to close the top and bottom of the tube. The top fitting would include a thin diaphragm that contains the tube contents, until it is punctured in the fission product recovery process. The inside tube wall of the targets would be plated with highly enriched uranium (93% enriched uranium). The uranium plating would be approximately 50 microns thick and uniformly plated throughout the length of the tube. Powdered uranium oxide feedstock would be dissolved in a nitric acid solution and transferred to two tanks containing the plating solution. Adequate highly enriched uranium feedstock currently is stored at the LANL site to be capable of supplying a quantity of targets that would meet full production needs for several years.

The solutions from each tank would be transferred to the plating glove boxes. The plating process would pump the solution through a cathode-connected stainless steel target tube. A carbon anode rod would be centered inside the target tube. Plating would require 12 h to 15 h and produce a maximum of 20 g of uranium coating per target. The target plating quantity, quality, and tube integrity would be verified according to LANL quality assurance requirements. The targets would be pyrolized, assembled, and welded, and the completed targets leak tested. The Chemistry and Metallurgy Research Facility, Wing 9 target fabrication layout, is shown in Figure 3-5.

From other initiatives, LANL has significant experience in recovering uranium from solution. Spent plating solution would be recycled in ion exchange glove boxes to recover the unused uranium. Residues from this process would be collected in drums, sampled, and analyzed before transport to the TA-50 Radioactive Liquid Waste Treatment Facility at LANL. The motivation for the uranium recovery is waste minimization, as opposed to economics.

For criticality safety, a limit of 800 g of uranium-235 per glove box has been established. A maximum of 6 kg of uranium-235 is allowed in the entire target fabrication area to maintain the area as a low-hazard category.

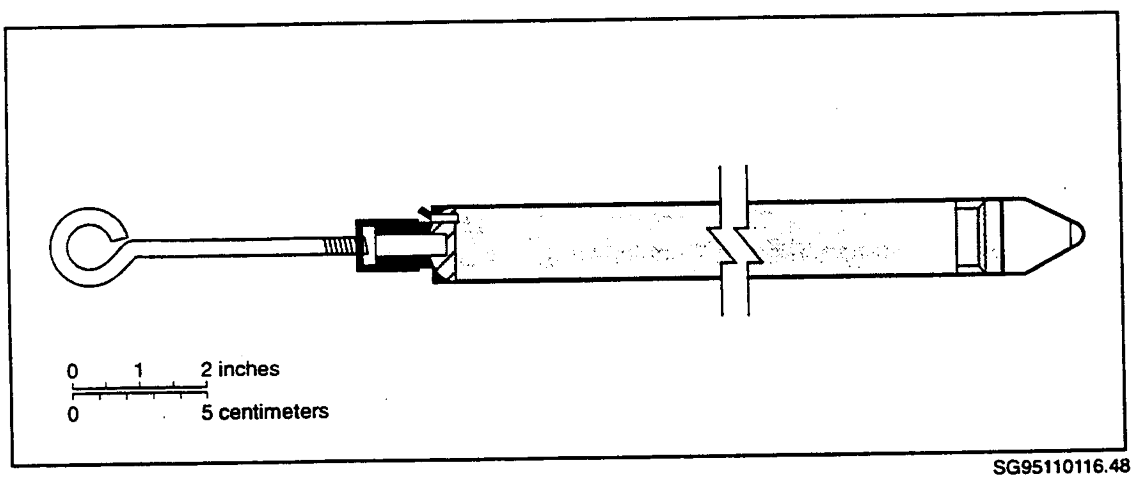

Figure 3-4. Configuration of Completed Target

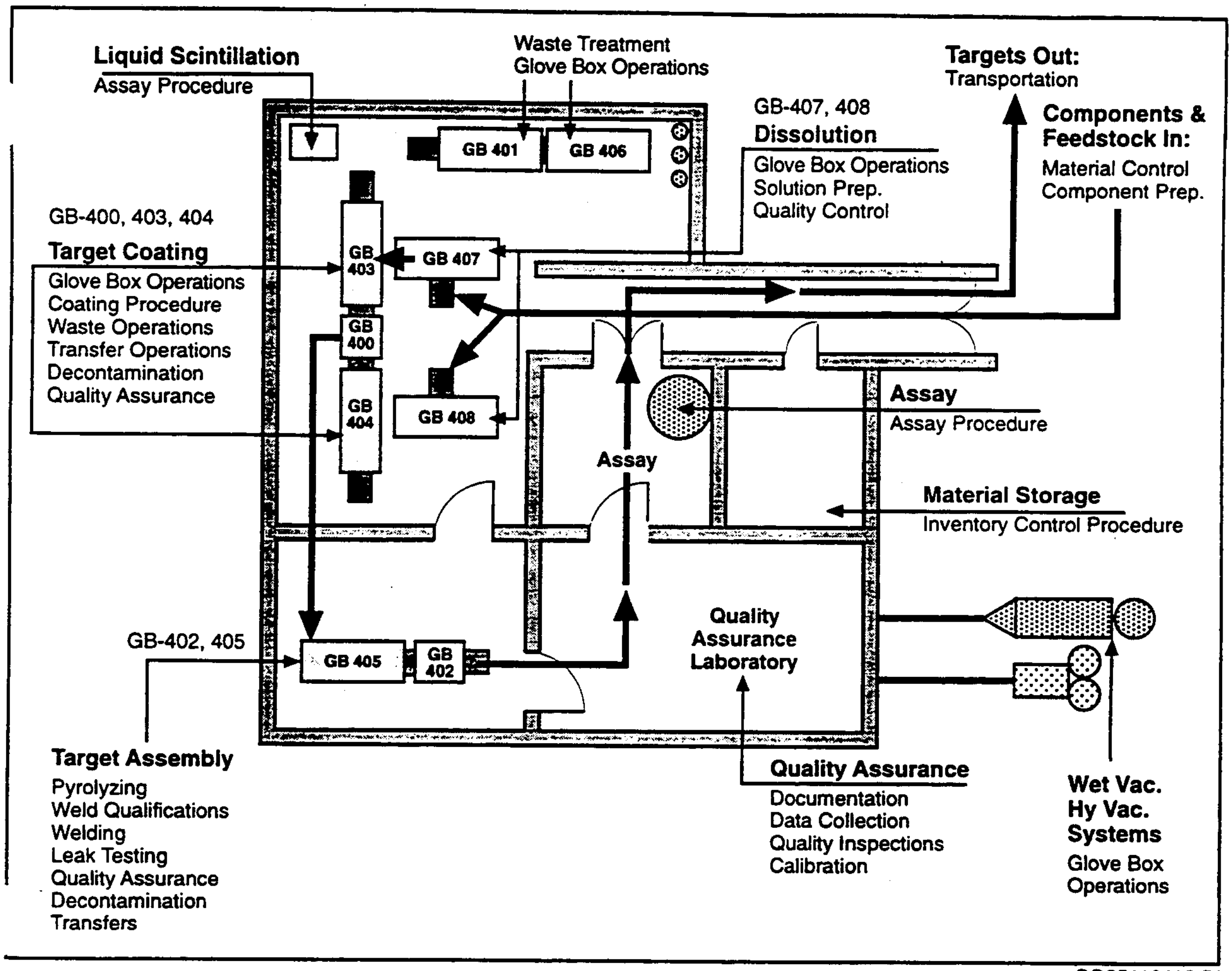

Figure 3-5. Uranium Target Fabrication Line, Process Flow and Procedures

Target Shipment to SNL/NM. Targets fabricated at LANL would be packaged and shipped to SNL/NM. The packaging would be U.S. Department of Transportation (DOT) approved Type A containers (specifically, BX-22 containers) designed to hold 12 targets each. Shipment of two of the BX-22 containers would supply 24 targets per week. The target supply required would depend on the percentage of U.S. demand for Mo-99 which the Annular Core Research Reactor would be required to fill and on the ability of the Annular Core Research Reactor to develop target power. As many as 35 and as few as 2 targets per week are anticipated to be required. The target packages would comply with DOT regulations for fissile materials delineated in Part 49, Code of Federal Regulations (CFR), Section 173.417.

Targets would be shipped to SNL/NM via NM 4, U.S. 84, and Interstate 25, as depicted in Figure 3-2. Target shipments would occur about once a week. Based on the nature of the Type A packaging proposed for use, each shipment would be limited to less than 500 g (17.5 oz) of uranium-235. Two BX-22 packages of targets with less than 250 g each would be allowed on a single shipment.

As specified in 49 CFR 173.457, the shipments would comply with DOT regulations for the transportation of Fissile Class III packages. Regulation 49 CFR 173.457 (b) (1) and 175.703 (c) (1) states that Fissile Class III packages must be shipped in exclusive-use conveyances. Fissile Class III shipments must incorporate controls designed to ensure

- nuclear criticality safety
- loading, storing, or transporting a shipment of Fissile Class III material with any other fissile material is prevented
- the shipping documents include the descriptions required in 49 CFR 172.203 (d).

Each shipment of unirradiated targets would involve the transportation of less than 500 g total of uranium-235. Under Nuclear Regulatory Commission (NRC) regulations, the material would be classified as Special Nuclear Material of Low Strategic Significance (10 CFR 73.2). Transportation of the target material would be performed under the requirements of 10 CFR 73.67(e). This section of the Code of Federal Regulations specifies the in-transit requirements for special nuclear materials of low strategic significance. The responsibilities of the shipper and receiver and physical protection requirements for the shipment are delineated.

An alternative method for packaging the unirradiated targets would be to use specific Type B containers, such as the DOT Specification 6M container, as specified in 49 CFR 173.417. In this case, 12 targets could be packaged into each container, for a total of 240 g (8.5 oz) of uranium-235 per package. Use of this type of container would qualify the packages of targets to be classified as Fissile Class I packages. It would also remove any criticality-based limit to the number of packages that could be transported in any shipment. The same physical protection measures for the Type A containers, as delineated in 10 CFR 73.67(e), would be required.

The targets would be processed through the normal special nuclear material receiving procedures of SNL/NM. These procedures contain appropriate corrections to the SNL/NM criticality safety and radiological controls procedures. Establishment of a separate receiving area for special nuclear materials, called a material balance area, is planned at Technical Area V for direct receipt of the target shipments. The targets would then be assigned to this material balance area where they would be stored awaiting use in the reactor. A 6-month supply of targets would be stored in Technical Area V. Each target would be identified with a sequential serial number. Special nuclear materials control would include identification of target locations while the targets were in the reactor.

Target Fabrication at SNL/NM. The target fabrication processes also could be implemented at SNL/NM. Because special facilities are not required, the target fabrication area could be located in any of a number of buildings located within Technical Area V without extensive facility modifications. The process described for fabricating targets at the Chemistry and Metallurgy Research Facility, Wing 9, would be used. Targets would be fabricated and stored onsite until needed for irradiation in the Annular Core Research Reactor, also located in Technical Area V.

The highly enriched uranium needed for target fabrication would be transported from DOE facilities at either Portsmouth, Ohio, or Oak Ridge, Tennessee. This material would be stored at SNL/NM in facilities designated for storage of highly enriched uranium and other special nuclear materials. The wastes from the fabrication process would be low-activity low-level waste which would be transported to the Nevada Test Site for disposal with the other low-level waste produced at SNL/NM.

3.3.1.4 Target Irradiation Activities at the Annular Core Research Reactor

The Annular Core Research Reactor is located in Technical Area V at SNL/NM. The facility consists of the reactor and all support systems required for its operation and conduct of experiments. A sketch of the Annular Core Research Reactor floor plan is shown in Figure 3-6. The Annular Core Research Reactor is a pool type research reactor capable of steady state, pulse, and tailored transient operation. It became operational in 1978 and was originally designed with characteristics suitable to support electronics testing and reactor safety research programs. The Annular Core Research Reactor is currently operational. The current Annular Core Research Reactor configuration consists of an annular (thick cylindrical or flat doughnut) array of 236 highly enriched uranium beryllium oxide-fueled elements with an active fuel length of 52 cm (20.5 in). This fuel would be used for initial Mo-99 production. However, the reactor would be transitioned to a completely low enriched uranium-fueled core as the highly enriched uranium fuel reaches a 5% burnup limit (approximately 10 months at a reactor power of 3 MW).

The reactor core is installed in a large open tank filled to a depth of approximately 10 m (33 ft) ntaining about 49 m^3 (1730 ft^3) of water to provide core cooling and radiation shielding. It has a central

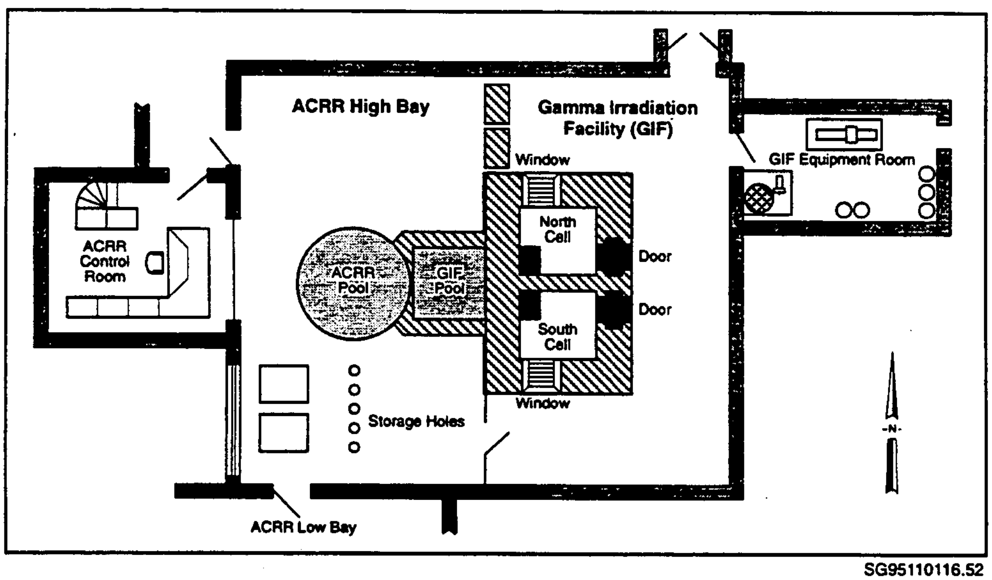

Figure 3-6. Annular Core Research Reactor Floor Plan

thermal flux region that configures 19 targets for irradiation in a partial production mode and 37 targets in a full production mode. The core is cooled by natural convection. The water pool is cooled by an external heat exchanger. Currently, the Annular Core Research Reactor is limited to operation at, or below, 2 MW in the steady state mode, due to the current cooling capability of the Annular Core Research Reactor pool water.

The core configuration would be changed for the isotope production program. The Annular Core Research Reactor would be operated exclusively in the steady-state mode with the reactor power cooling capability increased to 4 MW. The modified core would initially contain 170 highly enriched uranium beryllium oxide fuel elements. After the transition is complete, the core will be fueled with 190 low enriched uranium Training, Research, Isotope Production, General Atomics (TRIGA) type fuel elements with no zirconium hydride added. The fuel, without this compound added, would not acquire the inherent dynamic safety characteristics of a TRIGA reactor, but would generally retain the dynamic safety characteristics currently possessed by the Annular Core Research Reactor. TRIGA fuel with zirconium hydride has a very powerful prompt temperature coefficient that rapidly turns power transients. The current Annular Core Research Reactor dynamic characteristics have been used in the Annular Core Research Reactor safety analysis, which is acceptable for reactor operation. A modified central region, about 22.8 cm (9.0 in.) in diameter, would be used for irradiation of targets. A description of the proposed modifications to the Annular Core Research Reactor is contained in Section 3.3.1.9.

During irradiation, each target would generate a power level of approximately 20 kW at partial production levels and 15 kW at full production levels. This difference is due to the configuration required to produce an aggregate target power of approximately 490 kW. For a discussion of target power level and why it is important, see Appendix A.

The open pool reactor design would allow ready access for insertion and removal of the targets and fuel elements. Irradiated targets would be removed from the core and transferred via the pass-through ports to a rack in the Gamma Irradiation Facility pool.

3.3.1.5 Target Transfer to Hot Cell Facility

A transfer cask capable of supplying the required shielding for four 21-kW targets would be lowered into the adjacent Gamma Irradiation Facility pool. During initial operation, a single 21-kW target would be loaded and transferred to the Hot Cell Facility. After the new hot cell is completed, up to four irradiated 21-kW target(s) would be loaded into the cask for transfer to the Hot Cell Facility. The cask would then be removed from the pool using the bridge crane, surveyed for contamination, and moved, using a manned transport vehicle. The cask would not be sealed but would be closed. The distance between the reactor and the hot cell facilities is only a few hundred feet and does not require a sealed cask.

A manned transport vehicle would be used to move the targets out of the reactor room and into the adjacent Hot Cell Facility. The transporter would exit the reactor facility through the proposed airlock, which would permit the continued operation of the reactor, and proceed down the ramp to the Hot Cell

Facility (see Figure 3-7). The transporter would enter the Hot Cell Facility through the roll-up door at the west end and then proceed to the Hot Cell Facility transporter airlock.

When through the airlock, the cask would be moved to the far north end of the Hot Cell Facility, where it would be placed within the shielded region to be designated Zone 2B. This zone would consist of a long central room within the Hot Cell Facility with remote manipulators and lead-glass windows. The cask would then be moved below one of the dedicated processing boxes designed to conduct the initial steps of the isotope extraction process. When empty of targets, the transfer cask would be removed from Zone 2B and returned to the reactor facility to await the next movement of targets.

The movement of targets from the Annular Core Research Reactor room to the Hot Cell Facility would be conducted up to 3 times a day, 5 days a week, and 52 weeks a year. The number of targets transported would depend upon the required production rate and the individual target power that can be achieved after the Annular Core Research Reactor is reconfigured. Approximately 20% of the weekly demand could be produced by processing one 20-kW target a day for 5 days, and 100% could be produced from seven 15-kW targets a day for 5 days.

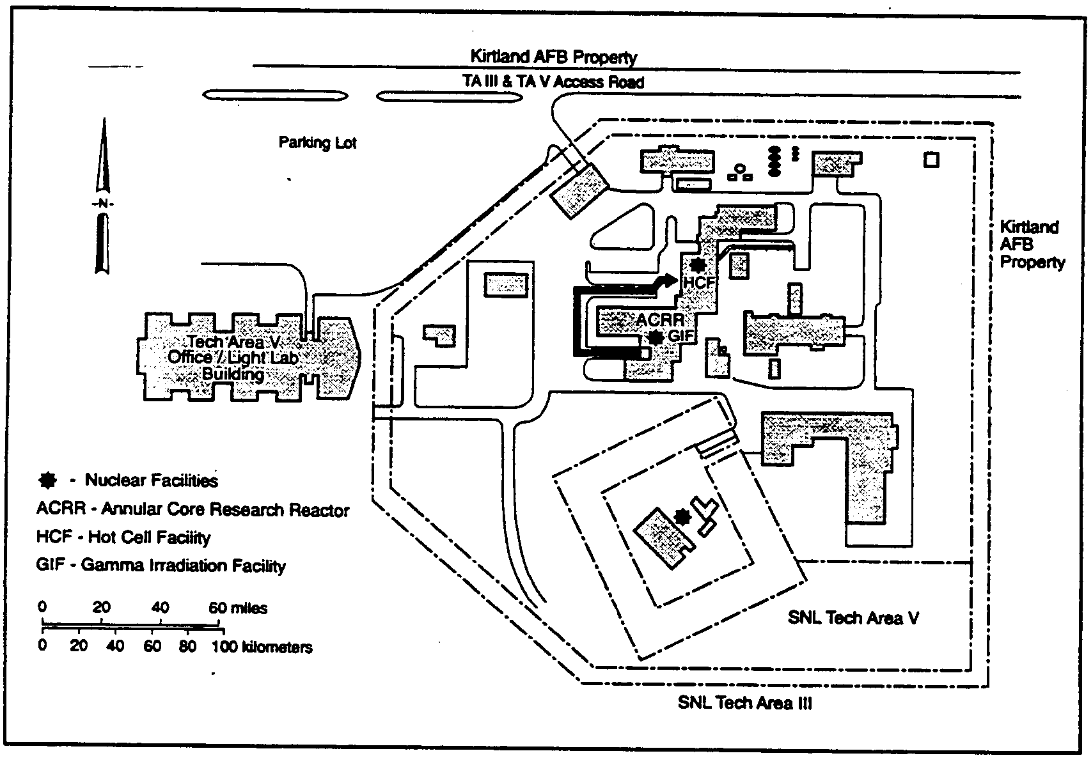

Figure 3-7. SNL/NM Technical Area V Complex

3.3.1.6 Isotope Extraction at Hot Cell Facility

The existing hot cell facility at SNL/NM would be used for the initial testing and initial processing at up to 10% production. However, because it was not designed for routine chemical processing or fission product recovery (Massey et al. 1995), it would not be adequate for conducting the full production Mo-99 mission (see Figure 3-8).

The cell wall of the existing hot cell is 106.7 cm (42 in.) thick with a concrete density of 2.35 g per cm^3. Approximately 2000 Ci of 1 MeV gamma photons at the wall of the cell would result in a dose rate of 1 mR/h at the surface of the cell wall. The hot cell is actually a single bay with five window and manipulator stations. The bay is segregated into three process boxes. Two process boxes contain two process stations, consisting of a window and a set of manipulator stations. The third box contains a single station. A spill in one of the boxes could impact other activities in the same box at an adjacent station, but not in an adjacent process box.

A second hot cell bay of five window and manipulator stations would be constructed in the same facility to accommodate full production of Mo-99. This new cell and stations would be adequate for a full Mo-99 production mission (greater than 100,000 Ci at 1 MeV would produce a dose rate of 1 mR/h at the surface of the cell wall). This set of cells would be segregated from one another by process boxes, effectively disposing of the potential spill problem with the existing cell (see Figure 3-9).

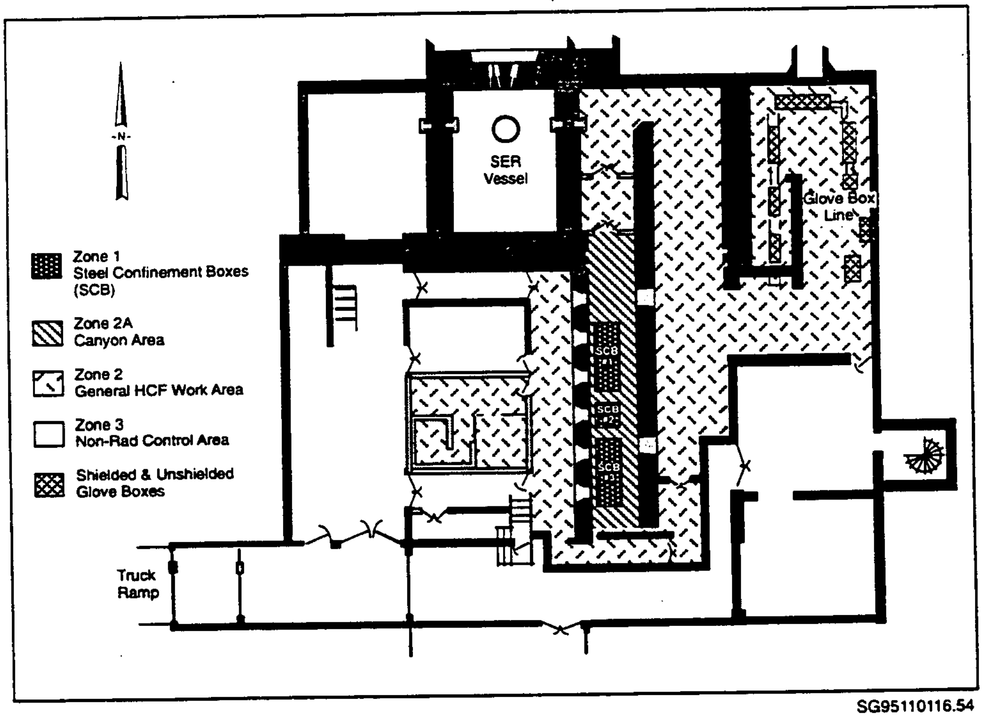

Figure 3-8. Current Hot Cell Configuration

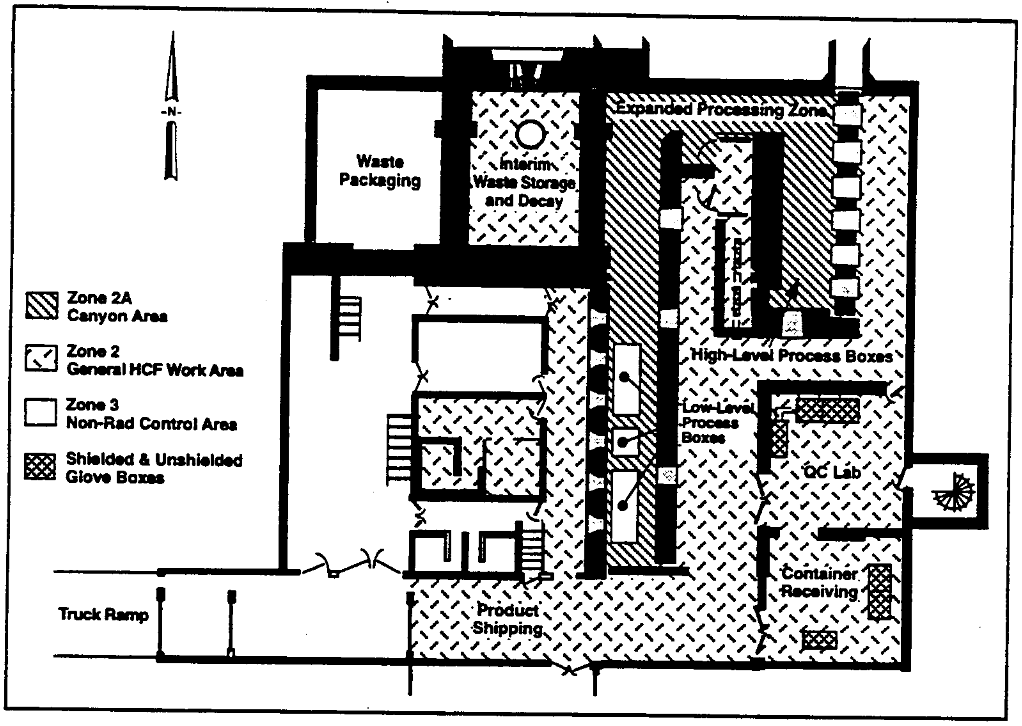

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Figure 3-9. Hot Cell Configuration for Full Isotope Production

Routine production of up to 10%of the U.S. demand would require additional shielding in the hot cells *o minimize the worker dose. Should greater than 10% production be necessary prior to the completion of nstruction of the new hot cell facility, it could be achieved with a proportionate increase in person-rem exposure to the hot cell operators. This production increases could be successfully accomplished without exceeding as low as reasonably achievable (ALARA) limits by increasing the number of trained hot cell operators or through careful dose management.

The irradiated targets would be opened in the hot cell, and noble gases and iodine would be condensed from the target fill gas. The liquid from the target dissolution would be drained into a bottle, treated to precipitate elemental iodine, and filtered to remove silver iodide. Molybdenum carrier (sodium hydroxide) would be added to the remaining solution. After several more steps of washing and removing impurities, including ruthenium, rhodium, and organic residues, the resulting product solution would contain sodium molybdate in dilute sodium hydroxide. Approximately 1200 to 1400 mCi/mL of Mo-99 would be expected per target. Immediately after irradiation, each 21 kW target would contain approximately 850 Ci of Mo-99.

After completing the procedure for the purification of Mo-99, the product would be tested by gamma spectroscopic analysis. Such analysis would be useful not only in determining the nature of contamination, but in enabling the quality control laboratory to quantify the impurities and the Mo-99 content. This information would be used to prepare the Material Safety Data Sheets that accompany the shipment.

The extraction process also would provide radioisotopes of xenon and iodine. Based on an irradiation power of 21 kW per target, each target could yield approximately 600 Ci of Mo-99, 200 Ci of iodine-131, and 600 Ci of xenon-133 one day after discharge from the reactor. A 15-kW target would reduce these contents linearly.

3.3.1.7 Product Shipment

The Mo-99 would be packaged in Type B accident-resistant packaging for shipment to the radio-pharmaceutical companies. Air express class of shipments would be used with direct routing, if possible, to the customer city. Passenger carrying aircraft could be used, as the Transport Index (a federal requirement discussed in 49 CFR 175, basically specifying the dose rate from a radioactive shipment measured at 1 meter from the package surface) of the Mo-99 package is within the limit allowed on passenger aircraft. Based on consultation with KAFB, product movement would be direct from Technical Area V to the airport transfer point, using KAFB access roads.

3.3.1.8 Waste and Spent Nuclear Fuel Management

Nonhazardous chemical waste, low-level solid and liquid radioactive waste, and spent nuclear fuel would be generated at SNL/NM as a result of the medical isotope production program. The solid waste generated would consist primarily of office trash and laboratory trash. Some chemical nonhazardous waste from process verification activities or from expired, contaminated, or otherwise unusable chemicals would also be generated. This solid waste and chemical waste would be handled through the established waste management processes at SNL/NM in accordance with all applicable federal, state, local, DOE, and SNL/NM requirements. Incidental mixed wastes may be generated, such as batteries and solvent cloths, which would be handled under standard SNL/NM waste management procedures. Approximately 56.3 m^3 of low-level waste would be generated per year from Mo-99 production activities at 100% of U.S. demand. Waste would be stored in the Hot Cell Facility for approximately 6 months to allow decay of short-lived radionuclides. The low-level waste would be shipped to the Nevada Test Site. The description of waste treatment and disposal is based on current practice and may change based on future decisions resulting from the DOE waste management study (1995a). Spent nuclear fuel would be stored in the Gamma Irradiation Facility pool pending a decision on its final disposition in accordance with the SNF PEIS (DOE 1995b).

SNL/NM estimates that, at a production rate of 80% of the U.S. demand, sufficient storage exists within the Hot Cell Facility to allow up to 2 years storage of waste generated (based on processing approximately 19 targets per week). At 100% production levels, approximately 34 targets at 15 kW would be required per the assumptions in Appendix A, which would reduce storage space to about one year's worth of waste.

3.3.1.9 Required Modifications

Some modification of existing facilities/operations would be required to implement the medical isotope production program. The following sections provide a description of these proposed modifications.

Chemistry and Metallurgy Research Facility Modifications at LANL. The changes required for the target fabrication operations in the Chemistry and Metallurgy Research Facility, Wing 9, are relatively minor. Some changes, which are in support of the target fabrication process validation activities (applicable to all alternatives), are ongoing.

In addition, some interior walls would be removed and doors would be relocated to form a single-point access suite of five rooms. Nine glove boxes would be custom fabricated to contain the apparatus for the process steps as two parallel, duplicate production lines. Each glove box exhaust would be fitted with a HEPA filter. Apparatus in glove boxes would include the following:

- dissolution tanks
- introduction boxes
- target coating lines
- quality assurance and assay equipment
- decontamination equipment
- ion exchange system
- storage tanks
- leak testing equipment
- pyrolyzing and welding equipment.

Additional exhaust ducting and fans would connect the glove box ventilation systems to the existing Chemistry and Metallurgy Research, Wing 9 ventilation system.

Annular Core Research Reactor Modifications at SNL/NM. The past missions of the Annular Core Research Reactor have required intermittent operations in both a power pulse mode and a steady state mode. The isotope production program would require continuous operation in steady state mode at 2 to 4 MW. The power pulse mode, an operational mode where a large power pulse generates a large number of fast neutrons for brief periods, is not needed for the Mo-99 production mission, but capability to operate in such a mode must be retained in order to support potential future defense needs. The pulse mode is required for the conduct of nuclear weapons research. Increasing the Annular Core Research Reactor continuous operational power level to 4 MW would require upgrades to the reactor cooling system to include additional redundant heat exchanger units and a cooling tower. The Annular Core Research Reactor tank has provisions that allow for use of a forced cooling system: however, this feature has never been used and operations at 4 MW are not expected to require the use of a forced cooling system.

In addition, the present fuel is a highly specialized design. A replacement fuel would have to be installed so the present fuel would not become highly exposed by the Mo-99 production activities. DOE has conducted extensive numerical modeling efforts to predict the reactor power and flux characteristics using various replacement fuels and core configurations. Calculations by DOE indicate the target irradiation level needed to meet U.S. demand for Mo-99 could be achieved with relatively minor modifications to the Annular Core Research Reactor core. Two different target/core configurations could produce 20% to 100% share of the U.S. market. Based on calculations, fuel availability, and cost, DOE proposes to use a low enriched uranium TRIGA-like fuel composed of uranium zirconium. This fuel would have the dimensions of standard TRIGA fuel, but would contain no zirconium hydride.

Expansion to meet a slightly greater than full demand could be performed by increasing the power level to 4 MW, utilizing the central irradiation facility in a 37-target gridplate design, and irradiating each target at a power level of 15 kW. The 37-target design would be required for >80% production.

After the Annular Core Research Reactor is reconfigured and the replacement fuel installed, testing would be performed to determine the number of targets required and the actual target fuel configuration to be deployed to meet the U.S. demand. The Safety Analysis Report and Technical Safety Requirements, which have been updated to meet current DOE Order requirements and to reflect the upgrade to 4MW, would also be modified to reflect the new fuel and reconfigured core. The number of targets that would have to be irradiated to meet the U.S. demand for Mo-99 would affect the amount of waste generated by the production process.

Additional modifications that would be required to successfully conduct the Mo-99 production mission follow:

Procurement/Installation of Heat Exchangers and Cooling Towers - The current steady state power limit for the Annular Core Research Reactor is 2 MW. This limit is due to the combined heat rejection limitations of the heat exchanger/cooling tower system. DOE calculations indicate the installation of additional heat exchanger and cooling tower heat rejection capacity (two towers, 4 m x 4 m x 3 m) would allow the reactor to run at 4 MW and maintain a pool water temperature of 40°C (104°F) for desired performance of the reactor and the pool water treatment system.

Removal of Central Cavity Liner Tube - The central cavity was used in past operations to provide a dry, high neutron flux location in the core. Removal of the central cavity liner tube would flood this area of the core and allow targets to be placed there for irradiation. Removal of the central cavity liner tube for isotope production also has the benefit of reducing argon-41 production and its subsequent release to the environment.

Hardware Upgrades and Redundancy - Because the Mo-99 production program would require continuous operation, redundancy features would be required to increase and sustain the performance of the Annular Core Research Reactor. Redundancy features include reactor control subsystems and rod drives. All upgrades and redundancy modifications would retain the objective of reliable and continuous operation. Minimizing personnel radiation exposure is a driving consideration for these upgrades.

Removal of Extraneous Hardware - Extraneous hardware would be removed from the Annular Core Research Reactor or core tank in order to make the reactor as flexible as possible for isotope production. he extraneous hardware includes the central cavity, a neutron radiography tube, and external cavities.

Ventilation and Environmental Monitoring Upgrade and Redundancy - The ventilation and radiation monitoring systems would be upgraded for continuous operation and redundancy.

Special Handling Equipment - Fuel racks, transfer casks, and target handling equipment would be designed or purchased to meet isotope production needs. Some of these items would be fabricated in the Area I Machine Shops. Other items would be fabricated at a local commercial machine shop.

Air Lock Addition - Operation of the Annular Core Research Reactor currently does not require use of an air lock. For the proposed action, however, delivery or removal of materials without an air lock would require shutdown of the reactor in order to minimize the potential for airborne emissions. Therefore, an air lock would be installed, so that a negative pressure differential relative to the atmosphere could be maintained in the Annular Core Research Reactor highbbay. Materials could then be transferred into and out of the Annular Core Research Reactor with a minimum of shutdown time. Installation of the airlock would require construction of a small (3.65 m by 3.65 m [about 12 ft by 12 ft]) addition to the building to enclose the airlock space.

Backup Electrical Power - To minimize interruptions of and to ensure continuous production operations, backup electrical power may be needed. Backup power is not a safety requirement. Backup electrical power could be provided by a diesel generator purchased and installed in Technical Area V.

Material Balance Area - A new material balance area would be established at Technical Area V to specifically handle the receipt of targets. Such a change would be primarily an administrative procedure and would require minimal modification of an existing facility.

Hot Cell Facility Modifications. By simply adding more shielding, the existing hot cell would be capable of producing approximately 10% of the current U.S. demand for Mo-99. However, routine production activities, at a target processing rate greater than 10% of the U.S. demand for Mo-99, would not be practical (refer to Figure 3-8).

To meet greater than 10% of the U.S. demand for Mo-99, a new hot cell with five sets of lead-glass windows and manipulators (Zone 2B) would be constructed in the existing hot cell facility. These stations would be physically separated inside the cell by means of process boxes. The new hot cell in Zone 2R would be located in the Hot Cell Facility adjacent to the existing hot cell in Zone 2A (refer to Figure 3.9). The new hot cell would be designed to handle a total content of 100,000 Ci of 1 MeV gamma-emitting radionuclides. Zone 2B would be designed to achieve the SNL/NM ALARA goal of 500 mrem/yr for an individual. While the new hot cell was being constructed, the existing hot cell would be used for process validation and FDA certification testing. By performing these activities in parallel with the construction of the new hot cell, the time required to begin Mo-99 production activities would be minimized. In addition, the existing hot cell would be used for Mo-99 purification activities that do not involve handling high activity materials.

Activities that are under way include removal of legacy radioactive materials from the existing hot cells, removal/relocation of several interior walls, and completion of the control console upgrades that have been under way for several years.

Hot Cell Facility Ventilation Upgrade - A major upgrade to the ventilation system for the existing hot cell would be necessary for handling potentially acidic atmospheres within the hot cell during the Mo-99 extraction process. The upgrade would also allow for the handling of an iodine release incident without the shutdown of the Mo-99 extraction process. Series-parallel arrangements of charcoal filtration units would allow one unit to hold up an iodine release and maintain hot cell operation by switching to the second unit.

Mo-99 Process Line Installation - Processing equipment unique to isotope production would have to be procured and installed prior to production. Examples include extraction process equipment and waste processing equipment.

Quality Control Laboratory - This laboratory would be required by the approved FDA procedure. The Quality Control Laboratory requires a minimal amount of space and equipment, such as ventilated shielded glove boxes and detection equipment. Additionally, small shielding enclosures would be installed around selected equipment. Floor space in the Hot Cell Facility has been identified and no significant construction is anticipated for this laboratory.

Reconfiguration of Hot Cell Facility to Streamline Process - Modifications to the east wall, entry door location, and internal overhead crane would be required. Wall modifications would involve providing cutouts for additional manipulators, lead-glass windows, and a pass-through. Moving the entry doors would produce more available space, thus minimizing crowding and facilitating remote replacement of containment boxes. Overhead handling equipment modifications would facilitate movement of materials, supplies, and containment boxes.

Steel Containment Boxes - Proposed replacement steel containment boxes would result in safer, more reliable, and more versatile hot cell operations to service isotope production. The new steel containment boxes would be designed to provide complete process control, including waste minimization and management. The boxes would also allow collection of by-products from the radioisotope extraction, processing the by-products, and packaging them into waste containers. The design of the steel containment boxes would be modular to allow easy replacement of components. Replacement of steel containment boxes would require the removal of existing steel containment boxes or interior walls.

Waste Storage Area - Existing rooms would be modified to efficiently manage waste from the process line. Minimal upgrades to the current area would be required. Installation of floor railing or motorized remotely operated moving equipment is anticipated.

Process Validation Testing. Prior to production, some activity would be devoted to reactor physics experiments and process design activities. Such activities would require the procurement of some equipment or hardware. These activities are characterized as *proof-of-principle* studies that would support design and operational activities related to medical isotope production.

- Process Design - One or more prototype steel containment boxes and prototype processing equipment would be set up for examination of equipment performance, reliability, and adequacy of design.

- Reactor Physics Experiments - The existing calculations for isotope production in the Annular Core Research Reactor would be verified by irradiating targets in the Annular Core Research Reactor after the conversion to continuous operation is complete. This process would help determine configurations, reactor power, reactor operations, and the number of targets required to meet the U.S. demand for Mo-99.

- Prototype Target Fabrication - Test targets would be fabricated and tested to verify processes.

Conversion of Annular Core Research Reactor to Support Defense Program Mission. If the Annular Core Research Reactor is transferred to the DOE Office of Nuclear Energy, Science and Technology, then the Office of Defense Programs would retain the right for the Annular Core Research Reactor to be available to support defense missions in times of national emergency to address security concerns. Under such an arrangement, the Annular Core Research Reactor must be made available, if required. Consequently, the proposed action would involve maintaining capabilities within the Annular Core Research Reactor to return to its current defense mission, operating under conditions similar to the ones that presently exist. It is possible that the Annular Core Research Reactor (ACRR) could be diverted to support defense missions in case of a national emergency. However, the Department has determined that the probability of needing the ACRR for defense purposes is sufficiently low to preclude disqualifying the reactor from consideration. The ability to convert the Annular Core Research Reactor to defense activities requires retaining the capability for a pulse-mode operation, the capability to install the irradiation cavity liner tube, and access to a steel containment box to support defense activities. The modifications required for the proposed action do not eliminate the possibility of returning the facilities to support national security requirements.

The Annular Core Research Reactor is currently fueled with beryllium oxide fuel elements that were developed specifically for Defense Program testing and are irreplaceable. As a result, the fuel currently in the Annular Core Research Reactor would be systematically replaced and stored onsite (in the Gamma Irradiation Facility pool) for possible use in the future. The plan is to use transition cores of beryllium oxide fuel, normal TRIGA fuel, and TRIGA fuel with no zirconium hydride. The final configuration would be a core of TRIGA fuel with no zirconium hydride, surrounded by a reflector blanket of normal TRIGA fuel.

The current Annular Core Research Reactor core has 236 fuel elements of a beryllium oxide highly enriched uranium design that are approximately 75 cm (29 in.) long and 3.8 cm (1.5 in.) in diameter. These fuel elements are of a specialized design that can be used for both steady-state and pulsed operation. The proposed isotope production program does not need the pulse-mode operational capability. A replacement low enriched uranium uranium fuel element design (not containing beryllium oxide) suitable for steady state operation would be used. Current plans call for the removal and storage of the current fuel elements so that they would be usable later for pulse-mode operation. The current core of fuel elements could be used for a brief duration at full production levels and still be usable for pulse mode operation to meet potential defense needs. The total depletion target for removal of these beryllium oxide elements is less than 5% depletion. The fuel element lifetime for both the beryllium oxide elements and the TRIGA elements would depend primarily on the amount of Mo-99 production required.

To ensure the Annular Core Research Reactor could be quickly reconfigured for pulse testing of nuclear weapons components in an emergency related to maintaining the nuclear stockpile, much of the hardware currently in the Annular Core Research Reactor pool would be stored in a configuration that would guarantee its long-term integrity and usability. The proposed storage area for hardware would be a new tank accessible by overhead crane. This equipment storage tank would be installed in the south part of the Annular Core Research Reactor building. The hardware stored in the equipment storage tank would include only nonfuel components required for this activity, such as the fuel-ringed external cavities (FREC-I and FREC-II) without the fuel, control elements and drives, support hardware, the central cavity liner tube, and the radiography system. The equipment storage tank would only be used for storage. No ongoing or sporadic operations involving movement of materials into or out of the tank would occur, unless the decision were made to move the stored hardware back into the Annular Core Research Reactor to support a defense mission in a national emergency.

The proposed equipment storage tank would not be designed or equipped for future operation as a reactor or weapons research facility. No major electrical connections or conduits, no cooling systems, and no mechanical service ports would be installed or allowed in the design. Only those items necessary for safely maintaining the hardware would be installed. These items would include a water treatment system for maintaining clean water in the tank used for radiation shielding, and the fittings for lights and leak sensors.

The FREC-II tube is approximately 7.6 m (25 ft) in length. The tube must be stored vertically to prevent distortion that would destroy the precision tooling of the tube, which was designed for precise radiation streaming control. The proposed equipment storage tank would be designed to allow vertical storage of the hardware. The tank would be sized only for storage of Annular Core Research Reactor defense-related hardware. The final size and shape of the equipment storage tank would be based on cost and hardware integrity needs. During inspections of the hardware in storage, the water in the tank would shield personnel from the radiation emitted by the activated hardware.

The construction and installation of the equipment storage tank would include the following:

- Relocation of the existing cavity purge system from the Building 6588 lowbay to the high bay roof.
- Extension of the 5.5 m (18 ft) wide by 15 m (50 ft) long penthouse a distance of 9 m (30 ft) to the south.
- Installation of a double-walled steel storage tank of approximately 13.5 m^2 (145 ft^2) surface area by 10.7 m (35 ft) deep in the low bay.
- Provision for maintaining water quality suitable for storage of equipment in the storage tank.
- Upgrading the heating, ventilation, and air-conditioning (HVAC), power, and lighting, as needed for the storage area.
- Relocating utilities and removing a portion of the wall between the existing high bay and the new high bay extension.

Constructing the equipment storage tank would not affect the operation or schedule for medical isotope production activities at SNL/NM. No radioactive material would be released to the atmosphere from the equipment storage tank.

3.3.1.10 Estimated Schedule for Modification

The SNL/NM has developed a detailed schedule for the modifications planned at the LANL and SNL/NM facilities. The proposed schedule was updated through July 1995. Initial Mo-99 production for FDA testing and certification could begin as early as 6 months from the date of the Record of Decision. The estimated date for completion of all construction and testing activities for Mo-99 production is 22 months from the date of the Record of Decision. Full production capability would follow at 28 months from the date of the Record of Decision.

3.3.2 Omega West Reactor/Chemistry and Metallurgy Research Facility: Los Alamos National Laboratory Alternative

The LANL was established in 1943 to design, develop, and test nuclear weapons. The LANL is operated by the University of California and supports research projects in nuclear physics, hydrodynamics, conventional explosives, chemistry, metallurgy, radiochemistry, and biology. In 1992, LANL expanded its mission to include development of programs in health and biotechnology, environmental technologies, and industrial partnerships. The LANL is located on 111 km² (43 mi²) of land in Los Alamos County in north central New Mexico, approximately 96.6 km (60 mi) north of Albuquerque, and 40.25 km (25 mi) northwest of Santa Fe.

The LANL has successfully produced and marketed radioisotopes for 50 years and has successfully produced and marketed medical radioisotopes for more than 20 years. LANL has a current ongoing program established in the medical radioisotope field. LANL received the FDA official certification of Drug Establishment in August 1991 (FDA 1995).

In response to the shutdown of the Cintichem reactor, LANL was identified, in late 1991, as the proposed site to provide a backup supply of Mo-99 to the medical community in the U.S., in response to the shutdown of the Cintichem reactor.

In December 1992, the Omega West Reactor experienced an unplanned reactor shutdown. In January 1993, during the shutdown, a leak from the primary cooling system was identified. The leak had occurred in the 76-cm (30-in.) delay line shown in Figure 3-10. This leak occurred as a result of organic attack on the outside of the line due to high sulfur content in the soil. DOE (1995c), Andrade (1995), and Peterson (1995) provide additional details relative to the Omega West Reactor shutdown.

Investigations have shown that the leaking pipe could be repaired without impairing the operating characteristics of the reactor. The details of the required remediation efforts are described in Section 3.3.2.9.

In 1993, no current or future programmatic need for the Omega West Reactor was identified and action was initiated to place it in safe shutdown. To preserve the Omega West Reactor for a potential Mo-99 mission, LANL has terminated its ongoing decontamination and decommissioning activities at the

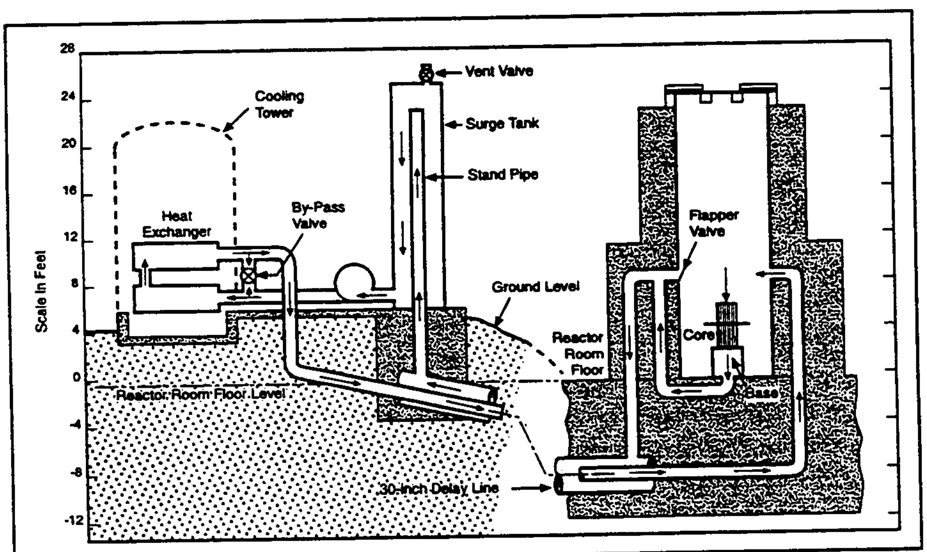

Figure 3-10. Core Cooling System for the Omega West Reactor

facility. LANL has completed some of the required activities that would precede a Mo-99 mission, such as completion of drafts of the licensing basis and draft Safety Analysis Report (SAR), and constructing a tringer assembly.

A restart of the Omega West Reactor faces the challenge of assessing reactor startup related activities. The schedule and the associated cost to deploy the LANL alternative would be influenced by the DOE requirements for the Omega West Reactor restart under DOE Order 425.1 (DOE 1995d). The requirements, which may require a few months to document, would not necessarily preclude a timely restart of the Omega West Reactor.

3.3.2.1 Description of the Alternative

The proposed method to produce Mo-99 at LANL entails the four basic steps of the Cintichem process. Each of the four steps would be conducted onsite at LANL. Wing 9 of the Chemistry and Metallurgy Research building in TA-3 would be used for manufacturing the targets and recovering the Mo-99 in the hot cells. The target irradiation would occur in the Omega West Reactor.

LANL would conduct the program in two phases. During the initial phase, four in-core positions would be dedicated to Mo-99 production, allowing 16 targets to be irradiated. In the second phase, LANL would reconfigure the core to accommodate seven in-core positions and two reflector positions. This reconfiguration would provide irradiation facilities for 36 targets. Mo-99 produced at LANL would be distributed and shipped to radiopharmaceutical manufacturers via commercial carriers using either the Los Alamos Airport, Santa Fe Airport, or the Albuquerque International Airport.

Adequate facilities exist at the site to handle, manage, and store all types of wastes generated during the Mo-99 production. The LANL plans to recycle the uranium that remains in the process waste stream. Low-level waste management at the LANL facilities is a *cradle-to-grave* process, where low-level waste is disposed onsite and no shipment of waste is required.

3.3.2.2 Existing Facilities

Existing facilities at LANL would provide the capability to conduct the four fundamental Mo-99 production operations. The Omega West Reactor would be repaired and restarted to irradiate Mo-99 production targets. The Chemistry and Metallurgy Research Facility would require minor modifications to conduct target fabrication and processing. Radioactive wastes would be disposed onsite. A description of each activity follows.

3.3.2.3 Target Fabrication

Target fabrication in the Chemistry and Metallurgy Research Facility, Wing 9 target fabrication area was previously described in Section 3.3.1.3.

3.3.2.4 Target Irradiation Activities

The targets fabricated in the Chemistry and Metallurgy Research Facility, Wing 9, would be transported in a DOT-approved container (BX-22) to the Omega West Reactor. The roads over which the transport would be conducted are controlled by LANL and could be closed to traffic if required. LANL possesses several BX-22 containers.

The Omega West Reactor, located at TA-2, is a thermal, heterogeneous, covered tank-type test and research reactor. The reactor is light-water moderated and cooled (Figure 3-11). Until it was shutdown in 1992, the Omega West Reactor had been operated by LANL since 1956 without an accident or major operational incident. It had provided 36 years of continuous experimental service with a forced outage rate of less than 2%.

The Omega West Reactor is very similar to the Cintichem reactor, the commercial U.S. reactor that had been producing Mo-99 prior to 1989

- Both designs use Materials Test Reactor plate type fuel and are water moderated and cooled
- Cooling for both designs is by forced circulation
- The irradiation stringers of both designs are nearly identical in all dimensions
- The concept of replacing a fuel element with a target stringer is the same for both designs
- The similarity of the Omega West Reactor to the Cintichem Reactor would reduce technical uncertainties in the transfer of the Cintichen target irradiation technology.

During its early years, the Omega West Reactor was operated at a power level of 5 MW. After facility upgrades during the 1960s, including the construction of a large cooling tower, the Omega West Reactor gained the capability to operate at 8 MW. The peak thermal flux that can be achieved in the Omega West Reactor at 8 MW is approximately 1.0×10^{14} n/cm^2-sec. Until 1971, the Omega West Reactor was operated 24 h/day, 5 days/week at the 8-MW level.

The Omega West Reactor would be fueled with Materials Test Reactor type fuel elements containing highly enriched uranium. At full power, approximately 29 fuel elements per year would be discharged from the reactor as spent fuel. The active portion of each element is about 0.625 m (2 ft) in length. The overall length of each element, including the aluminum end caps, is 1.1 m (3.6 ft).

The Omega West Reactor would initiate Mo-99 production using the currently existing highly enriched uranium fuel. After depletion of the current supply, the reactor would be transitioned to use low enriched uranium fuel. Currently, the Omega West Reactor highly enriched uranium fuel in storage is sufficient to conduct the Mo-99 production operation for at least 7 years. Calculations at other facilities

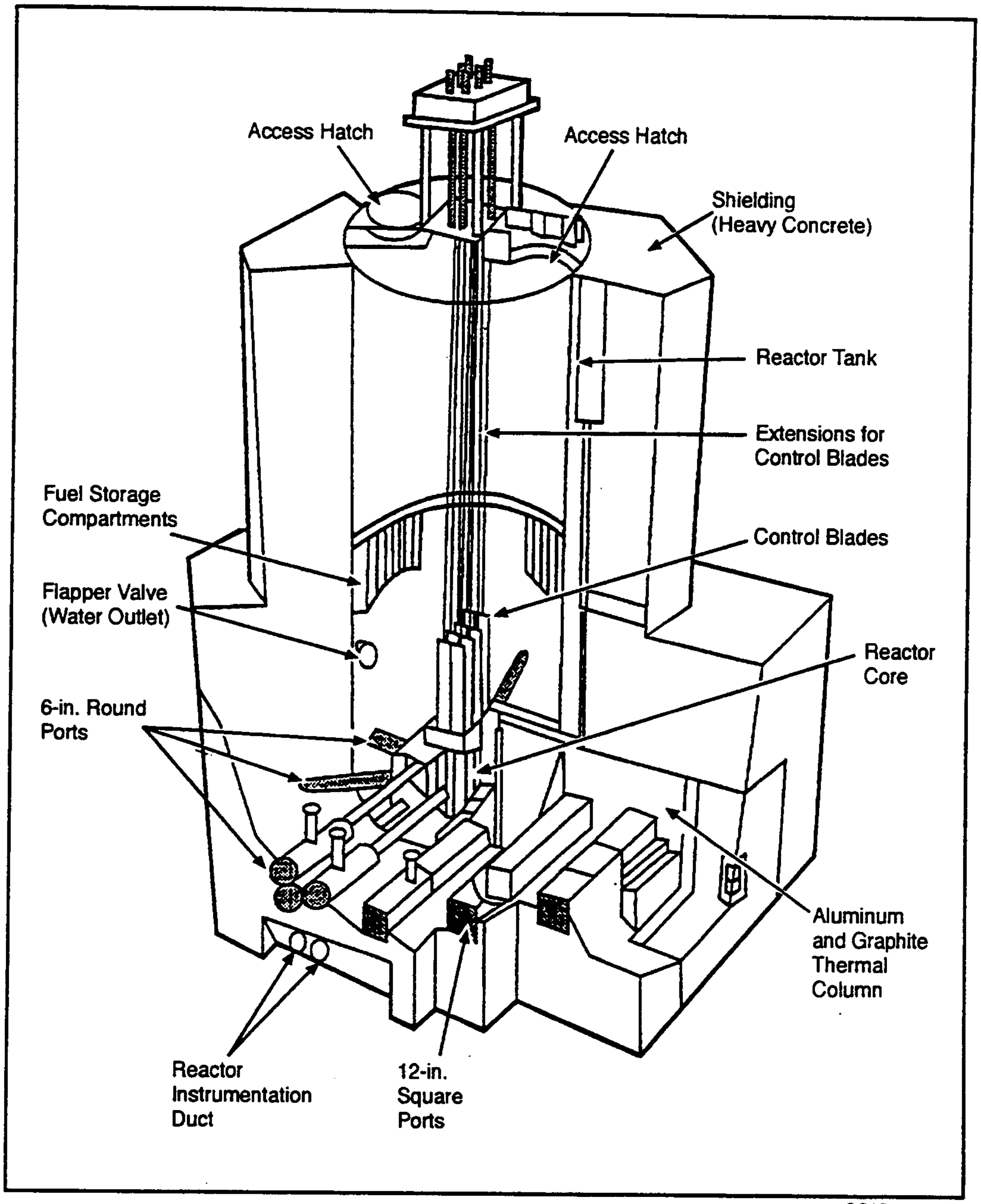

Figure 3-11. Cutaway Illustration of the Omega West Reactor

have been performed to support the use of low enriched uranium fuel of similar design. Because this conversion of Materials Test Reactor type fuel has been completed successfully several times without degrading the flux (for example, at the University of Michigan), this conversion would not present a technical challenge.

Approximately 16 targets per week would be irradiated in the Omega West Reactor under the current core configuration. Four targets would be placed into a stringer assembly (Figure 3-12). The stringer assembly body design is virtually identical to the one used at the Cintichem Reactor. To permit insertion into the Omega West Reactor grid plate, different nose caps would be required. Each stringer would be designed to fit in locations previously occupied or designed for fuel elements. The stringers allow primary coolant to flow down the stringer and around the target cylinders. Stringers are interchangeable with fuel elements, but can only be used in positions for which core configuration calculations have been performed. Each target marginally impacts the reactivity of the core. This nearly neutral reactivity is due to the parasitic absorption of the stainless steel target cylinders balancing the production from the fission rate of the target fuel.

Each target stringer would be irradiated at a target power of approximately 20 kW for approximately 7 days. The irradiated target would be removed from the reactor and allowed to cool for 6 h in the fuel storage bins located on a shelf on the inside wall of the reactor. A basket would be installed around the storage shelf to prevent targets from falling onto the core.

The stringer would be removed from the reactor vessel with a special handling tool through one of the top hatches and pulled into a movable radiation-shield transfer cask. This cask would transfer the targets

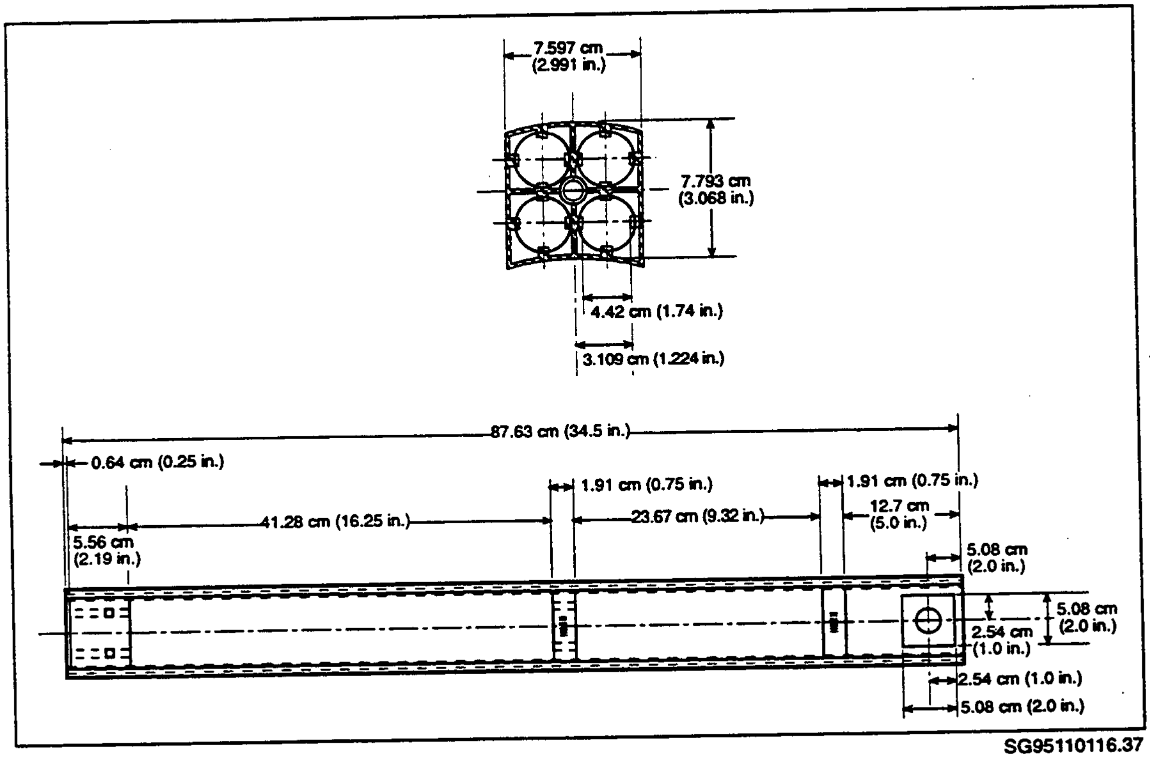

Figure 3-12. Target Stringer Assembly Diagram

and stringer to the holding tank where the four targets would be removed and loaded into a DOT-certified B-3 cask for transport to the Chemistry and Metallurgy Research Wing 9. Transfer from the reactor to the ruck would require approximately 1 h.

The reactor recirculation flow rate ensures that targets fissioning at powers of 20 kW can be cooled (departure from nucleate boiling ratio of greater than 5). Simplistic heat transfer calculations show that target powers of greater than 20 kW should be achievable.

3.3.2.5 Target Transfer to the Hot Cell Facilities

Truck transfer of the B-3 cask and insert containing one to four irradiated targets from the Omega West Reactor to the Chemistry and Metallurgy Research Facility, Wing 9 hot cell corridor would involve transport of less than 1 mi and require less than 1 h. The LANL possesses four B-3 casks onsite. The transfer would occur over LANL access controlled roads. The irradiated targets would be processed in the hot cells to glean the Mo-99 product.

3.3.2.6 Isotope Extraction at Hot Cell Facility

The LANL hot cells have adequate shielding to handle greater than 100,000 Ci of 1-MeV gamma-emitting radionuclides, which would be significantly greater than required for the proposed fission product separation process. A total of 16 such cells are resident in the Chemistry and Metallurgy Research, Wing 9 facility, with an additional two cells at each end, designated as blister (clean) cells for final product packaging. For processing four 20-kW targets at once, a source term of 64,000 Ci per cell is estimated. The exposure to hot cell operators is estimated to be 44 mrem per 2000 h of chemical processing. This exposure level is completely consistent with the LANL and the DOE ALARA goals. The ventilation system is more than adequate, with series-parallel paths consisting of a HEPA filter, charcoal bed, another HEPA filter, a delay volume, two stages of HEPA, two stages of charcoal, and the stack. The delay line allows for detection of a release and isolation of the stack before the release can reach the stack. Figure 3-13 is a plan view of the hot cell processing.

The targets in the B-3 cask would be unloaded in the receiving hall between the cell banks. In the receiving cell, the target would be connected to the product recovery line and the target would be opened. Fission gases would be removed through an iodine trap into a cold trap using liquid nitrogen. Following gas removal, an acid solution would be injected into the target to dissolve the plated uranium oxide. Both the iodine and the xenon trapped in the cold trap would be processed and packaged for shipment.

The liquid from the target dissolution would be drained into a bottle, treated to precipitate elemental iodine, and filtered to remove silver iodide. Molybdenum carrier (sodium hydroxide) would be added to the remaining solution. After several more steps of washing and removing impurities, including ruthenium, rhodium, and organic residues, the resulting product solution would contain sodium molybdate in dilute sodium hydroxide. Approximately 1200 to 1400 mCi/mL of Mo-99 would be expected per target.

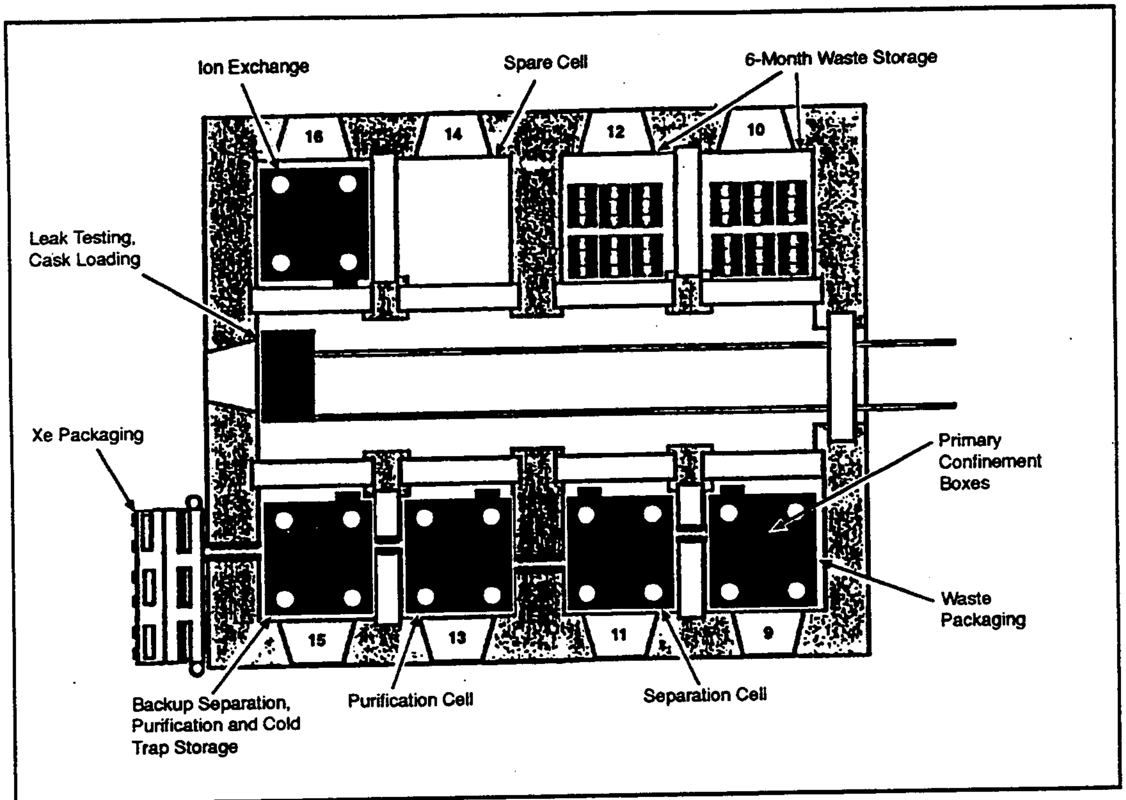

Figure 3-13. Molybdenum-99 Hot Cell Processing (Plan View)

In the event of an operational difficulty with a hot cell, spare hot cells would exist in the same bay to preclude disruptions from routine operations.

To minimize releases during normal hot cell processing operations, LANL has designed process devices using three-way valves with O-ring seals for each step of the separation process. Use of this type of apparatus would minimize the release of noble gases present during the target puncture activities. The process device would also minimize the release of noble gases generated from the decay of halogens during the remaining process steps. Noble gases would be cold trapped periodically throughout the process.

The captured radioactive gases would be held in gas storage containers for approximately 40 days. The gas remaining at this time, consisting of approximately 0.5% of the xenon-133 and all of the krypton-85 that was trapped, would be released in the Chemistry and Metallurgy Research Facility stack ventilation flow path. This method of processing could be implemented at any of the other sites for the purpose of minimizing the release.

After completing the procedure for the purification of Mo-99, the product would be tested by gamma spectroscopic analysis of an appropriate aliquot of sample extracted from the product vial. Such analysis would be useful not only in determining the nature of contamination, but in enabling the quality control laboratory to quantify the impurities and the Mo-99 content of the product vial. This information would ' used to prepare the Material Safety Data Sheets that accompany the shipment.

The extraction process would also provide radioisotopes of xenon and iodine. Based on an irradiation power of 21 kW per target, each target could yield approximately 600 Ci of Mo-99, 200 Ci of iodine-131, and 600 Ci of xenon-133 one day after discharge from the reactor.

3.3.2.7 Product Shipment

The Mo-99 would be packaged in Type B accident-resistant packaging for shipment to the radio-pharmaceutical companies. Air express class of shipments would be used with direct routing, if possible, to the customer city. Passenger carrying aircraft could be used, as the Transport Index (a federal requirement discussed in 49 CFR 175, basically specifying the dose rate from a radioactive shipment measured at 1 m from the package surface) of the Mo-99 package is within the limit allowed on passenger aircraft. Mo-99 that is produced at LANL would be distributed and shipped to radiopharmaceutical manufacturers using either the Los Alamos Airport, Santa Fe Airport, or the Albuquerque Airport.

3.3.2.8 Waste and Spent Nuclear Fuel Management

LANL has sufficient waste management facilities for the treatment and disposal of both solid and liquid radioactive wastes. From a waste handling perspective, LANL is a cradle-to-grave operation. Approximately 22.8 m^3 (30 cu yd) of low-level waste (solid and liquid) would be generated per year from Mo-99 production activities at 100% of U.S. demand. LANL crushes solid waste, significantly minimizing the volume presented for disposition. Waste disposal is predicted to entail weekly disposals of 0.2 to 0.4 m^3 (one to two 55-gal) drums. Waste from the target processing would be stored at the hot cell facility for approximately 3 months before processing. Liquid radioactive waste would be handled in TA-50, while solid, chemical and incidental mixed wastes would be handled in TA-54. The description of waste treatment and disposal is based on current practice and may change based on future decisions resulting from the DOE waste management study (1995a). Spent fuel from the reactor will be cooled for approximately 6 months and then transported to the onsite storage area. Both wet and dry spent fuel storage capability exists onsite. Spent nuclear fuel would be stored at LANL pending a decision on its final disposition in accordance with the SNF PEIS (DOE 1995b).

Storage Facilities. Onsite storage is available for both uranium and process consumables at the Chemistry and Metallurgy Research building. A large quantity of uranium-235 can be stored in the form of raw material, fabricated targets, and recoverable waste. Adequate storage is required to satisfy FDA Good Manufacturing Practice requirements. Storage for tubing, pipettes, glassware, and other items required for the chemical processing and separation is readily available adjacent to the hot cell facilities.

3.3.2.9 Required Modifications

Several categories of activities that had commenced prior to the termination of the Omega West Mo-99 initiative are discussed as follows. For discussion of modifications at the Chemistry and Metallurgy Research Facility, refer to Section 3.3.1.9.

Remediation of the leak associated with the underground pipe at the Omega West Reactor was a key issue that has been partially addressed. The leaking was terminated. The source, and cause, of the leak has been determined and analyzed. Excavation around the delay line was performed to assess the cause and determine the activities required for the repair. Non-destructive testing examinations proved that only the piping in contact with the soil showed any erosion. Analysis of piping samples determined that microbial action, in conjunction with stressed conditions, was the cause of the failure. Analysis concluded that it could be repaired.

Hardware upgrades and staffing plans are nearly complete. The hardware upgrades completed include several systems upgrades, one of which was nuclear instrumentation. Dual cooling towers and EPA-approved air monitoring equipment remain to be upgraded.

A DOE Order 5480.23 (DOE 1992a) Nuclear Safety Analysis Report and a DOE Order 5480.22 (DOE 1992b) Technical Safety Requirements document have been drafted with comments incorporated from an initial review. Operating procedures reflecting the Safety Analysis Report have been prepared in accordance with DOE Order 425.1, Startup and Restart of Nuclear Facilities (1995d). The Maintenance Implementation Plan and the Training Implementation Plan have been completed. All of these documents will require review, and possibly some revisions, to be finalized.

Process Validation Testing. Prior to production, some activity would be devoted to reactor physics experiments and process design activities. Such activities would require the procurement of some equipment or hardware. These activities are characterized as *proof-of-principle* studies that would support design and operational activities related to medical isotope production.

- Process Design - One or more prototype steel containment boxes and prototype processing equipment would be set up for examination of equipment performance, reliability, and adequacy of design.

- Reactor Physics Experiments - The existing calculations for isotope production in the Omega West Reactor would be verified by irradiating targets in the Omega West Reactor after the conversion to continuous operation is complete. This process would help determine configurations, reactor power, reactor operations, and the number of targets required to meet the U.S. demand for Mo-99.

- Prototype Target Fabrication - Test targets would be fabricated and tested to verify processes.

3.3.2.10 Estimated Schedule for Modification

A 1995 update to the schedule has been completed, and approximately 13 months from the date of the Record of Decision would be required to prepare the Omega West Reactor for operation. This schedule includes all the hardware modifications and document upgrades necessary. However, uncertainty is associated with the restart of a reactor that has been shut down for a long period of time. When the reactor is operational, LANL could produce Mo-99 within 5 months and attain the 100% production level 2 months thereafter.

3.3.3 Oak Ridge Research Reactor/Radioisotope Development Laboratory: Oak Ridge National Laboratory Alternative

The Oak Ridge National Laboratory (ORNL) is located 40 km (25 mi) west of Knoxville, Tennessee. The ORNL began operating in 1943 and is currently managed by Lockheed-Martin Energy Research, Inc. for the U.S. Department of Energy. The ORNL has facilities to produce isotopes via the fission process, as well as by neutron activation. The ORNL pioneered the production and distribution of radioisotopes for medical, research, and industry applications during the 1950s and the 1960s and is experienced in all aspects of radioisotope production.

3.3.3.1 Description of the Alternative

The ORNL would produce Mo-99 by irradiating Cintichem type targets using the Oak Ridge Research Reactor. A nearby facility, the Radioisotope Development Laboratory, would be dedicated for Mo-99 processing. A separate area in the Radioisotope Development Laboratory would be set up for uranium-235 target fabrication. Processed Mo-99 would be shipped to the radiopharmaceutical companies for further purification and distribution, using the Knoxville airport which is 48 km (30 mi) from ORNL.

3.3.3.2 Existing Facilities

The ORNL would ship the low-level waste generated by the Mo-99 production process to the Nevada Test Site. All other aspects of the production process would be conducted using existing site facilities. The Oak Ridge Research Reactor would be restarted to irradiate Mo-99 production targets. The Oak Ridge Research Reactor had been operated as a Class A reactor (≥ 20 MW), but would be restarted as a Class B reactor (< 20 MW) and redesignated as the Medical Isotope Production Center. The Radioisotope Development Laboratory would require minor modifications to conduct target fabrication and processing.

3.3.3.3 Target Fabrication at ORNL

Target fabrication would be carried out on the second floor of the Radioisotope Development Laboratory using glove boxes, each having a separate ventilation system and provided with HEPA filters. The target fabrication process would be conducted as described in Section 3.3.1.3.

3.3.3.4 Target Irradiation Activities

Currently, the Oak Ridge Research Reactor is not in operation. Commissioned in 1958 at the X-10 site of the Oak Ridge Reservation, the Oak Ridge Research Reactor is a 30-MW tank-type reactor. The Oak Ridge Research Reactor uses Materials Test Reactor type highly enriched uranium fuel (93%) elements and beryllium reflector elements in a seven-by-nine element rectangular lattice. Neutron moderation and core cooling are provided through forced convection of demineralized water. The Oak Ridge Research Reactor provides a maximum thermal neutron flux of 5×10^{14} n/cm^2-s and an average thermal flux of 1.6×10^{14} n/cm^2-s.

Another feature of the Oak Ridge Research Reactor is the location of its reactor tank in one end of a water-filled rectangular pool. This tank provides shielding for the core, experiments, and refueling operations, and supplies researchers with easy access to the core region. The control rod drives are operated from below the reactor. Safety features include a filter scrubber system and a dynamic confinement building around the reactor to protect the offsite population against any accidental radioactive releases. The adjoining storage pools provide shielding and storage for up to 180 depleted fuel elements.

The Oak Ridge Research Reactor has two hot cells located above one end of the reactor storage pool. These hot cells allow irradiated samples to be moved under water from the core region directly into the hot cell. Depleted fuel and control elements can also be removed from the Oak Ridge Research Reactor through the rectangular hatch at the top of the reactor tank and then moved under water to the storage pool area or to the adjacent hot cell for experimentation. A 20-ton crane traverses the entire bay area.

A typical outage in the past varied from 2 to 3 days after operating at a power level of 30 MW for 4 weeks. The refueling operation was handled manually from the bridge over the pool.

The primary mission of the Oak Ridge Research Reactor was to 1) test the materials and potential fuels for power reactors; 2) facilitate solid state physics research; and 3) to produce and supply radioisotopes to medical, industrial, and academic users.

The reactor was used for basic studies on the properties of metals, alloys, ceramics, and nuclear fuels, as well as for neutron scattering and spectroscopy. Oak Ridge Research Reactor's neutron activation facilities were designed for radioisotope production. Due to the Oak Ridge Research Reactor's high neutron flux, large sample capacity and flexibility, ORNL could produce, process, package, and distribute 25 different isotopes, such as phosphorous-32, Mo-99, iodine-131 for medical applications, and iridium-192 for industrial radiography, for the entire western hemisphere. Because governmental policies dictated that ORNL produce only those isotopes commercial suppliers do not market, Oak Ridge Research Reactor phased out its production of major radioisotopes by the mid-1960s.

The reactor was shut down briefly in 1983, due to a leak in the 91-m (300-ft) pipe carrying the primary coolant to the heat exchanger located outside the reactor building. This aluminum piping was originally designed for 10 years of reactor operation. Subsequent investigation had revealed the pipe had corroded from the outside, due to the spring water (ground water) surrounding the exterior of the pipe. The leak was fixed and the reactor resumed operation the same year. The leak was not related to reactor chemistry and ll other reactor systems were in an operational status.

In 1987, Oak Ridge Research Reactor's core had been modified to accept low enriched uranium (<20%) as part of an experimental study in collaboration with Argonne National Laboratory (ANL). The Oak Ridge Research Reactor was shut down later in 1987 due to lack of programmatic support, as improved irradiation and neutron scattering facilities at the ORNL High Flux Isotope Reactor became available.

If selected for Mo-99 production, the Oak Ridge Research Reactor would be restarted at a power level of 10 MW using either highly enriched uranium or low enriched uranium fuel or using a mixed core of both types of fuel. Transition to a core using all low enriched uranium fuel would be performed during the first two years of full power operation. For every 2 to 3 months of operation at 10 MW power, Oak Ridge Research Reactor could require an outage time of 12 h to 3 days for refueling, providing an equivalent availability factor of >0.90. The primary mission of the reactor would be the production of Mo-99. Some costs could be offset by sharing expenses with other users of its experimental facilities on a non-interference basis.

Operating on an low enriched uranium fuel at 10 MW power, the Oak Ridge Research Reactor would irradiate up to 10 target stringers per week at an average thermal neutron flux of 8.7×10^{13} n/cm^2-s. The target loading and target number per stringer would be adjusted to produce an aggregate target power greater than 500 kW. Four targets would be housed in each stringer, similar to the stringers at Cintichem. Targets would be introduced and retrieved on a daily basis using a quick change procedure. The total .o-99 content of all the 40 targets, with an integrated target power of 500 kW at the time of target retrieval, would be approximately 19,600 actual Ci after processing. This amount would supply over 3000 6-day curies to the radiopharmaceutical houses. The Oak Ridge Research Reactor is capable of supplying additional Mo-99 capacity to well above 120% of the current U.S. demand.

3.3.3.5 Target Transfer to the Hot Cell Facility

The irradiated target would be transferred into a transfer cask within the pool and transported (less than 1000 ft) to the receiving hot cell in the Radioisotope Development Laboratory located adjacent to the Oak Ridge Research Reactor building that would become the Medical Isotope Production Center (MIPC) (Figure 3-14). Four shielded manipulator cells and all necessary support systems would be dedicated to processing Mo-99 (Figure 3-15). Irradiated targets would be processed using the Cintichem process per the schedules, commensurate with the production and delivery requirements.

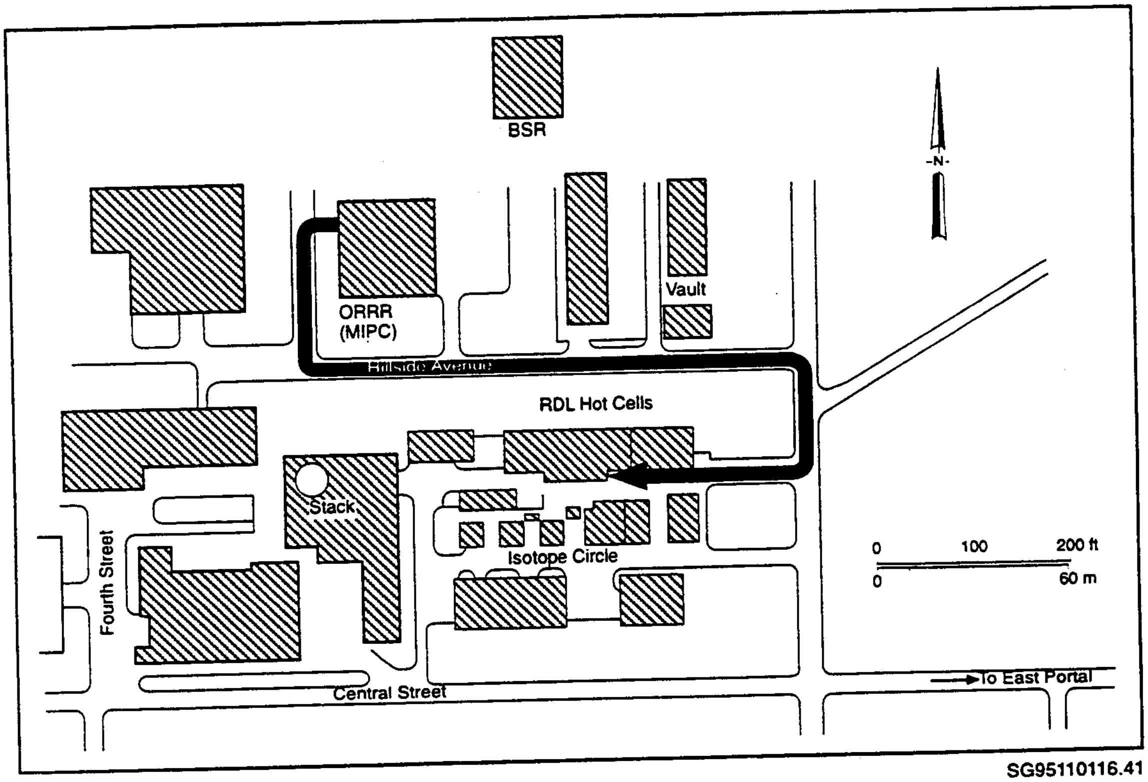

Figure 3-14. Relative Locations of the Bulk Shielding Reactor, Oak Ridge Research Reactor, and the Radioisotope Development Laboratory Hot Cells

3.3.3.6 Isotope Extraction at the Hot Cell Facility

The target would be opened in a fission gas recovery system provided with cryogenic traps to recover radioactive iodine and xenon isotopes. The uranium containing Mo-99 and other fission products would be dissolved using an acid solution. The amount and the specific activity of Mo-99 obtained would vary according to the target loading, irradiation time, and the target power.

The liquid from the target dissolution would be drained into a bottle, treated to precipitate elemental iodine, and filtered to remove silver iodide. Molybdenum carrier (sodium hydroxide) would be added to the remaining solution. After several more steps of washing and removing impurities, including ruthenium, rhodium, and organic residues, the resulting product solution would contain sodium molybdate in dilute sodium hydroxide. Approximately 1200 to 1400 mCi/mL of Mo-99 would be expected per target. In the event of an operational difficulty with a hot cell, spare hot cells would exist in the same bay to preclude disruptions from routine operations.

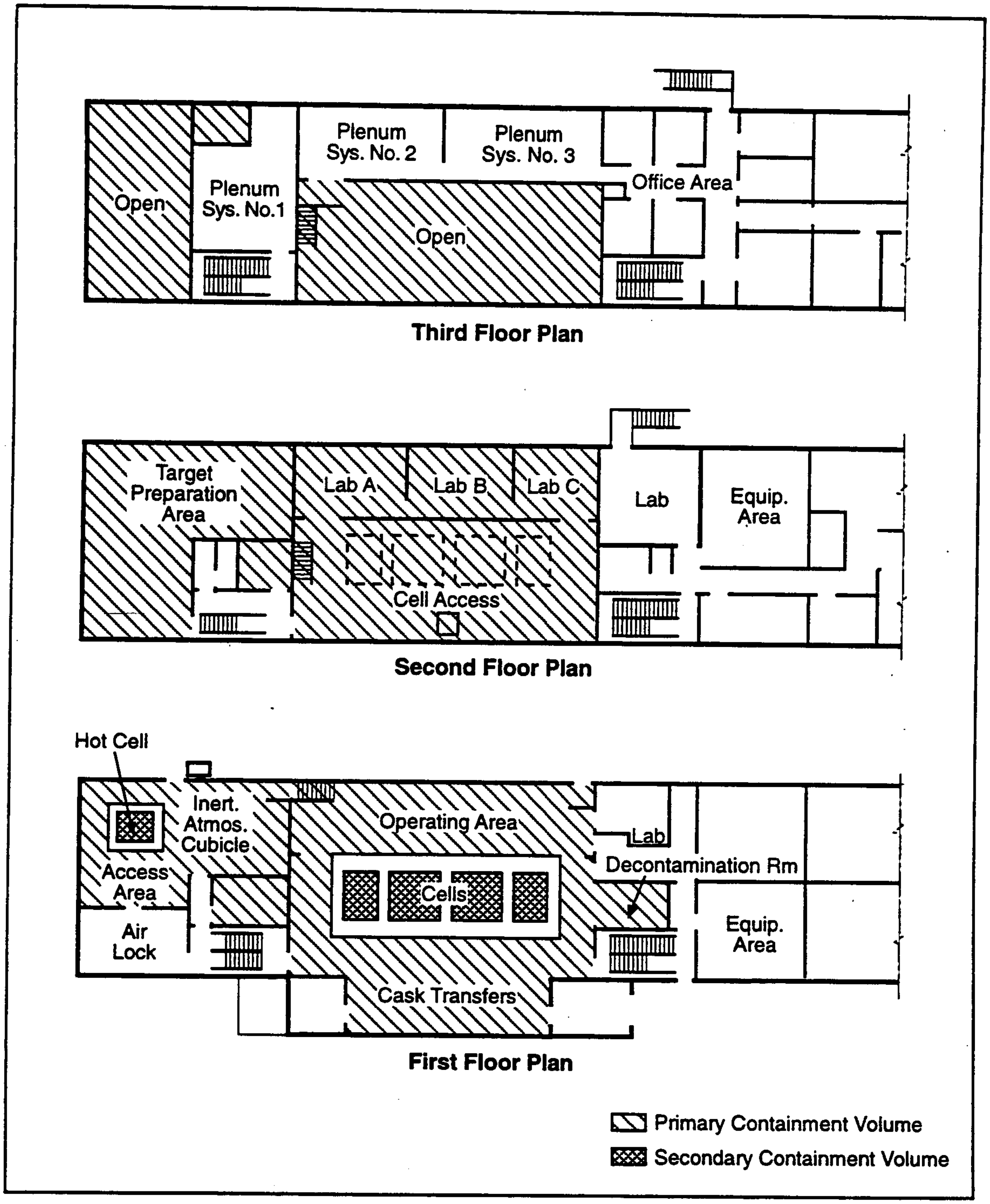

Figure 3-15. Layout of the Three Floor Levels of the Radioisotope Development Laboratory Facility

After completing the procedure for the purification of Mo-99, the product would be tested by gamma spectroscopic analysis of an appropriate aliquot of sample extracted from the product vial. Such analysis would be useful not only in determining the nature of contamination, but in enabling the quality control laboratory to quantify the impurities and the Mo-99 content of the product vial. This information would be used to prepare the Material Safety Data Sheets that accompany the shipment.

The extraction process would also provide radioisotopes of xenon and iodine. Based on an irradiation power of 21 kW per target, each target could yield approximately 600 Ci of Mo-99, 200 Ci of iodine-131, and 600 Ci of xenon-133 one day after discharge from the reactor.

3.3.3.7 Product Shipment

The Mo-99 would be packaged in Type B accident-resistant packaging for shipment to the radio-pharmaceutical companies. Air express class of shipments would be used with direct routing, if possible, to the customer city. Passenger carrying aircraft could be used, as the Transport Index (a federal requirement discussed in 49 CFR 175, basically specifying the dose rate from a radioactive shipment measured at 1 meter from the package surface) of the Mo-99 package is within the limit allowed on passenger aircraft. The Knoxville airport is located 48 km (30 mi) from ORNL and is serviced by the major airlines.

3.3.3.8 Waste and Spent Nuclear Fuel Management

Approximately 73.2 m^3 (95.7 cu yd) of low-level waste (solid and liquid) would be generated per year from Mo-99 production activities at 100% of U.S. demand. Radioactive waste from target processing would be held in the hot cell area for approximately 6 months. After this radioactive decay period, the waste would be solidified, packed, and transferred to storage on above-ground pads. The waste would then be shipped to the Nevada Test Site for final disposal. Incidental mixed waste would be stored in permitted mixed waste areas. The description of waste treatment and disposal is based on current practice and may change based on future decisions resulting from the DOE waste management study (1995a). Oak Ridge Research Reactor has the capacity to handle spent nuclear fuel onsite. Spent nuclear fuel would be stored at Oak Ridge pending a decision on its final disposition in accordance with the SNF PEIS (DOE 1995b).

3.3.3.9 Required Modifications

Oak Ridge Research Reactor Modifications. The Oak Ridge Research Reactor has been maintained for some time in standby mode and would require modification to restart. Use of this reactor would require the preparation of a Safety Analysis Report, and revisions of the technical specifications and of the operating procedures. Certain licenses and permits would also be necessary. Before restart, an Operational Readiness Review would also be required.

Changes to the current physical plant would be needed: the control room upgraded, a new resin slurry system installed, and new pumps/plate type heat exchangers procured for the Oak Ridge Research Reactor basement. As required, out-of-service instrumentation and equipment would be assessed and repaired. New reflector pieces and hold-down arms would be fabricated, as well as six shim rods (if low enriched ‑anium-based operation is required).

Radioisotope Development Laboratory Modifications. The modifications to the Radioisotope Development Laboratory would include customizing the second floor for the target fabrication and customizing the hot cells to allow irradiated Cintichem-type target processing for Mo-99. Training of ORNL radiochemistry and health physics personnel for Mo-99 operations would also be necessary.

Process Validation Testing. Prior to production, process validation testing would be conducted. The process described in Section 3.3.1.9 is generally applicable to the Oak Ridge Research Reactor.

3.3.3.10 Estimated Schedule for Modification

Approximately 30 months from the date of the Record of Decision would be required to prepare the Oak Ridge Research Reactor for operation (estimated startup in August 1998). This schedule includes all the necessary hardware modifications and document upgrades.

3.3.4 Power Burst Facility/Test Area North: Idaho National Engineering Laboratory Alternative

The U.S. Atomic Energy Commission, a predecessor of DOE, established INEL (formerly known as the National Reactor Testing Station) to build, test, and operate various types of nuclear reactors, support ˋants, and associated equipment. Since its establishment in 1949, DOE and its predecessor agencies have .ilt 52 reactors at INEL. In support of the DOE reactor research program and as part of the spent nuclear fuel reprocessing program, INEL has received spent nuclear fuel from more than 30 offsite sources, including naval reactors, university reactors, commercial reactors, and DOE research reactors, as well as fuels fabricated in the U.S. and irradiated in foreign reactors.

In 1974, the National Reactor Testing Station became INEL. The INEL mission broadened to include research and engineering for nonnuclear programs and environmental restoration and waste management activities. In 1980, INEL further expanded its mission to include isotope production for medical, industrial, and research applications.

3.3.4.1 Description of the Alternative

This alternative would require restart of the Power Burst Facility and modifications to other INEL facilities to produce Mo-99. The location of INEL and the location of the facilities discussed in the following sections are shown in Section 4. The major proposed activities would include fabricating uranium targets at INEL and then shipping the targets to the Power Burst Facility for irradiation. The irradiated targets would be processed at Test Area North or at stand-alone hot cells constructed in a suitable location adjacent to the Power Burst Facility. The Mo-99 product would be shipped to radio-pharmaceutical companies via the Idaho Falls Airport. Low-level radioactive wastes would be packaged and shipped to the Radioactive Waste Management Complex at INEL.

3.3.4.2 Existing Facilities

Existing facilities at INEL would be used for the four fundamental Mo-99 production operations. An onsite facility would be modified to fabricate targets (several adequate facilities exist on the site). The Power Burst Facility would be restarted to irradiate Mo-99 production targets. Hot cells at the Test Area North would be modified, or new hot cells would be constructed, to process the targets. Radioactive wastes would be disposed onsite at INEL.

3.3.4.3 Target Fabrication at INEL

The target fabrication processes that were developed by Cintichem, and which are being refined by LANL, could be implemented at a number of facilities at INEL. The target fabrication process would be the same as that being developed by LANL, described in Section 3.3.1.3.

Because special facilities are not required, the target production area would be located at the Test Area North in a building similar to the Experimental Test Reactor Critical Facility annex or the lower floor of the Materials Test Reactor building. Targets would be fabricated and stored onsite until needed for irradiation in the Power Burst Facility.

3.3.4.4 Target Irradiation Activities

The unirradiated targets would be transported by truck to the Power Burst Facility for irradiation. The Power Burst Facility consists of an low enriched uranium oxide-fueled, epithermal reactor, plus supporting systems and equipment. The facility is housed in two buildings, a reactor building, and a control building. The reactor building is located approximately 0.8 km (0.5 mi) northwest of the control building. The reactor is currently in an operational standby status.

The driver core installed in the Power Burst Facility is the original reactor fuel core. This core has been operated for 24,925 MWh with calculations to indicate that 100,000 to 150,000 MWh remain in the installed core and unirradiated fuel rods on hand.

In 1987, a program was proposed to DOE by the Idaho Brain Tumor Center for using the Power Burst Facility as a neutron source for treating a certain type of brain tumor with Boron Neutron Capture Therapy. Several peer reviews failed to support maintaining the Power Burst Facility in standby mode solely for the developing technology. As a result of the peer reviews, and because no other program could be identified for the Power Burst Facility, DOE-Idaho directed the contractor to place the Power Burst Facility in a shutdown condition. This direction was given on April 8, 1992. However, Idaho Brain Tumor Center holds a lease option on the Power Burst Facility until January 1997. The Power Burst Facility could be :ed to produce Mo-99 and, concurrently, as a Boron Neutron Capture Therapy treatment center.

The targets would be irradiated at a power level of approximately 20 kW per target. Three configurations of the Power Burst Facility core would be suitable for Mo-99 production. These configurations are identified:

1. Removal of the central experimental tube and installation of a Mo-99 target holder with a diameter of approximately 21 cm (8 in.).

2. Removal and replacement of four installed annular transient rods with a special irradiation fixture for Mo-99 production targets.

3. Removal of one or more of the six types of fuel canisters and replacing this position(s) with a Mo-99 irradiation target holder.

The normal steady state power level of the Power Burst Facility has been reduced from the published value of 28 MW to 10 MW for these production calculations. This power reduction will reduce the flux densities for the fuel and central core test space to 4.5 x 10^{12} and 3.7 x 10^{13} n/cm^2-s, respectively. The following summary provides the corresponding Mo-99 production rates for the three core configuration options previously identified.

1. Power Burst Facility Center Test Space: Removing the central experimental tube and machining a special holder could provide space for at least 19 Cintichem type Mo-99 production targets. The process would then have the capability of producing approximately 2400 6-day Ci of Mo-99 every 6 days of reactor operation. This arrangement would allow sufficient coolant flow to limit increases in core heat flux.

2. Annular Transient Rod Positions: If additional Mo-99 production is required, the four transient rod positions (not required for steady state power operation) could be utilized. Each transient rod location could contain two, or possibly three, Mo-99 production targets. Even with lower core thermal neutron flux, these four locations could potentially produce another 600 to 900 6-day Ci of Mo-99 every 8 to 10 days of reactor operation (2000 to 3000 Ci at reactor shutdown).

3. Fuel Canister Removal: Fuel canisters contain from 28 to 62 fuel pins per canister. Removal of a 28-pin fuel canister and replacement with a special Mo-99 production holder is also an option. The addition of highly enriched uranium in the Mo-99 production targets would partially offset the removal of 18.5 wt% uranium-235 Power Burst Facility fuel pins. Detailed thermal hydraulic and multigroup diffusion theory analyses would be required to accurately determine feasibility for this configuration. The issue of target accessibility for these positions would also need to be addressed.

3.3.4.5 Target Transfer to the Hot Cell Facility

The shipment of irradiated Mo-99 targets from the Power Burst Facility reactor to the Test Area North processing facility could be accomplished with an approved container having a site-approved transport plan. The DOT- or NRC-approved containers are not required for transport of the targets within the INEL. However, transport of the targets must be performed in accordance with DOE Order 0460.2 (DOE 1995e). Several containers not approved by DOT were identified that could be used for this purpose. These containers included the TFBP-1, WE #2, or Advanced Test Reactor spent fuel cask. In addition, the CNS1-13, although not approved for DOT transport, could be included in an addendum transport plan that could permit its use for transport of Mo-99 targets within the INEL. All of these containers could be handled and loaded from the Power Burst Facility reactor canal area. All would require the preparation of a new transport plan.

3.3.4.6 Isotope Extraction at the Hot Cell Facility

The target would be opened in a fission gas recovery system provided with cryogenic traps to recover radioactive iodine and xenon isotopes. The uranium containing Mo-99 and other fission products would be dissolved using an acid solution. The amount and the specific activity of Mo-99 obtained would vary according to the target loading, irradiation time, and the target power.

When the irradiated target element is received in the process cell, it would be punctured to vent the iodine, xenon, krypton and other fission product gases into a liquid nitrogen cold trap for capture as a liquid or solid. These cold-trapped gases would then be allowed to vaporize and be collected in gas collection containers.

The liquid from the target dissolution would be drained into a bottle, treated to precipitate elemental iodine, and filtered to remove silver iodide. Molybdenum carrier (sodium hydroxide) would be added to the remaining solution. After several more steps of washing and removing impurities, including ruthenium, rhodium, and organic residues, the resulting product solution would contain sodium molybdate in dilute sodium hydroxide. Approximately 1200 to 1400 mCi/mL of Mo-99 would be expected per target. In the event of an operational difficulty with a hot cell, spare hot cells would exist in the same bay to preclude disruptions from routine operations.

After completing the procedure for the purification of Mo-99, the product would be tested by gamma spectroscopic analysis of an appropriate aliquot of sample extracted from the product vial. Such analysis would be useful not only in determining the nature of contamination, but in enabling the quality control laboratory to quantify the impurities and the Mo-99 content of the product vial. This information would be used to prepare the Material Safety Data Sheets that accompany the shipment.

The extraction process would also provide radioisotopes of xenon and iodine. Based on an irradiation power of 21 kW per target, each target could yield approximately 600 Ci of Mo-99, 200 Ci of iodine-131, and 600 Ci of xenon-133 one day after discharge from the reactor.

3.3.4.7 Product Shipment

The Mo-99 would be packaged in Type B accident-resistant packaging for shipment to the radio-pharmaceutical companies. Air express class of shipments would be used with direct routing, if possible, to the customer city. Passenger carrying aircraft could be used, as the Transport Index (a federal requirement discussed in 49 CFR 175, basically specifying the dose rate from a radioactive shipment measured at 1 meter from the package surface) of the Mo-99 package is within the limit allowed on passenger aircraft. Product movement would be from the processing facility to the Idaho Falls airport, approximately 72.5 km (45 mi) away.

3.3.4.8 Waste and Spent Nuclear Fuel Management

INEL has the capability to handle onsite all of its generated waste. From a waste handling perspective, INEL is a cradle-to-grave operation. Approximately 85.2 m^3 (111.4 cu yd) of low-level waste would be produced per year from Mo-99 production activities at 100% of U.S. demand. Waste would be stored in the hot cell facility for approximately 6 months to permit decay of short-lived radionuclides. All generated waste would be handled through the established waste management processes at INEL in accordance with all applicable federal, state, local, DOE, and INEL requirements. Waste treatment and disposal practices may change based on future decisions resulting from the waste management study (DOE 1995a). Adequate wet and dry spent fuel storage exists onsite. Final disposition of spent fuel will be in accordance with the SNF PEIS (DOE 1995b).

3.3.4.9 Required Modifications

Power Burst Facility Modifications. The Power Burst Facility has been maintained in standby condition and is anticipated to require a few modifications to be able to restart. A significant portion of the reactor instrumentation would need to be replaced and all of the systems would need to be tested to determine operability. Use of the Power Burst Facility would also require the preparation of a revised safety analysis report for Mo-99 production.

The Power Burst Facility SAR and Technical Safety Requirements documents would have to be reviewed and upgraded to address the new facility mission, and to reflect the current requirements of the DOE Orders 5480.22 (1992b) and 5480.23 (1992a). Additionally, the restart of the Power Burst Facility would require an Operational Readiness Review.

In addition to the facility modifications required, Power Burst Facility reactor core modifications would be required to support Mo-99 target irradiation. Several modifications would be required to conduct medical isotope production. Besides modifying the central cavity, the reactor control system would need to be modified for a continued steady state, non-pulse mode. The transient rods would need to be removed and fixtures for target irradiation placed in the vacant locations. All material removed from the central cavity would require disposal, as would the transient rods and mechanisms. Cooling flow to the central cavity would need to be appropriately established along with the normal core cooling flow in lieu of the contained loop that currently exists. Flow balance valves for the central irradiation cavity would have to be designed and installed to ensure that appropriate target cooling flow is established without flow induced vibration of the targets occurring. The core would need to be redesigned to supply a hardened spectrum of neutrons to the central irradiation cavity. Concentration of the power to the core center would be needed to establish the appropriate flux level, without needing to operate the reactor above 10 MW, to make the facility competitive regarding fuel utilization.

Hot Cell Facility Modifications. Two options were considered in evaluating the feasibility of utilizing existing processing facilities at the INEL. These options included either using existing facilities or purchasing stand-alone process cells that could be placed in any convenient location at the INEL.

The hot cell annex, at the Test Area North hot cell area, was considered as an existing facility option for the recovery of the Mo-99 from the irradiated targets. This facility is in an acceptable state of repair and only minor facility modifications would be required to place it in operation. The facility safety documentation has undergone a recent upgrade and would provide a nearly complete basis for facility operation and Mo-99 production there. Transportation of irradiated targets from the Power Burst Facility to this location would be the most difficult barrier to the use of the Test Area North facility.

Unlike other hot cell alternatives at INEL, transport to Test Area North requires travel over approximately 8 km (5 mi) of State Highway 33. Transportation in this area requires a DOT-approved container. Either the BMI-1 cask or the GE-2000 cask could be used for this purpose. The DOE currently possesses both of these casks.

The Test Area North hot cells were not considered as an acceptable existing hot cell facility because those cells are currently in use for other medical and industrial isotope production programs. Additionally, the facility is presently classified as a hazard Class II facility. This classification limits the fissile material inventory in the facility to less than 350 g of uranium-235 in a moderated condition. The Test Area North hot cells, therefore, are not an option for the processing of irradiated Mo-99 targets.

Mo-99 production feasibility studies addressed the possibility of conducting all processing in stand-alone cells purchased from a commercial supplier. Such an arrangement would be of great financial advantage, if these cells could be located in an existing facility close to the Power Burst Facility and possibly even be considered as a single facility with the Power Burst Facility. This arrangement would eliminate the cost of preparing additional safety documents for added facilities, and it would permit Power Burst Facility staff to conduct processing operations, as well as reactor operation. This evaluation determined that anticipated radiation and airborne activity levels in the Power Burst Facility building during reactor operation are not consistent with those required for the continuous occupancy that would be required for Mo-99 processing activities. However, it may be feasible to erect an additional annex to the Power Burst Facility structure, shielded from the main reactor building, and connected to existing Power Burst Facility effluent ventilation and radiation monitoring systems. Such a facility would provide great advantage by the use of stand-alone manufactured cells and would eliminate transportation time and liability.

Additionally, the hot cells chosen would require the Mo-99 Process Line Installation and Quality Control Laboratory as follows:

- Mo-99 Process Line Installation - Processing equipment unique to isotope production would have to be procured and installed prior to production. Examples include extraction process equipment and waste processing equipment.

- Quality Control Laboratory - This laboratory would be required by the approved FDA procedure. The Quality Control Laboratory requires a minimal amount of space (no significant construction) and equipment, such as ventilated shielded glove boxes and detection equipment. Additionally, small shielding enclosures would be installed around selected equipment.

Process Validation Testing. Prior to production, process validation testing would be conducted. The process described in Section 3.3.1.9 for the Annular Core Research Reactor is generally applicable to the Power Burst Facility.

3.3.4.10 Estimated Schedule for Modification

The INEL option would be capable of producing Mo-99 22 months after the Record of Decision and in a full production mode after an additional 6 months.

3.4 Alternatives Considered and Dismissed

The following alternatives were considered as candidates for the domestic production source of Mo-99, but were dismissed from detailed consideration because they do not satisfy the screening criteria set forth in Section 3.1.1. A brief description of each alternative and the reason(s) for its dismissal are presented in this section.

3.4.1 Other Federal Facilities

3.4.1.1 Advanced Test Reactor - Idaho National Engineering Laboratory

The Advanced Test Reactor is a 250-MW pressurized water reactor, light water moderated and cooled, with a beryllium reflector. It operates with a cycle of 30 to 45 days of operation followed by 7 to 10 days of refueling. The reactor vessel is sealed during operation so access to the reactor internals is available only during reactor shutdown/refueling.

Two Mo-99 production methods were considered at the Advanced Test Reactor (DOE 1995f). Neither method met the screening criteria.

In the first method, the standard Cintichem type targets would be placed in one of the irradiation positions in the core, at the start of an operating cycle, and then irradiated for the ensuing 30 to 40 days. At the end of the cycle, the target would be removed from the reactor and processed in the hot cells onsite. The primary problem with this method of Mo-99 production at the Advanced Test Reactor is the reactor's operating characteristics. The Advanced Test Reactor operates for 30 to 45 days, followed by a week to 10 days of refueling. Mo-99 would not be produced during this period when the reactor is shut down. Therefore, the Advanced Test Reactor would not provide a reliable continuous supply of Mo-99--a basic requirement of the project. A second reason the Advanced Test Reactor would not be suitable for this project is the long irradiation period. The molybdenum isotopes from 95 through 100 are all produced from fission. All are stable with the exception of Mo-99. Due to the short half life of Mo-99, the quantity would equilibrate within about 15 days of target irradiation, while the other isotopes continue to build. The specific activity, or Ci of Mo-99 per gram of elemental molybdenum, begins to decrease rapidly after approximately 8 days of target irradiation. The long irradiation periods required by the Advanced Test Reactor operating cycle impact the quality of the product, due to the low specific activity.

In the second method, mini-targets, about 10.2 to 12.7 cm (4.0 to 5.0 in.) long, similar to the Cintichem type targets (coated with ≅ 5 g uranium-235), would be placed in a hollow tube, called a *rabbit*. The hollow tube containing the target would be inserted remotely in the core and irradiated for a predetermined period (few hours to a few days) and then processed in the hot cell similar to the regular targets. The rabbit would permit the removal/insertion of a target through a remote manipulator during reactor operation. This approach would overcome the long reactor operating cycle shortcoming. The regular 45.7-cm (18.0-in.) long Cintichem targets could not be accommodated in the rabbit. Instead, a target ~11.4 cm (4.5 in.) would be used. Such a smaller target, that is significantly different from the Cintichem design, may warrant additional scrutiny by the FDA for granting a Drug Master File.

To have sufficient cooling of the target during irradiation, a hydraulically cooled rabbit, instead of a pneumatically cooled device, would be needed. The rabbit facility would be a multiple facility in one of the Advanced Test Reactor lobes and would contain six separate hydraulic rabbit tubes. Each tube would operate independently of the others. Target powers in excess of 30 kW per target are possible, due to the forced hydraulic cooling capability. The aggregate target power from this configuration would be approximately 200 kW, less than half the target power required for full Mo-99 production. This limitation precludes the rabbit method from further consideration.

On the basis of the reasons stated, it is apparent that Advanced Test Reactor cannot produce Mo-99 on a schedule or in quantities necessary to meet the selection criteria. Therefore, this alternative is rejected.

3.4.1.2 National Institute of Standards and Technology Reactor/Armed Forces Radiobiology Research Institute Hot Cell Facilities

This alternative considered the use of the National Institute of Standards and Technology reactor in Gaithersburg, Maryland, to irradiate the targets, and the hot cell facilities at the Armed Forces Radiobiology Research Institute in Bethesda, Maryland, to process Mo-99.

The National Institute of Standards and Technology has a tank type reactor that achieved full operational power of 20 MW in 1969. Heavy water serves as the primary coolant, moderator, and the :flector. The primary coolant is circulated through forced convection. As the purity of heavy water is very important, the reactor vessel is completely sealed during the operation and pressurized with helium. The fuel elements are Materials Test Reactor type containing 350 g of 93% uranium-235. Each element is 1.5 m (5.0 ft) in length, with two 28-cm (11-in.) fuel columns, separated by a 17.8-cm (7.0-in.) long column of light water that serves as a neutron trap.

The National Institute of Standards and Technology reactor is not suitable for Mo-99 production for the following reasons:

- The mission of the National Institute of Standards and Technology reactor is to provide its neutron activation, depth profiling, radiography, and its cold neutron facilities to nearly 1200 customers, worldwide. It normally has a significant waiting list for its use. The Mo-99 production project, if adopted, would severely hurt its primary mission.

- The reactor is a sealed tank type and the targets cannot be moved in and out of the reactor without shutting down the reactor. The 35-day fuel cycle of the tank precludes this reactor from using it for Mo-99 mission, due to specific activity considerations.

- The reactor is provided with a rabbit, a mechanical device allowing access to the reactor without shutting it down. However, the rabbit can admit samples only as large as 2.5 cm (1.0 in.) diameter by 7.6 cm (3.0 in.) long. These parameters are not adequate for the Cintichem target irradiation. A typical Cintichem target measures 3.19 cm (1.25 in.) in diameter by 45.7 cm (18.0 in.) long.

3.4.1.3 One or More TRIGA Reactors

TRIGAs are a type of reactor built by General Atomics. They are designed for training, research, and isotope production, hence the acronym TRIGA. A distinguishing characteristic of the TRIGA design is the exceptionally large prompt negative temperature coefficient due to the zirconium hydride in the fuel. This characteristic means that any increase in temperature results in a decrease in reactor power. A large TRIGA core with reduced leakage can have an equilibrium core lifetime of approximately 6000 MW/day, while a smaller, high-leakage core would be expected to have a significantly smaller equilibrium core lifetime. TRIGA fuel can be purchased at 8-1/2 wt% (38 g uranium-235), 12 wt% (49 g uranium-235), and 20 wt% (97 g uranium-235).

It has been suggested that a few reactors, with a designated hot cell facility, could be used to provide the full supply of the U.S. demand for Mo-99. The following evaluation specifically addresses the use of multiple TRIGA reactors but is generally applicable to all multiple reactor concepts.

The objective in the TRIGA option would be to irradiate targets in fuel locations throughout the core. This objective is virtually identical to the Annular Core Research Reactor alternative option of running targets in fuel locations. TRIGA fuel and Mo-99 targets are approximately the same diameter (3.7 cm for TRIGA fuel and 3.2 cm for Mo-99 targets). For a typical 2-MW TRIGA reactor, the average fuel element power is approximately 20 kW, and target loading could be adjusted for target power. It is unclear what percentage of target power could be cooled by natural circulation in a fuel location. Further, target powers greater than average fuel element power may pose a licensing issue.

The replacement of TRIGA fuel with fissionable material that has no zirconium hydride (that is, a target) impacts the inherent safety mechanism of the TRIGA design. The zirconium hydride creates the strong negative temperature feedback mechanism characteristic with the TRIGA reactors. As fuel is replaced, the reactor dynamic parameters would be changed, and the licensing would be impacted. A conservative estimate would be that up to 10% of the fuel locations (10 targets replacing elements) could be used to contain Mo-99 targets. Licensing the TRIGA reactor with greater than 10% of the core power being generated from Mo-99 targets, which do not have the unique shutdown characteristics of TRIGA fuel, may pose a challenge.

The option of using two TRIGAs, with each having a power level of 2 MW to supply portions of the required demand, could be viable if they were in advantageous geographic locations. The best situation that was investigated is the Pacific Northwest where four small TRIGAs reside within several hours of one another. TRIGAs exist at Hanford in Richland, Washington; Washington State University at Pullman, Washington; Oregon State University in Corvallis, Oregon; and Reed College in Portland, Oregon. However, none of these reactors has a power level of 2 MW, and all would have to be upgraded.

This option would require that Mo-99 processing lines be established at two different facilities, or that irradiated targets be shipped from one (or both) reactors to a common processing facility. (The Hanford site has hot cell facilities that would be capable of performing the processing.) This procedure would either roughly double processing facility costs, or would necessitate routine shipment of freshly irradiated targets. Due to the time-sensitive nature of Mo-99 production, it is desirable to avoid having to ship irradiated targets by collocating the processing facility with the irradiation facility.

Also, it is important to maintain the capability of the facilities and personnel to produce 100% of the U.S. demand for Mo-99, if necessary. Therefore, under a two-reactor scenario, both reactors (and both processing facilities, if applicable) would have to be operated routinely in a standby mode. This arrangement would require that two full reactor staffs and facilities be maintained, which would increase the cost of the Mo-99 production capability.

This option would require the upgrade of several small reactors to 2 MW in a timely fashion, would require routine operation of two reactors, and would require either that significant shipping issues be addressed or that redundant processing capability be established. These activities would be costly and could not be achieved within the time frame specified in the evaluation criteria.

3.4.1.4 High Flux Isotope Reactor - Oak Ridge

The High Flux Isotope Reactor is a beryllium-reflected, light water cooled and moderated flux trap type 85 MW production and test reactor that uses highly enriched uranium fuel. The reactor core assembly is contained in an 2.4 m (8 ft) diameter pressure vessel located in a water-filled pool. The top of the pressure vessel is 5 m (17 ft) below the pool surface.

Typically, the High Flux Isotope Reactor operates continuously for 22 to 26 days at 85 MW followed by a 7- to 10-day outage for refueling and maintenance. In the past, unscheduled outages have also occurred, resulting in an on-stream time of approximately 65% over the past 2 years, which is not favorable to Mo-99 production. Also the primary mission of the High Flux Isotope Reactor is the production of transplutonic isotopes. The irradiation and experimental facilities that support this mission require steady state operation of the reactor for the longest possible period of time. Shutdown of the reactor (minimum of 3 days) to facilitate insertion and removal of the targets for Mo-99 production would be very disruptive to the primary missions. Long irradiation periods impact the quality of the molybdenum product due to specific activity arguments, as delineated in Section 3.4.1.1.

The High Flux Isotope Reactor alternative is rejected because its operating characteristics and its current primary mission will not allow it to meet the Mo-99 production facility selection criteria.

3.4.1.5 Bulk Shielding Reactor - Oak Ridge

The Bulk Shielding Reactor (BSR) has a forced cooling system and is capable of continuous operation at 2-MW power level. Operation of the BSR with low enriched uranium would be feasible. At full production capacity, 2330 6-day Ci of Mo-99 would be produced per week. The BSR could not meet the 3000 6-day Ci weekly Mo-99 production requirement specified in the selection criteria. The BSR could provide an estimated aggregate target power level of 380 kW. The requirement to meet the weekly U.S. demand is ≥ 490 kW continuously for 6 days. Because the BSR cannot meet the selection criteria specified in Section 3.1.1, it has been eliminated from detailed consideration.

3.4.1.6 Fast Flux Test Facility - Hanford

The Fast Flux Test Facility (FFTF) is a DOE reactor located on the Hanford Site, Richland, Washington. The reactor is a liquid sodium cooled, mixed oxide fast reactor. The initial criticality of the reactor occurred in 1980. The reactor is currently shut down. The reactor is rated at 400 MW and was designed to perform tests on fuels and components for liquid metal cooled reactors. In comparison, the reactor that Cintichem used to produce Mo-99 was a 5-MW reactor. The FFTF has many irradiation facilities.

The FFTF is located within a few miles of hot cell facilities adequate for Mo-99 target processing. The post irradiation Fuel Materials Examining Facility, which is adjacent to the FFTF, contains several banks of hot cells that were never completed due to loss of mission. Several other hot cell facilities with >100,000 curie ratings exist in the Hanford 300 area, approximately 8 km (5 mi) away.

The reactor operating cycle would preclude continuous Mo-99 production due to the required outage periods of a reactor of this size. Further, the FFTF is much too large to economically produce Mo-99. As a single mission for a facility that large, the rate of nuclear fuel utilization required to produce the neutrons for the Mo-99 production could not be reasonably justified. Therefore, the FFTF has been eliminated from detailed consideration.

3.4.1.7 Accelerator Facilities - Los Alamos and Others

Accelerators provide a means of accelerating charged particles such as electrons, protons, or deuterons to high energies. In a linear accelerator (LINAC), a beam of ions from an ion source is injected into an accelerating tube containing a number of coaxial cylindrical sections. Alternating sections are connected to a high-frequency alternating voltage from a high-powered oscillator. An ion traveling down the tube will be accelerated at a gap between electrodes, if the voltage is in the proper phase. Using a LINAC, electrons can be accelerated to several GeV and protons to about 600 MeV of energy. For proton acceleration to GeV levels, a device known as a cyclotron is used. In a cyclotron, a charged particle follows a circular path under the influence of an applied external magnetic field. Variations of cyclotrons are also known as a synchrotron, or an alternating gradient synchrotron. A number of radionuclides, including Mo-99 for use in medical applications, can be produced by bombarding a variety of targets with beams of particles from the accelerators.

This alternative explores the feasibility of using an accelerator to produce Mo-99, taking into consideration such factors as technical feasibility, time constraints, economic viability, and compliance with current federal regulations.

The accelerated charged particles, such as a protons or deuterons, can be used to bombard a target to produce nuclear reactions. Accelerators can serve as a source of neutrons through intermediate charged particle reactions (known as spallation neutron reactions) leading to neutron emission. These neutrons, in turn, can cause nuclear reactions in a target or cause nuclear fission, if the target contains fissile material. Accelerators are used to produce a variety of isotopes for use in research, medical diagnosis and therapy, and industry. The following paragraphs describe a few state-of-the-art facilities producing isotopes in the U.S.

Built and commissioned in 1973, the Brookhaven LINAC Isotope Producer (BLIP) was one of the world's first facilities to demonstrate the capability of a large proton-LINAC for efficient medical radionuclide production by proton spallation of neutrons, as well as lower energy reactions. With its beam current of 50 μA, a beam power of 100 kW, and a beam width of 1.9 cm (1.1 in.), BLIP successfully served as a workhorse for the production of medical isotopes for over two decades. This facility is planned to be upgraded during 1996 to triple its beam characteristics. However, the quantity of various isotopes that could be produced even after the upgrade varies from a few μCi to a few Ci. This production capa- 'lity would not meet the quantity and schedule requirements of the U.S. Mo-99 needs.

The Los Alamos Meson Physics Facility (LAMPF) at LANL has a proton LINAC with a beam current of 1 mA and power of 0.8 MW. It can accelerate protons to 800 MeV. The Isotope Production Facility at LAMPF has 13 shielded hot cells at its radiochemistry site at TA-18 that are fitted with remote manipulators.

The Isotope Production Facility at LAMPF currently produces several medical isotopes. Although LAMPF has a long record of producing isotopes, its capabilities are three orders of magnitude less than that required to produce 100% of the U.S. need for Mo-99.

Mo-99 can be produced using an accelerator through a variety of reactions on natural or enriched molybdenum or uranium including: Mo-98 (n,γ); Mo-98 (d,p); Mo-100 (n,2n); Mo-100 (γ,n); Mo-100 (p,pn); Mo-100 (p,2p); U-235 (n,f); and U-238 (p,f).

Consideration of the cross sections and reaction threshold energies for these reactions (DOE 1995c, and Andrade 1995) suggest that Mo-98 (n,γ), Mo-98 (d,p), Mo-100 (p,pn) and Mo-100 (p,2p) and U-238 (p,f) reactions are favored for the production of Mo-99 using accelerators. Approximately 9 x 10^{-5} Mo-99 atoms are reportedly produced per 15-MeV deuteron particle incident upon a Mo-98 target.

To produce 100% of U.S. weekly requirement of 3000 6-day Ci, requirements include a beam current ^f 740 mA of deuteron current and a beam power of about 11 MW, which are beyond the current state-of- -art in accelerator technology.

One of the major problems in producing Mo-99 by using accelerators would be the state-of-the-art limitation in achieving heat transfer from the target. For example, Brookhaven National Laboratory currently produces copper-67 by irradiating a 5.7-cm-diameter x 0.79-cm-thick zirconium target. At the current beam current of 50 μA and beam power of 100 kW at the peak power density, the target at the beam center reaches temperatures as high as 541°C. When the power level increases to 150 μA at the completion of the upgrades, the target temperature is projected to reach 990°C. The target heating, during irradiation in an accelerator, is a significant problem even with beam currents on the order of a few hundred μA. Mo-99 production to meet 100% the U.S. demand would require operating at more than three orders of magnitude higher than the condition previously illustrated. Current state-of-the-art in accelerator physics precludes the possibility of producing this isotope on a commercial scale to adequately meet 100% of the present U.S. demand.

Work at the University of California-Davis, has created a novel approach of producing Mo-99 which consists of bombarding an enriched (>97%) Mo-100 target (5 g) with a 70-MeV negatively charged hydrogen ion dual beam with a total beam current of 400 μA. However, the expected specific activity of

Mo-99 would be only 48 Ci/g at the end-of-bombardment. This specific activity falls far short of the required specific activity of 10,000 Ci/g. In fact, all isotopes produced by nuclear transmutation have, in general, very low specific activity.

Mo-99 can be produced through (n,γ) reaction with Mo-98 using reactor-generated neutrons or using spallation neutrons derived from charged particle reactions. Published reports (Sameth and Hans 1987) suggest that specific activity of 1 to 10 Ci of Mo-99 are achievable using natural or 100% enriched Mo-98 targets, respectively. Theoretical calculations using thermal neutron flux of 10^{14} n/cm^2-s yield specific activities of 0.6 Ci and 2.35 Ci with the natural molybdenum or 100% enriched Mo-98, respectively. Thermal neutron flux of about 4.3 x 10^{17} n/cm^2-s would be needed to achieve the specific activity goal of 10,000 Ci/g of Mo-99. With the current state-of-the-art in nuclear technology. this goal would be unattainable using either spallation neutron sources or nuclear reactors.

In conclusion, using current technology accelerators for the production of Mo-99 in quantities sufficient to meet with the U.S. demand is neither technically feasible nor economically viable in the foreseeable future.

3.4.2 University Reactors

3.4.2.1 University of Missouri Research Reactor

The Missouri University Research Reactor operates a 10-MW light water moderated reactor. The reactor core consists of eight pie-shaped fuel elements that each contain 775 g of 93.5% enriched uranium-235 (University of Missouri 1994).

Mo-99 could be extracted from irradiated fuel from the Missouri University Research Reactor by a process similar to the one used by the AECL to produce raw Mo-99 for Nordion. The difference between these two processes is that AECL irradiates highly enriched uranium targets while the proposed Missouri process would use irradiated highly enriched uranium fuel.

At full production levels, a fresh fuel element could be added to the Missouri University Research Reactor core on a weekly basis. This fresh fuel element would be added during the normal reactor shutdown for refueling and maintenance. This process normally requires 4 to 8 h. Because of specific activity arguments presented in Section 3.4.1.1, processing of a spent fuel element would not yield a usable or marketable product. No additional waste would be produced at the Missouri University Research Reactor because of the Mo-99 production activities. However, waste would be generated at the Mo-99 separation facility.

The three scenarios that were evaluated for processing of the Missouri University Research Reactor fuel elements are summarized as follows:

- The Missouri University Research Reactor fuel would be shipped to AECL for initial processing by a method similar to the one currently used to process targets for Nordion.

- The Missouri University Research Reactor fuel would be shipped to one of the DOE national laboratories at Argonne, Oak Ridge, Hanford, Idaho Falls, or Los Alamos for processing by the method used by AECL to remove the raw Mo-99. The raw molybdenum would be shipped to Nordion for purification and distribution to the radiopharmaceutical companies.

- The Missouri University Research Reactor fuel would be shipped to one of the DOE national laboratories and processed to remove the Mo-99, purified, and distributed directly to the radio-pharmaceutical companies within the U.S.

The proposed University of Missouri option would supply a single amount of Mo-99 to the radio-pharmaceutical houses only once a week. The medical community uses the product on a near continuous basis, and receives Tc-99m generators from the radiopharmaceutical companies every weekday. This periodicity has been long established by the ultimate users, the physicians performing the procedures. A change to this periodic process is not impossible but would be extremely impractical. The user, not the supplier, will almost certainly determine the demand frequency.

In addition to acquiring access to the Nordion proprietary process, the Missouri University Research Reactor option would require that hot cells rated at approximately 400,000 Ci of 1-MeV gamma be constructed at the reactor site to process a freshly irradiated fuel element. The process would be functional but very waste intensive. Without the substantial hot cells, the option would not be acceptable. The analysis of this position follows.

Shipping a fresh fuel element after a 7-day irradiation period has at least two associated problems. One is with regard to specific activity. The other is with regard to shipping significant quantities of halogens and noble gases. For assessment purposes, assume that all fuel elements operate at the same power level of 1.2 MW each. This value is not a conservative one, in that a fresh fuel element would probably produce 10 to 20% more power than a fuel element having several cycles of exposure. The product from a 1.2 MW fuel element would be approximately 48,000 Ci of Mo-99 with a specific activity of about 75,000 Ci per gram.

The best cask currently designed for this type of shipment would be the BMI-1 cask. Maximum decay heat generation from material contained in this cask would be 1.5 kW. Using General Electric decay heat curves for light water reactors and an irradiation period of 7 days, greater than 62 h would be required for a 1.2-MW fuel element to cool to 1.5 kW. The international standard on decay heat calculation (INS 10645) confirms this result. At least two dedicated BMI-1 casks would be required for this effort.

If the cask were loaded and the truck surveyed and released within 3 h, about 65 h would have passed since release of the fuel element from the reactor. Remaining in the fuel element would be 72% of the xenon-133, 79% of the iodine-131, 13% of the iodine-133, and all the krypton-85. This situation is an unusual one with exception of the krypton-85, which has a very low (0.3%) fission yield. Shipment of spent fuel usually requires 180 days of cooling to ensure that noble gases and halogens have decayed. This unusual situation is a licensing challenge, but it is probably not insurmountable.

Shipping to the nearest suitable hot cell would require transportation of the fuel element to Los Alamos, approximately 20 h distance by truck. Processing of the fuel element would commence approximately 87 h after removal of the fuel element from the reactor, assuming a 2-h truck and cask unloading period. Assuming the processing, packaging, and shipment would require an additional 16 h, the product would reach the radiopharmaceutical houses approximately 103 h after irradiation. The total activity at this time is approximately 16,250 Ci with a specific activity of 25,500 Ci per gram. The product falls below the required specific activity levels in 88 more hours, or less than 4 days. Further, delivering approximately 2750 actual Ci per day, plus radioactive decay, would deplete the lump quantity extracted from the fuel element in 3 days. No deliveries would be made during the fourth and fifth days of the weekly cycle, as the ultimate user requires.

The other two general options considered involve similar shipping delay times, and would be unacceptable for the same reasons. Additionally, AECL is opposed to the first option because of liquid waste storage constraints at the AECL facility.

Mo-99 recovery from the Missouri University Research Reactor fuel elements would entail two other disadvantages, applicable to all Missouri University Research Reactor options. First, this alternative would involve the dissolution of highly enriched uranium-reactor fuel and require continued operation of the reactor with highly enriched uranium fuel. DOE does not encourage the civilian use of highly enriched uranium, and has a program to convert highly enriched uranium-fueled research reactors to low enriched uranium fuel. The selection of this alternative would make DOE dependent on the highly enriched uranium fuel in the Missouri University Research Reactor for the production of Mo-99. Second, the processing activities are more waste intensive than a target type system. The fuel element, including cladding, must be dissolved to extract the product. Machines could probably be designed to cut the upper and lower unfueled sections from the fuel element. Milling the sides to free all the plates could also be performed by some machinery. Even with these improvements, virtually all the cladding, plus extra material, must be dissolved with the fuel. This process generates significantly more radioactive waste than the target process, in which only a thin layer of uranium is dissolved.

For the reasons stated, it was determined the Missouri University Research Reactor fuel processing option, as currently configured, does not meet the screening criteria and the alternative was dismissed from further consideration.

3.4.2.2 Other University Reactors

In addition to the Missouri University Research Reactor, a number of other research reactors operated by domestic universities were considered for the Mo-99 production project. These reactors were dismissed as reasonable alternatives for the following reasons:

- Most of the reactors operated by the universities are rated at less than 2 MW power and were individually too small for the U.S. Mo-99 production requirements.

- Very few of the university reactors have adjacent hot cells facilities that could accommodate the Mo-99 extraction activities of a full U.S. demand production rate. Lack of hot cells would require shipment of the irradiated targets to another location for processing or the construction of new facilities.

- Many university reactors do not have an operational history that was deemed reliable for Mo-99 production.

- Most of the university reactors have other missions (such as, research and education) and simply are not available for dedication to the Mo-99 production program.

3.4.3 Other Public/Private Options

The DOE has taken the position that, in the long-term, production of Mo-99 in the U.S. should be conducted by the private sector. Therefore, DOE encourages the development of private sources in the U.S. for the production of Mo-99 and would phase-out DOE production as a private source(s) begins reliably producing Mo-99. However, each of the options identified following does not represent a viable near-term option for the production of Mo-99, and these options are not considered to be reasonable alternatives to satisfy the purpose of and need for the proposed action.

3.4.3.1 Isotopes U.S.A.

A proposal submitted to the DOE in October 1994 by personnel from DOE's INEL and the University of Idaho outlined a concept referred to as Isotopes U.S.A. The proposal described the creation of a not-for-profit corporation dedicated to education, research, and other scientific purposes relevant to the production and use of stable and radioactive isotopes.

As proposed, Isotopes U.S.A. would oversee and direct isotope production and distribution, isotopes research, education and training, administration, and not-for-profit isotope ventures. Isotopes U.S.A. proposes to use existing DOE facilities for the production and distribution of radioisotopes, including Mo-99; however, no specific DOE facility has been identified.

The Isotopes U.S.A. concept offers a possible vehicle to facilitate the privatization of isotope production activities in the U.S. However, because the concept is based on utilizing existing DOE irradiation and processing facilities, it does not offer any advantage or expediency to the near-term development of a domestic backup source for Mo-99. It was dismissed as a reasonable alternative because it is a management, not a production, concept.

3.4.3.2 Babcock and Wilcox Medical Isotope Production Reactor

The Medical Isotope Production Reactor (MIPR) concept developed by Babcock & Wilcox would use an aqueous solution of uranyl nitrate contained in an aluminum or stainless steel vessel immersed in a large pool of water that can provide shielding and a medium of heat exchange. This concept would use a liquid-fueled reactor to produce Mo-99, and it may offer some advantages over the Cintichem process, especially in the area of waste minimization. However, the concept is still at the conceptual design and feasibility demonstration stage and does not represent a reasonable near-term production source for Mo-99. Therefore, it was dismissed from further consideration.

3.4.3.3 Thermo Technology Ventures, Inc.

Thermo Technology Ventures, Inc., is in the process of evaluating an alternative production method for Tc-99m, the daughter product of Mo-99. This production method would use small linear accelerators to directly produce Tc-99m. These accelerators would be located at or near medical facilities, which would greatly simplify handling and transportation of the Tc-99m. However, the concept is still at the conceptual design and feasibility demonstration stage, and does not represent a reasonable near-term production source of Mo-99.

Accelerator-based production of Tc-99m is technically feasible, as explained in Section 3.4.1.7. This small accelerator concept does not involve the use of highly enriched uranium, and may offer other improvements over current Mo-99/Tc-99m production methods, especially in the area of radioactive waste generation. However, to be able to supply 100% of the U.S. demand for Tc-99m, many of these small accelerators would have to be built. Thermo Technology Ventures plans to accomplish this goal with about 20 accelerator centers. The Thermo Technology Ventures concept is currently in the conceptual design and feasibility stage, but plans are to complete technology development by the end of 1996. While Thermo Technology Ventures plans to initiate operations in 1997, they estimate that implementation to supply the entire U.S. demand for Mo-99 could not be completed until December 1999. Therefore, the concept does not represent a near-term option to satisfy the purpose of and need for the proposed action. However, as mentioned earlier, DOE could phase out production of Mo-99 at such time as this or any other private source begins producing Mo-99 reliably.

3.5 Comparison of Alternatives

The tables at the end of this section comparatively summarize the reasonable alternatives analyzed in this FEIS in terms of their expected environmental impacts and other factors. Table 3-1 compares the environmental impacts of the alternatives, as discussed in detail in Section 5. Table 3-2 compares other aspects of the reasonable alternatives, such as facility operating parameters, estimated schedule, and other factors.

Table 3-1. Summary of Environmental Consequences and Comparison of Alternative

Consequence Category	Unit of Measure	Alternatives: SNL/NM-ACRR LANL/CMR	LANL OWR/CMR	ORNL ORRR/RDL	INEL PBF/TAN
Air Quality					
Dose from Radionuclide Emissions to Air (normal operations)					
Onsite Collocated Worker	mrem/yr				
Target Irradiation		0.00011	0.012	0.00036	0.0013
Target Processing		0.037	0.00015	0.022	0.29
Offsite Maximally Exposed Individual	mrem/yr				
Target Irradiation		0.00017	0.15	0.0040	0.0013
Target Processing		0.17	0.0042	0.31	0.13
Population Within 80 km (50 mi)	person-rem/yr				
Target Irradiation		0.023	0.63	0.41	0.011
Target Processing		13.0	0.032	15.	1.2
Risk of Latent Fatal Cancer[a]		0.007	0.0003	0.008	0.0006
Occupational Health and Safety					
Radiological Dose to Project Workers	person-rem/yr	22-25	9-12		
Risk of Latent Fatal Cancer[a]	-	0.01	0.005	(b)	(b)
Industrial Accidents-Illnesses and Injuries					
Construction	total incidence	6	6	7	6
Operations	annual incidence	2	1	2	2
Transportation					
Incident Free Transport (Annual Shipments of Targets, Products, and Waste)					
Radiological Dose	person-rem/yr	Total 76	75	49	76
Crew		24	23	23	23
Public		52	52	26	53
Risk of Latent Fatal Cancer[a]	-				
Crew		0.01	0.01	0.01	0.01
Public		0.03	0.03	0.01	0.03
Nonradiological Consequences Risk of Latent Fatal Cancer from Vehicle Emissions[a]	-	0.009	0.008	0.009	0.008

Table 3-1. (contd)

Consequence Category	Unit of Measure	Alternatives: SNL/NM-ACRR LANL/CMR	LANL OWR/CMR	ORNL ORRR/RDL	INEL PBF/TAN
Transportation Accidents (Ground and Air)					
Dose to Maximally Exposed Individual at 100 m (If accident occurs):	rem		Similar for all alternatives		
Unirradiated Targets		0.91			
Irradiated Targets		1.3			
Separated Mo-99		0.62			
Separated I-125		0.054			
Separated I-131		2.6			
Separated Xe-133		0.063			
Low-Level Waste		1.4×10^{-6}			
Collective Public Risk from Transportation Accidents Involving Radioactive Materials					
Risk of Latent Fatal Cancer[a]	-	2×10^{-5}	2×10^{-5}	1×10^{-5}	2×10^{-5}
Vehicle Accident Fatalities	-	0.01	0.01	0.02	0.01
Highest Consequence Facility Accidents					
Target Irradiation		Multiple Fuel Element Rupture	Fuel Melt	Fuel Melt	Fuel Melt
Accident Frequency	events/yr	5×10^{-5}	10^{-6} to 10^{-4}	10^{-6} to 10^{-4}	10^{-6} to 10^{-4}
Dose to Offsite Maximally Exposed Individual	rem				
Inhalation/External[c]		0.076	0.48	0.037	0.099
All Pathways[c]		0.20	5.7	0.42	1.6
Dose to Population Within 80 km (50 mi)	person-rem				
Inhalation/External[c]		150-2300	91-930	750-1400	20-170
All Pathways[c]		151-2350	91-940	5400-11000	900-7300
Latent Fatal Cancers (if accident occurs)	-	≤1	<1	<1 - 6	<1 - 4
Risk of Latent Fatal Cancer[a]		4×10^{-6} to 6×10^{-6}	5×10^{-6}	7×10^{-6} to 3×10^{-4}	9×10^{-7} to 4×10^{-5}
Target Processing		Mo-99 Target Process (Operator error)	Mo-99 Target Process (Operator error)	Mo-99 Target Process (Operator error)	I-125 Target Process (Operator error)
Accident Frequency	events/yr	1.0	1.0	1.0	0.1
Dose to Offsite Maximally Exposed Individual	rem				
Inhalation/External[c]		7.4×10^{-4}	8.9×10^{-3}	1.3×10^{-4}	3.1×10^{-5}
All Pathways[c]		7.4×10^{-4}	8.9×10^{-3}	1.3×10^{-4}	5.9×10^{-3}

Table 3.1. (contd)

Consequence Category	Unit of Measure	Alternatives SNL/NM-ACRR LANL/CMR	LANL OWR/CMR	ORNL ORRR/RDL	INEL PBF/TAN
Dose to Population Within 80 km (50 mi)	person-rem				
Inhalation/External[c]		2.6 - 32.	1.8 - 10.	2.5 - 4.8	0.0062 - 0.40
All Pathways[d]		2.6 - 32.	1.8 - 10.	2.5 - 4.8	0.38 - 1.2
Latent Fatal Cancers (If accident occurs)	-	<1	<1	<1	<1
Risk of Latent Fatal Cancer[e]		1×10^{-3} to 2×10^{-3}	5×10^{-4} to 9×10^{-4}	2×10^{-4} to 1×10^{-3}	3×10^{-7} to 2×10^{-5}
Resource Use - Construction					
Electricity	kilowatt-h	230	negligible	4	450
Concrete	cubic meters	1200	0	20	2400
Constructon Steel	tonnes	0.21	0	negligible	0.39
Stainless Steel	tonnes	1.0	0.2	3.5	1.5
Resource Use - Operation					
Water	1000 m³/yr	40	120	120	120
Electricity	megawatt-h/yr	400	500	500	500
Materials - Target Fabrication					
HEU	kg/yr	4-36[d]	3[d]	3-26[d]	3-26[d]
Stainless Steel	tonnes/yr	0.50	0.36	0.36	0.36
Chemicals - Isotope Recovery					
Sulfuric acid, 2N	liters	(e)	120	Same as LANL	
Sulfuric acid, 0.1N	liters		36		
Hydrochloric acid, Reagent grade	liters		1.2		
Nitric acid, reagent grade	liters		6		
Sodium hydroxide, 0.2N	liters		24		
Sodium iodide	grams		120		
Silver Nitrate	grams		600		
Benzoin-∝-oxine	kilograms		2.4		
Molybdenum trioxide	grams		24		
Potassium permanganate	grams		100		
Rhodium trichloride	grams		24		
Potassium hexachlororuthenate	grams		24		
Hydrogen peroxide	liters		2.4		
Calcium oxide	liters		12		
Calcium sulfate "drierite"	liters		36		
Molecular sieve type 13X	liters		36		
Reactor Fuel					
Kilograms of uranium used in fuel	kilograms U/yr	16	32	32	32

Table 3.1. (contd)

Consequence Category	Unit of Measure	Alternatives: SNL/NM-ACRR LANL/CMR	LANL OWR/CMR	ORNL ORRR/RDL	INEL PBF/TAN
Operational Wastes					
Low-Level Radioactive Liquid	cubic meters/yr	7.3[f]	5.2[f]	5.2[f]	5.2
Low-Level Radioactive Solid	cubic meters/yr	49	17.6	68	80
Socioeconomics					
Primary Employment					
Construction/Modifications	worker-years	92	92	113	97
Routine Operations	workers	59	45	62	59
Costs					
Construction/Modifications	million dollars	19.6	19.6	21.0[g]	17.2
Routine Operations	million dollars	12.8	11.0	9.6[g]	8.4[g]

(a) Radiological risk from normal operations or accidents is calculated as the latent cancer fatalities that might result if a radiological exposure occurred, multiplied by the estimated frequency of the event. The risk for normal operation assumes a frequency of 1.0 (i.e., the exposure is assumed to occur), whereas the risk for accidents is estimated using the combined frequency of the accident and the assumed atmospheric conditions (if applicable) for a particular accident scenario. Where the risk of latent fatal cancer is less than 1, no cancers would be expected to result from a year of operation.

(b) Operational doses for ORNL and INEL are assumed to fall within the range of those estimated for SNL and LANL.

(c) Accident consequences are conservative estimates that assume no protective actions are taken for offsite members of the public. The "Inhalation/External" pathway results correspond to a hypothetical release during a season when no agricultural products for human or animal consumption are growing. The "All Pathways" results correspond to a hypothetical release just before harvest, thereby maximizing the potential consequences of ingesting contaminated food. Neither analysis assumes protective action such as evacuation, sheltering, or interdiction of contaminated food products for the public.

(d) Minimum values assume 90% recovery of HEU after isotope extraction. Uranium recovery would occur at LANL, and could be implemented at other sites. However, consequence analyses presented in Section 5 do not assume uranium recovery at other sites other than LANL.

(e) Consumption of chemicals for target processing assumes irradiation of targets to a power of 20 kW. At SNL/NM, production rates corresponding to 100% replacement of U.S. needs would likely require processing of a greater number of targets at lower power. In that case, the quantity of chemicals used to process the targets would increase by about 40%.

(f) Liquid waste volume is before solidification. Liquid wastes would be solidified at indicated sites prior to disposal.
ACRR - Annular Core Research Reactor; CMR - Chemistry and Metallurgy Research Facility; ORRR - Oak Ridge Research Reactor; OWR - Omega West Reactor; RDL - Radioisotope Development Laboratory; TRA - Test Reactor Area.

(g) As explained in Section 5.22, the cost estimates for ORNL and INEL are expected to contain greater than those presented for SNL/NM and LANL.

Table 3-2. Comparison of Alternatives for Mo-99 Production at 100% Production

Comparison Category	Unit of Measure	Alternatives			
		SNL/NM-ACRR LANL-CMR	LANL OWR/CMR	ORNL ORRR/RDL	INEL PBF/TAN
Reactor Parameters					
Reactor Power	MW	Approx. 3 MW	8	10	8
Neutron Flux	n/cm²-s	$8x10^{15}$	$1x10^{14}$	$4x10^{13}$	$3.7x10^{13}$
Reactor and Target Cooling		Natural convection	Forced convection (Natural convection ≤ 0.5 MW)	Forced convection	Forced convection
Fuel Utilization	1.052 gms U-235 per MWD for all sites	56 TRIGA elements/yr (3.73 cm dia, 75 cm long)	29 fuel elements/yr (7.6 x 7.7cm x 86 cm)	36 fuel elements/yr (slightly larger than OWR)	19 bundles/yr (14.7 cm x 14.7 cm x 80 cm)
Spent Nuclear Fuel Storage Capacity	elements	300 elements current capacity. Expansion to 1000 elements possible through installation of additional spent nuclear fuel racks.	1091 elements	984 elements	786 bundles
Current Status		Operational	Shut down	Shut down	Standby
Target Power Level	kW				
No. of Irradiation Targets Possible		19 at 21 kW at partial production 37 at 16 kW at full production	16 (1st phase) 36 (2nd phase)	Up to 40, to be minimized	19
Target Transport		Short distance (hundreds of ft) closed but unsealed cask	Four miles, sealed casks	Short distance (hundreds of ft) sealed cask	Several miles, sealed cask
Hot Cells After Irradiation		Current hot cells at SNL/NM about 2,000 Ci @ 1 MeV, 5 bays, not completely segregated, would only be used for testing/startup and some initial production. New hot cells required for full production. Planned for 100,000 Ci @ 1 MeV, 1 cell, 5 segregated bays. Upgrade to hot cell ventilation reqd for operation. Current is single-train, single-stage filtration. Planned for single-state series parallel HEPA and charcoal bed.	No major modifications needed. 16 cells, 100,000 Ci, 2 small cells at each end for packaging. Series-parallel ventilation as follows: HEPA-charcoal bed-HEPA-Holdup volume-two-stage charcoal beds-two-stage HEPA.	No major modifications needed. 4 cells, 100,000 Ci. Series-parallel vnetilation, single-stage HEPA and charcoal beds.	Cells are adequate, but would require minor modifications. Test Area North has 4 cells, 100,000 Ci, series parallel ventilation.
Schedule (from date of record of decision)		6 months from ROD to initial production 28 months from ROD to full production.	13 months from ROD to initial production 20 months from ROD to full production	24 months from ROD to initial production 30 months from ROD to full production	22 months from ROD to initial production 28 months from ROD to full production

Table 3-2. (contd)

Comparison Category	Unit of Measure	Alternatives: SNL/NM-ACRR LANL-CMR	LANL OWR/CMR	ORNL ORRR/RDL	INEL PBF/TAN
Waste Management		Low-level waste stored onsite until shipment for disposal at Nevada Test Site. Liquids solidified.	Cradle-to-grave waste management. No shipping, all waste disposed at LANL facilities. Solid waste crusher minimizes volume. Liquids solidified.	Low-level waste stored onsite until shipment for disposal at Nevada Test Site. Liquids solidification.	Cradle-to-grave waste management. No shipping, all waste disposed at INEL facilities. Liquid low-level waste treated and stored onsite.
Isotope Production History on Site		None	50 years isotope production experience. 20 years medical isotope production experience. Received FDA official certification of "Drug Establishment" in August 1991.	50 years isotope production experience. 50 years medical isotope production experience. Received FDA official certification of "Drug Establishment" in August 1991.	35 years isotope production experience.
Other Issues		DOE Preferred Alternative. Must maintain ACRR to be available to DOE Defense Programs to utilize in times of national emergency to address national security concerns.	Many redundant hot cells for online backup. Target fabrication process developed and in place at LANL. Uranium recovery from target wastes established from previous programs.		PBF lease agreement in place Idaho Brain Tumor Center for Boron Neutron Capture Therapy. Idaho Brain Tumor Center interested in shared cost venture.

ACRR - Annular Core Research Reactor; CMR - Chemistry and Metallurgy Research Facility; ORRR - Oak Ridge Research Reactor; OWR - Omega West Reactor; RDL - Radioisotope Development Laboratory; PBF - Power Burst Facility; TAN - Test Area North; ROD - record of decision.

4.0 Affected Environment

This section describes the affected environment at each of the alternative sites being considered for the production of molybdenum-99 (Mo-99). Aspects of the affected environment discussed include land use, socioeconomic environment, cultural resources, aesthetic and scenic resources, geologic resources, air quality, water quality, ecological resources, noise, transportation, occupational and public health and safety, site services, and waste management.

For the reader's convenience, discussion of each of the four alternative sites begins with an overview of the site. Further detail is then provided in subsequent sections where such detail is necessary or appropriate for explaining environmental impacts. Additional descriptive information for each site can be found in referenced source documents.

4.1 Sandia National Laboratories—Albuquerque

4.1.1 Overview

This overview section describes the affected environment for the Annular Core Research Reactor and associated hot cell facilities that are located in Technical Area V within Sandia National Laboratories/New Mexico (SNL/NM) on Kirtland Air Force Base in Albuquerque, New Mexico.

The city of Albuquerque is located in Bernalillo County in north-central New Mexico (Figure 4-1). ₐne Sandia Mountains rise steeply immediately north and east of the city, and the Manzano Mountains are to the southeast. The Rio Grande runs southward through Albuquerque and is the major river traversing central New Mexico.

Major transportation services are provided by the Albuquerque International Airport and interstate highways I-40 and I-25. Other significant regional highways include U.S. 60 and U.S. 285.

The closest Native American population is about 13 km (8 mi) southwest of the Annular Core Research Reactor site. All other areas within a radius of 6.0 km (3.7 mi) are under the control of SNL/NM, except a small area immediately east of SNL/NM, which is within the Albuquerque city limits. The Annular Core Research Reactor is an existing facility within a developed area, and no archaeological or Native American resource properties would be affected by use or upgrade of this reactor. The facility is unlikely to be eligible for inclusion on the National Register of Historic Places.

Seismically, the Albuquerque area is characterized as a region of high activity but relatively low magnitude and intensity. Statistical studies show that a nondamaging earthquake (Modified Mercalli Intensity less than III) may be expected every 2 years, with a damaging event every 100 years.

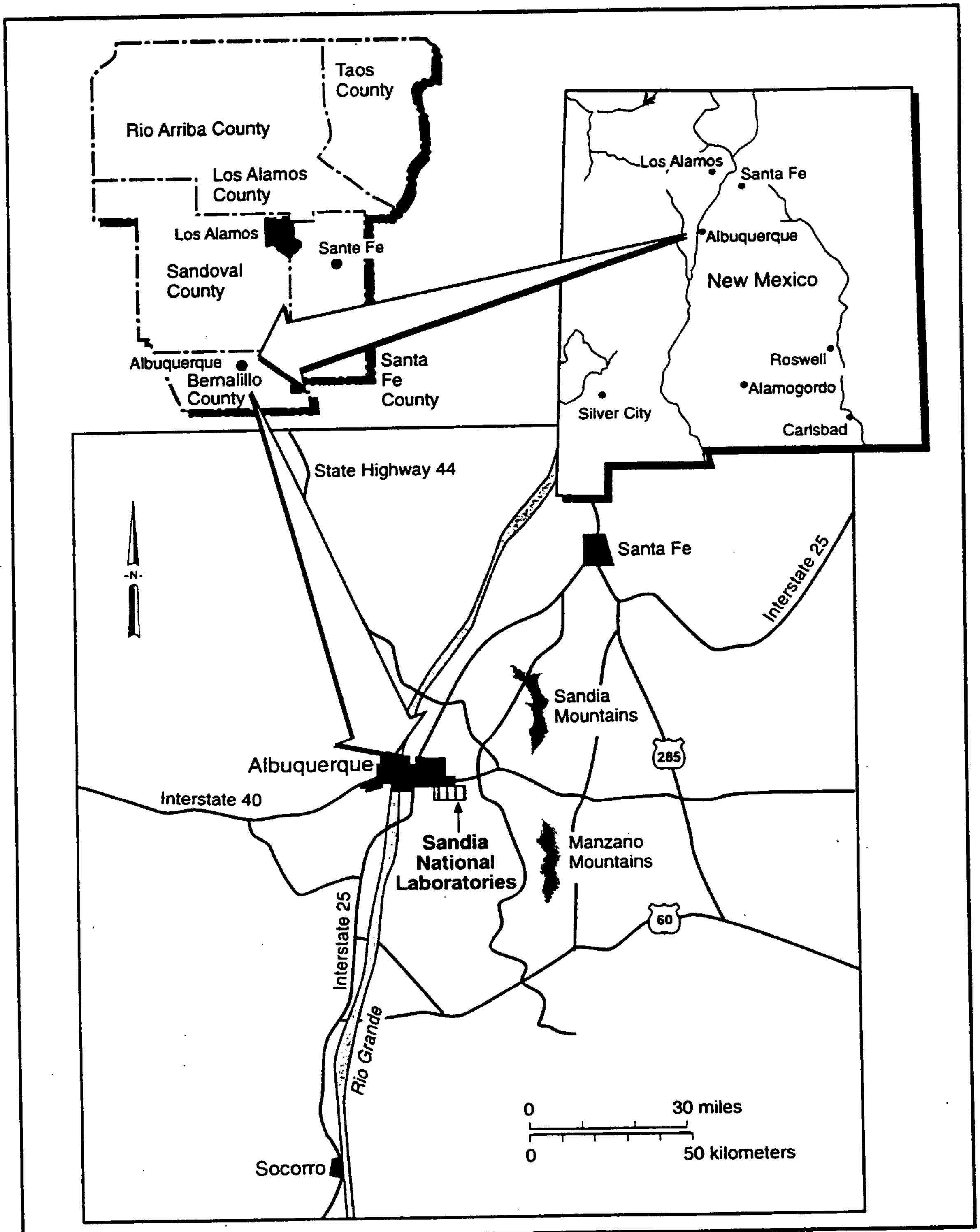

Figure 4-1. Location of Albuquerque, New Mexico and Surrounding Areas

The total 1993 population dose within an 80-km (50-mi) radius surrounding SNL/NM was calculated to be 0.027 person-rem from SNL/NM operations, compared with 57,000 person-rem from external exposure to natural background radiation. Current operation of the Annular Core Research Reactor releases approximately 218 Ci/yr of argon-41. The dose calculated for maximum capacity is less than 0.1 mrem/yr to the maximally exposed individual at the KAFB.

The SNL/NM produces low-level radioactive and low-level mixed waste. These wastes are generated at SNL/NM in technical and remote test areas as the result of research, development, and technology activities. Low-level mixed wastes at SNL/NM include radioactively contaminated oils and solvents, radioactively contaminated or activated lead, or other heavy metals.

4.1.2 Land Use

4.1.2.1 Albuquerque Area

The Albuquerque metropolitan area is divided into quadrants, with the city occupying all land from the southwest quadrant clockwise through the northeast quadrant. Resources and facilities within Albuquerque include the University of New Mexico and other post-secondary schools, numerous shopping and residential areas, several museums, and recreational areas along the Rio Grande and within the nearby mountains. Major transportation services are provided by the Albuquerque International Airport and Interstates 40 and 25. Adjacent to the city, in the southeast quadrant, is KAFB, which includes the SNL/NM. KAFB shares runways and other flight facilities with the Albuquerque International Airport. Nearby communities include Rio Rancho and Corrales to the northwest, Sandia Pueblo to the north, and Isleta Pueblo, Los Lunas, and Belen to the south.

4.1.2.2 Sandia National Laboratories

The SNL/NM is located on DOE-owned land within the KAFB installation (Figure 4-2) and covers approximately 210 km^2 (81 mi^2). The SNL/NM facilities occupy about 96 km^2 (37 mi^2), of which 11.3 km^2 (4.4 mi^2) are DOE-owned land.

Research activities at SNL/NM are organized by function and are centered within one or more of the five technical areas and one test area that have been established. These areas and uses are

- Technical Area I: Administration, site support, technical support, component development, research, energy programs, microelectronics, defense programs, and exploratory systems.

- Technical Area II: Testing of explosive components. See figures in Section 4.1.11.1.

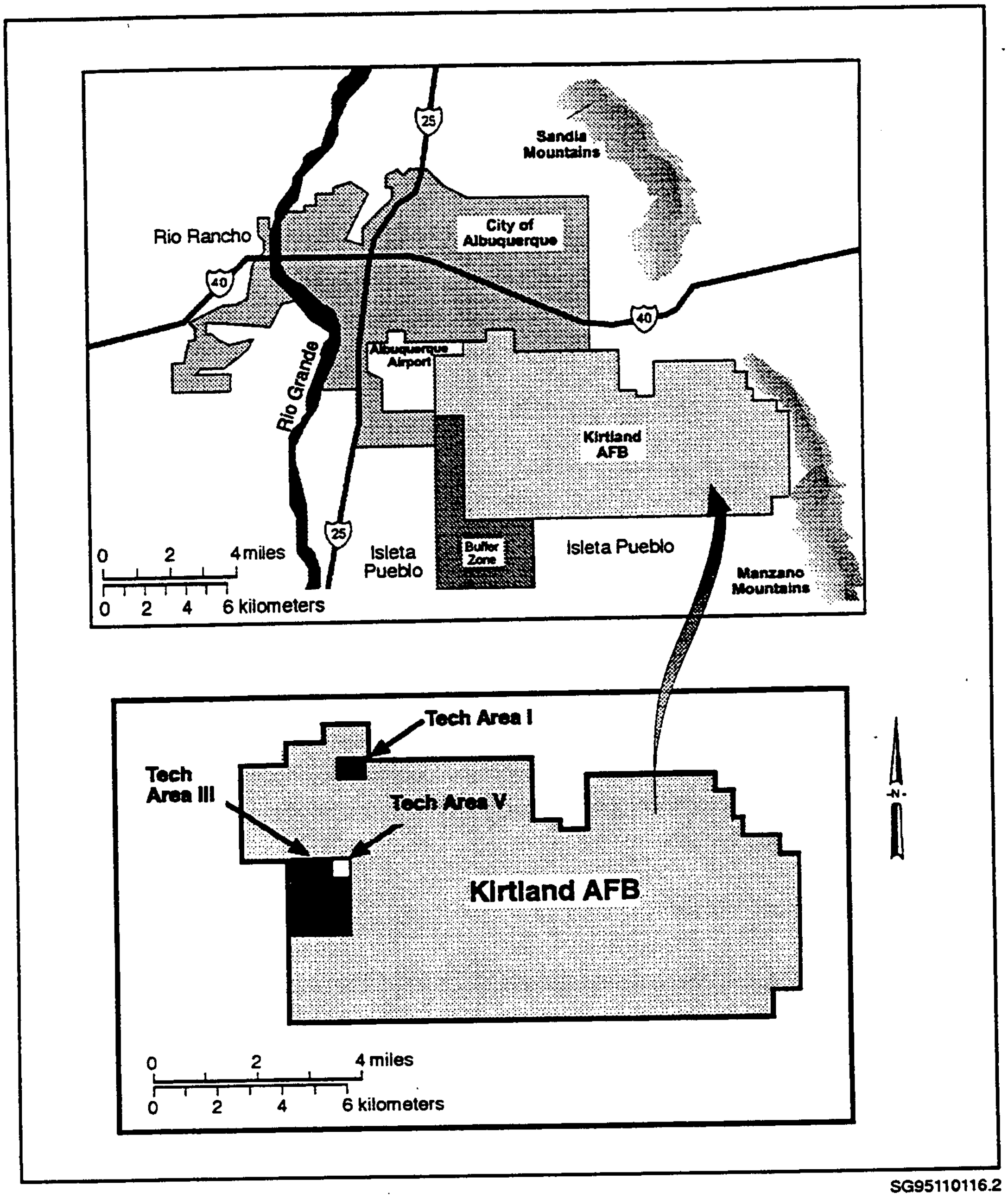

Figure 4-2. Location of Technical Areas Within KAFB and Sandia National Laboratories

- Technical Area IV: Applied pulsed-power sciences, such as x-ray, gamma-ray, and particle-beam fusion accelerators that are used to simulate nuclear weapon effects; research on inertial-confinement fusion and particle-beam weapons. See figures in Section 4.1.11.1.

- Technical Area V: Research and testing of various materials, such as electronics, in a nuclear environment provided by low-power nuclear reactors. The Annular Core Research Reactor and associated hot cells are located within this area.

- Coyote Test Field: Various test activities on land parcels scattered throughout Coyote Test Field. These parcels are on 1- to 5-year land-use permits from the U.S. Air Force.

4.1.2.3 Technical Area V

Technical Area V, which contains the Annular Core Research Reactor, slopes toward the Rio Grande and is situated on a slight ridge that has numerous small canyons (arroyos). One arroyo of significance, Arroyo del Coyote, is about 0.8 km (0.5 mi) east of the complex, running southeast to northwest and emptying into Tijeras Arroyo. About 3 km (1.9 mi) to the north of Technical Area V, the topography is dominated by Tijeras Canyon. Routine access to the Technical Area V complex is provided by a paved road from Pennsylvania Street. Normal access to the area can be restricted. The shortest distance between the city limits and the Technical Area V complex is about 2 km (1.2 mi) (Massey and Coats 1995).

4.1.3 Socioeconomic Environment

4.1.3.1 Demographic Characteristics

The population center of major concern is metropolitan Albuquerque. The 1993 U.S. Department of Commerce figures indicate 506,700 people live in Bernalillo County. The majority of the population in the county is white, accounting for 76.8% of the total, with 3.4% Native Americans, 2.8% Black, 1.6% Asian, and 15.4% various other origins. People of Hispanic origin of all races account for 37.1% of the total population. Approximately 63% of the population is between 18 and 65 years of age, while 26% is under 18 years of age. Over 80% of the population has a high school education, and 26% has a college degree.

The 1990 median household income for Bernalillo County was $27,382 and 1990 per capita income was $19,854. The county's median household income is just below the state average of $27,623. Approximately 10.9% of the total number of families in Bernalillo County lived under the poverty line at the time of the 1990 census.

4.1.3.2 Economic Base

The SNL/NM is located in a major metropolitan area surrounded by a local economy that has generated an increasingly higher level of personal income. Total personal income has grown by 22.7%

from 1990 to 1993 to a total annual of $10.06 billion. By far, the largest contributor to personal income has been the services industry, accounting for 28% of the total, followed by government and government enterprises at 17%. The rest of the sectors of the economy are below the 10% level. During the same period, significant growth was experienced by various other sectors. For example, in 1993 the mining industry generated $7.2 million dollars, which represented a 58% increase over its 1990 level. At the same time, the construction, services, and retail trade sectors experienced growth rates greater than 25%.

The private sector accounts for 63% of total income generated; the remaining 37% comes from the federal civilian, military, government and government enterprises, and state and local government sectors. Within the governmental sectors, the largest contributor is government and government enterprises with 50% of this share.

Total 1993 employment in Bernalillo County was estimated at 336,688 jobs, representing an average growth of 7% from 1990. SNL/NM is a major source of employment in Bernalillo County. In 1993, of the total labor force employed in Bernalillo County, 86% were salaried employees. The services industry was the largest employer, accounting for 33% of the total (see Table 4-1). Total unemployment was recorded at 5.2% in 1991.

Table 4-1. Employment by Major Industry for Bernalillo County (number of jobs)

Sector	1990	1993
Agriculture, Forestry, Fishery Services	1,902	2,064
Mining	1,180	1,074
Construction	16,688	19,461
Manufacturing	22,990	23,676
Transportation and Public Utilities	13,842	13,852
Wholesale Trade	15,999	17,033
Retail Trade	54,832	58,999
Finance, Insurance, and Real Estate	24,885	24,477
Services	100,517	112,283
Government and Government Enterprises	61,428	63,081
Federal, Civilian	14,087	14,489
Military	7,567	7,200
State and Local	39,774	41,392
(a) Source: DOC 1994d.		

4.1.4 Cultural Resources

Because the Annular Core Research Reactor is an existing facility in a greatly modified landscape, no archaeological or Native American resource properties would be affected by the upgrade or use of this reactor. The facility itself was originally constructed in 1967 and now houses a second-generation reactor that replaced a predecessor. Because of a lack of the original integrity and its relatively recent vintage, the facility is an unlikely candidate for inclusion on the National Register of Historic Places.

4.1.5 Aesthetic and Scenic Resources

The topography of the Albuquerque area and the proximity of the Sandia and Manzano mountains afford a nearly unrestricted view of mountain scenery from Albuquerque. The view to the south from the city consists partially of KAFB, Albuquerque International Airport, and SNL/NM facilities, as well as some open rangeland. Development of the U.S. Air Force and SNL/NM facilities has had a significant impact on the landscape south of Albuquerque.

4.1.6 Geologic Resources

This section summarizes the physiography, geology, and seismic hazards at the SNL/NM. A more detailed summary of these subjects can be found in SNLA (1993a).

4.1.6.1 General Geology

Physiography. The SNL/NM is contained entirely within the boundaries of the KAFB. The KAFB is located on the eastern edge of the Albuquerque-Belen Basin, one of the largest of a series of north-south aligned basins in the Rio Grande trough (Figure 4-3). Elevations range from 1500 m (4920 ft) at the Rio Grande River to 2435 m (7988 ft) at the Manzano Lookout Tower in the Manzano Mountains. The western two-thirds of the area is relatively flat, sloping gently westward toward the Rio Grande.

Geology. A detailed description of the geology of this area is found in SNLA (1990, 1993a).

Structure. SNL/NM and KAFB lie directly over the intersection of several major faults along the eastern boundary of the Albuquerque-Belen Basin (SNLA 1993c). These fault systems include the Manzano, Hubbell Springs, Sandia, and Tijeras faults (Figure 4-4). For more detailed information, refer to SNLA (1993b and 1993a).

Soils. Well-drained loamy soils dominate throughout the Albuquerque Basin, with minor amounts of gravelly and stony soils along arroyos and on mountains (SNLA 1993a). Description of the soil associations in Bernalillo County and parts of Sandoval and Valencia counties, New Mexico, can be found in USDA-SCS (1977).

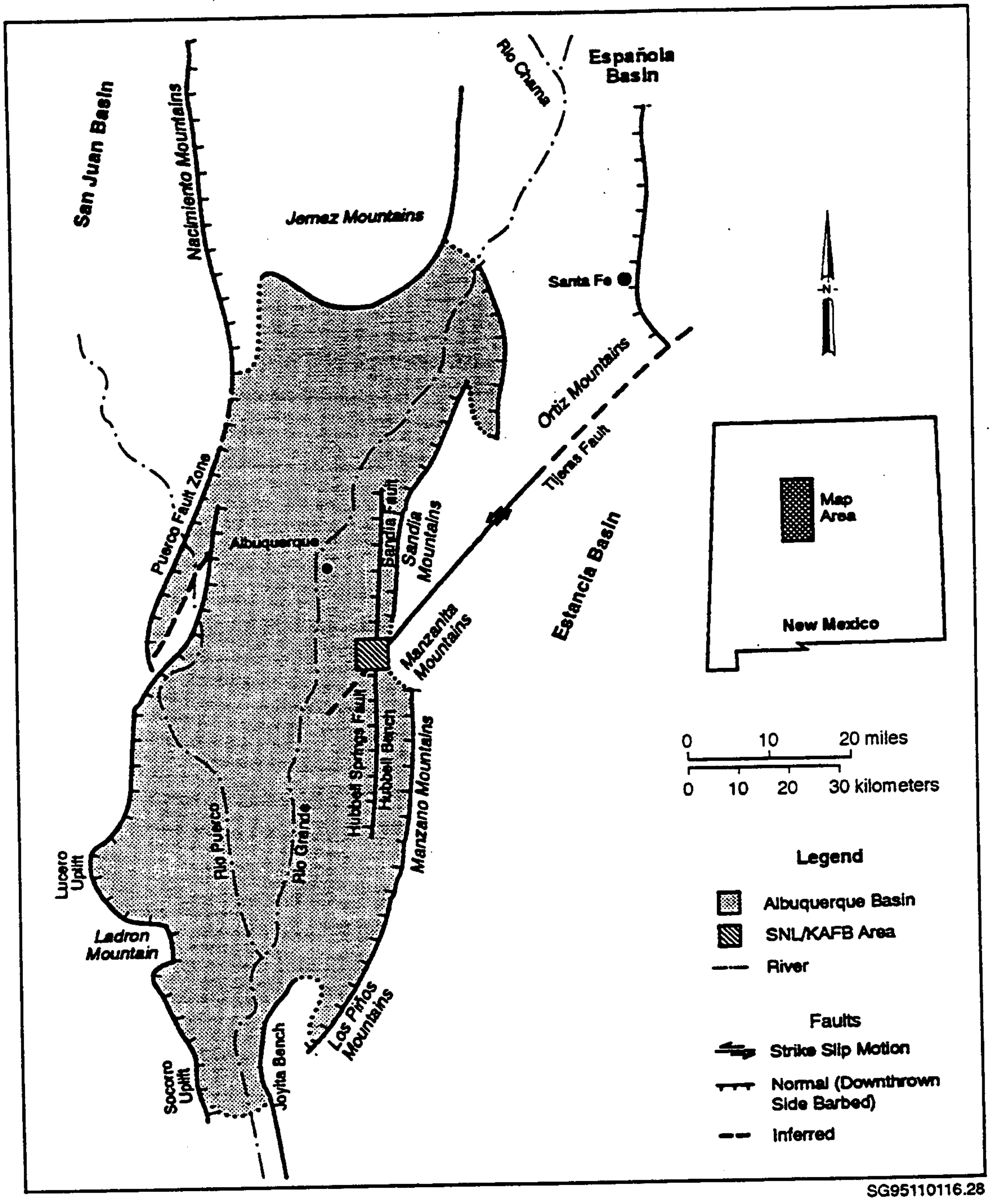

Figure 4-3. Location of the Albuquerque-Belen Basin (SNLA 1993a)

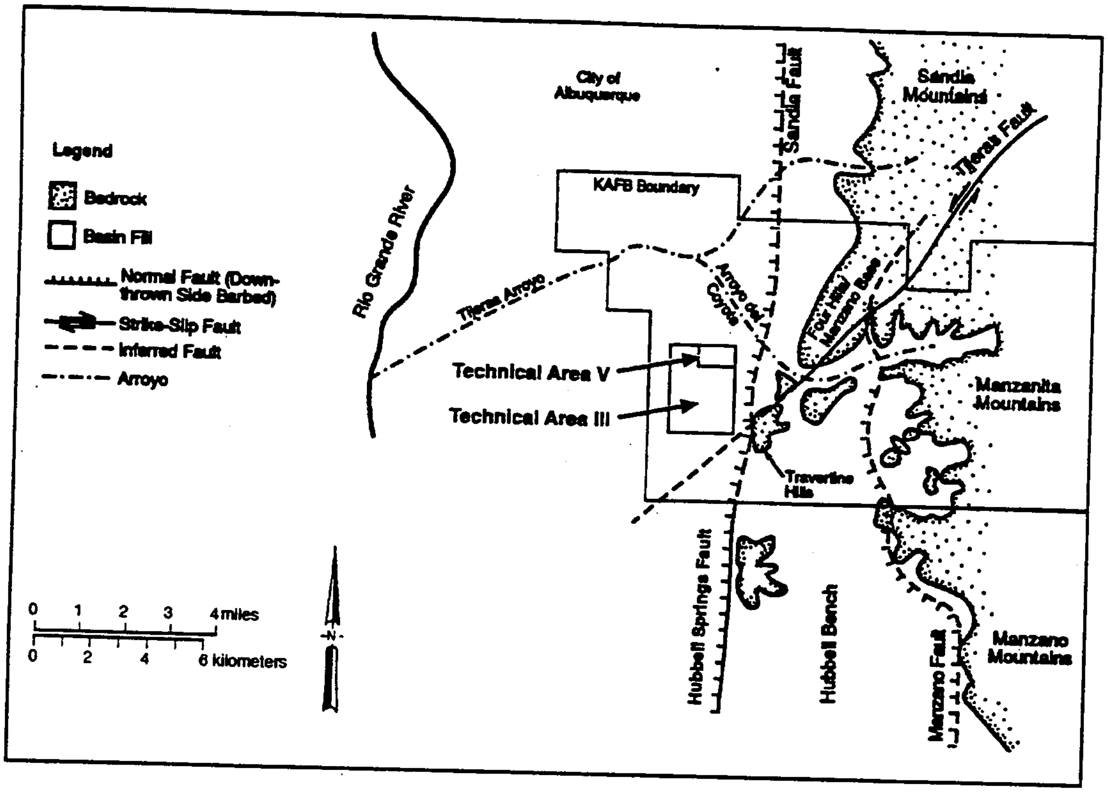

Figure 4-4. Fault Zones Near Sandia National Laboratories/New Mexico (SNLA 1993b)

4.1.6.2 Mineral Resources

Sand and gravel deposits are ubiquitous to the Albuquerque-Belen Basin. The known resources exposed on the SNL/KAFB are limited to industrial minerals, primarily quarry sands and gravels.

4.1.6.3 Site Stability

SNL/KAFB lies in the Uniform Building Code 2B seismic hazard area (DOE 1995b). This classification implies frequent moderate damage that corresponds to a Richter scale magnitude of 5 to 6. Horizontal accelerations that are typical of these magnitudes range from 0.07 to 0.3 g. Seismically, the Albuquerque area is characterized as a region of high activity but relatively low magnitude and intensity and has been relatively stable for a long period of time. For more information on seismicity, refer to DOE (1993a), Massey and Coats (1995).

4.1.7 Air Quality

The climate and meteorology of the site are typical of a high desert plateau (Culp et al. 1993). A brief characterization of the climate is presented in Appendix D.

4.1.7.1 Nonradiological Air Quality

The SNL/NM is located within the Albuquerque-Mid Rio Grande New Mexico Intrastate Air Quality Control Region (DOE 1993b). Ambient air quality is regulated by the Albuquerque/Bernalillo County Air Quality Control Board (SNLA 1993b), which also monitors compliance with federal and state air quality regulations. Air quality in the city of Albuquerque is generally good.

During many winter nights (those characterized by clear skies and light winds), a low-level atmospheric inversion can form, trapping pollutants near the surface in the metropolitan area. This inversion can create periods of poor air quality. Pollutant emissions of carbon monoxide (CO) and particulate matter (PM_{10}) can be a concern under these conditions.

Primary sources of these pollutants are mobile vehicle exhaust and woodburning (DOE 1993a). Carbon monoxide levels have exceeded U.S. Environmental Protection Agency ambient air quality standards (40 CFR 81.332) on occasion. Visibility degradation can also be a problem in the region (SNLA 1987).

Air quality under ambient conditions at SNL/NM is shown in Table 4-2. This table compares SNL/NM maximum ambient background concentrations in air with the most stringent Ambient Air Quality Standards. Data on maximum background concentrations are from air quality monitoring in the vicinity of SNL/NM during 1991 and 1994. With the exception of ozone, baseline air quality concentrations at SNL/NM do not exceed any applicable guidelines or regulations. Principal sources of criteria air pollutants at SNL/NM are the steam plant, paint shops, toxic machine shop, process development laboratory, and the emergency diesel generator plant at Technical Area I. Explosives testing at Technical Area II is also a significant source (DOE 1993a). Other emissions include fugitive particulate emissions from waste-burial activities, other process emissions, vehicular emissions, and temporary emissions from various construction activities.

4.1.7.2 Radiological Air Quality

Calculations indicate that small quantities of hydrogen, nitrogen, oxygen, argon, krypton, and xenon were released to the atmosphere as a result of SNL/NM 1993 operations. Eight facilities at SNL/NM reported releases of airborne radionuclides during 1993 (Culp et al. 1994). A total of 3.2 Ci of argon, 0.62 Ci of nitrogen, 0.012 Ci of oxygen, and 1.9 Ci of hydrogen were released as a result of SNL/NM activities in 1993. The radioactive air emissions at SNL/NM were so small, they were not measurable with the existing monitors at those facilities. Therefore, the radionuclide release data are calculated based on

Table 4-2. Comparison of Air Quality Standards and Maximum Concentrations at Sandia National Laboratories

Pollutant	Averaging Time	Most Stringent Regulation or Guideline (μg/m³)	Maximum Background Concentration (μg/m³)[a]
Carbon Monoxide (CO)	8-h 1-h	10,000[b] 15,000[b]	7600[c] 13,700
Hydrogen Sulfide (H_2S)	1-h	14[b]	(d)
Lead (Pb)	Calendar qtr. 30-Day	1.5[f] 3.0[j]	(d) 0.084[i]
Nitrogen Dioxide (NO_2)	Annual 24-h	94[b] 188[b]	(g) 77[i]
Ozone (O_3)	1-h	118[b]	192[c]/96[i]
Particulate Matter (PM_{10})[h]	Annual 24-h	50[f] 150[f]	36[c] 104[c]/66[i]
Sulfur Dioxide (SO_2)	Annual 24-h 3-h	52[b] 262[b] 1300[f]	4[i] 16[i] 22[i]
Total Reduced Sulfur	1-h	4[b]	(d)
Total Suspended Particulates	Annual 30-d 7-d 24-h	60[b] 90[b] 110[b] 150[b]	(d) (d) (d) (d)
Hazardous Air Pollutants and Other Toxic Compounds:			
1,1,1-Trichloroethane	8-h	1	(d)
Acetone	8-h	5900[b]	(d)
Amyl Acetate	8-h	5300[b]	(d)
Hydrogen Chloride	8-h	70[b]	(d)
Isopropyl Acetate	8-h	9500[b]	(d)
Isopropyl Alcohol	8-h	9800[b]	(d)
Methyl Alcohol	8-h	2600[b]	(d)
Methylene Chloride	8-h	2610[b]	(d)
Toluene	8-h	3750[b]	(d)
Trichloroethylene	8-h	250[b]	(d)
Trichlorotrifluoroethane	8-h	1	(d)
Xylene	8-h	4350[b]	(d)

(a) Maximum of the concentrations as provided from the ambient air quality network
(b) State standard (20 NMAC)
(c) Ambient air quality monitoring data for 1991
(d) Data unavailable
(e) Not estimated because potential release is negligible
(f) Federal standard (40 CFR 50)
(g) Data not representative
(h) Particulate matter less than 10 microns in diameter
(I) Ambient air quality monitoring for 1994 from the SNL/NM Clean Air Network
(j) City of Albuquerque/Bernalillo County Ambient Air Quality Standard (20 NAMC 11.01) December 1, 1995

theoretical parameters, such as reactor operating power and the generation rates per unit power for activation products and noble gases (such as argon) from the reactors in Technical Area V.

4.1.8 Water Quality

This section summarizes the surface water and groundwater resources at SNL/NM. Additional information is available in SNLA (1993b and 1993a).

4.1.8.1 Surface Water

The major surface water feature of the Albuquerque area is the Rio Grande, which flows southward with an annual average flow of 9.0 x 10^9 m^3 (730,000 acre-feet) (SNLA 1993c). The Rio Grande is located approximately 11 km (7 mi) west of SNL/KAFB. The major surface drainage feature is the Tijeras Arroyo, which flows westward from the Sandia and Manzano mountains to the Rio Grande. Arroyo del Coyote, Tijeras Arroyo, and all other surface water features at SNL/KAFB are ephemeral streams, with the exception of small portions of Arroyo del Coyote, near Coyote Springs, and G Spring, which are intermittent.

Floods in the Albuquerque area usually occur between May and October during high-intensity thunderstorms (SNLA 1993c). During heavy precipitation, the arroyos effectively collect runoff from the mountains and divert surface flow away from the area. Floods in Tijeras Arroyo and Arroyo del Coyote are characterized by high peak flows, small volumes, and short durations. The heaviest precipitation to date in this area has not produced general flooding in Technical Area V, which is the location of the Annular Core Research Reactor.

4.1.8.2 Groundwater

The hydrogeology within the vicinity of the Annular Core Research Reactor east of the faults is poorly understood because there are few wells, and the geology between the faults and the canyons of the Manzanita Mountains is complex (DOE 1988). The valley floor consists of unconsolidated and semi-consolidated sands, gravels, silts, and clays of the Santa Fe Formation (SNLA 1993c).

4.1.9 Ecological Resources

The Annular Core Research Reactor is located in a highly developed area. Consequently, few natural ecological features in the immediate area would be affected by the proposed activities; therefore, only a brief discussion of ecological resources is provided.

4.1.9.1 Terrestrial Resources

The semidesert southwest climate combines with the low water availability to produce many species of drought resistant plants, such as cacti and other xerophytes. The mesa vegetation on KAFB consists mostly of grasses and shrubs and is typical of that found in similar habitats in central New Mexico. The size and diversity of wildlife populations is thought to be limited by the poor availability of water (DOE 93a). Higher elevations contain juniper (*Juniperus spp.)* trees and cacti. Disturbed areas are often ..ivaded by Russian thistle (*Salsola kali*) (Culp et al. 1992).

4.1.9.2 Aquatic Resources

Naturally occurring permanent surface water bodies are found in several locations in KAFB, but outside of SNL/NM Technical Areas. The most significant springs include Coyote Springs, Sol se Mete Spring, and G Spring (DOE 1995h). The largest of these is only a few acres in extent (Fischer 1990). Some artificial ponds are also found within KAFB. Lake Christian is an 0.8-hectare (2-acre) permanent pond adjacent to a KAFB testing facility 1.6 km (1 mi) northeast of the Inhalation Toxicology Research Institute (DOE 1995h). Permanent ponds are also found on the golf course, 1.6 km (1 mi) southeast of Technical Area IV.

4.1.9.3 Wetlands

A wetland inventory of SNL/NM has been conducted by KAFB. Coyote Springs, Sol se mete Spring, and G Spring provide the most significant areas of natural wetlands within KAFB (Fischer 1990). Coyote Springs supports a number of cottonwoods and saltcedars, cattails, rushes, and wetland grasses. The other springs are located in canyons above Coyote Springs. These have been partially developed and are not associated with significant wetland habitat, although they do provide a water source for local wildlife.

Some artificial ponds also provide wetland-like habitats. These ponds may be used by migratory .erfowl in the spring and fall.

4.1.9.4 Threatened and Endangered Species

No federally listed threatened or endangered species are known to occur on SNL/NM (DOE 1993a; Fischer 1990). Grama grass cactus (*Pediocactus papyracanthus*), a federal candidate and state-listed endangered species, has been reported in grasslands on KAFB. The peregrine falcon (*Falco peregrinus*) and the spotted bat (*Euderma maculatum*), both federal candidate and state-listed endangered species, could potentially occur in the mountainous areas of KAFB surrounding SNL/NM, but the likelihood is low because of the poor quality habitat for these species.

4.1.10 Noise

The potential for noise to result in community complaints depends on terrain, vegetation, and existing noise levels. In undeveloped areas, noise levels may range from 30 to 40 dB(A). At industrial locations, background noise levels range from 50 to 70 dB(A) and are largely influenced by traffic. Community noise regulations apply at the site or facility boundary. Background noise levels for the Annular Core Research Reactor are dominated by traffic and industrial activities.

4.1.11 Transportation

This section describes the regional and local transportation infrastructure affected by the alternatives involving SNL/NM. Included are descriptions of the highway and air transportation infrastructure that would be used to support production of Mo-99 at SNL/NM. No rail shipments are planned at SNL/NM to support production of Mo-99.

4.1.11.1 Roadways

Regional and local transportation routes are shown in Figures 4-5 and 4-6. Interstate 40 runs approximately east-west through Albuquerque and is approximately 1.6 km (1 mi) north of the SNL/NM site boundary at its nearest approach. Interstate 25 runs approximately north-south and is approximately 2.6 km (1.6 mi) west of the SNL/NM site boundary at its nearest approach. Other significant regional highways include U.S. 60, approximately 40 km (25 mi) south of SNL/NM, and U.S. 285, approximately 44 km (28 mi) east of the site.

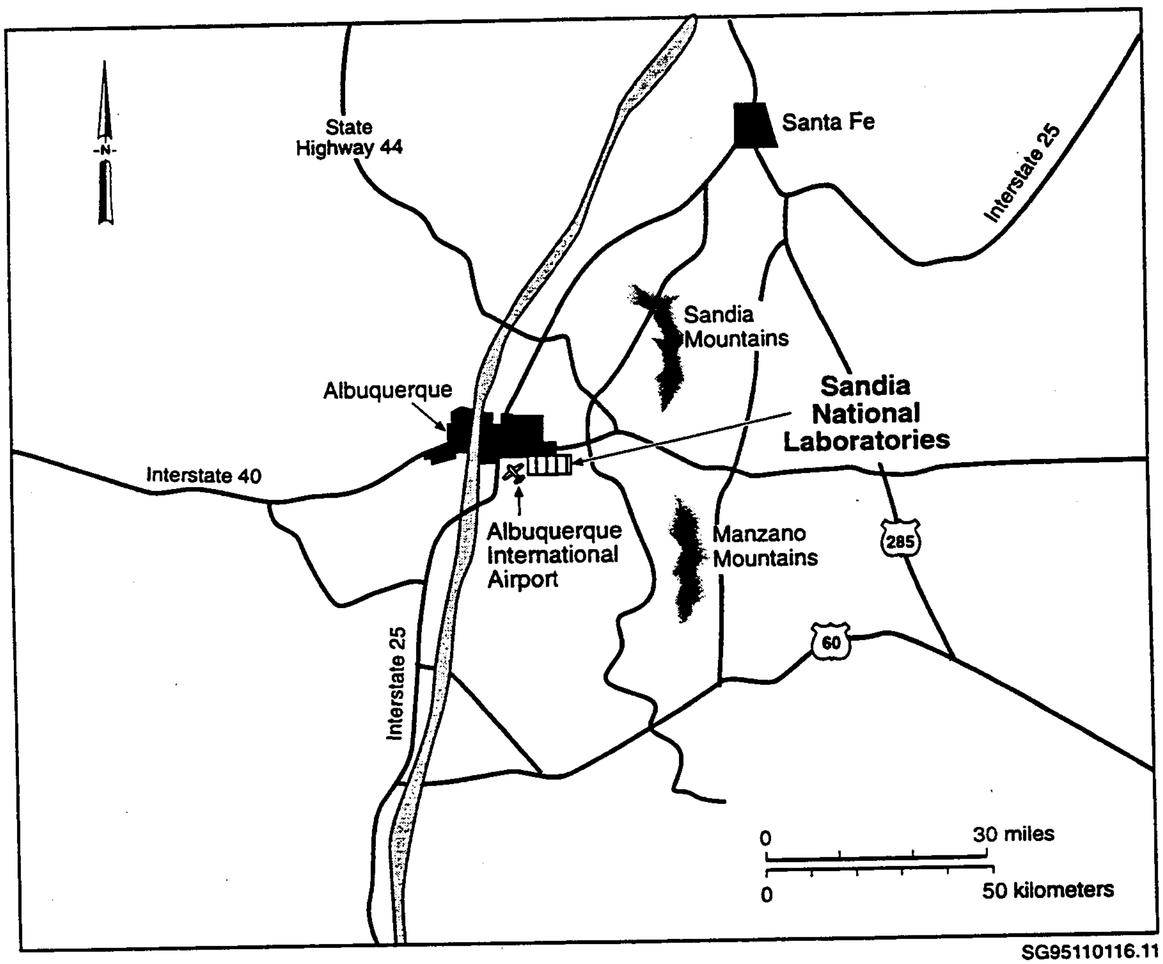

Figure 4-5. Major Transportation Services Near Sandia National Laboratories/New Mexico

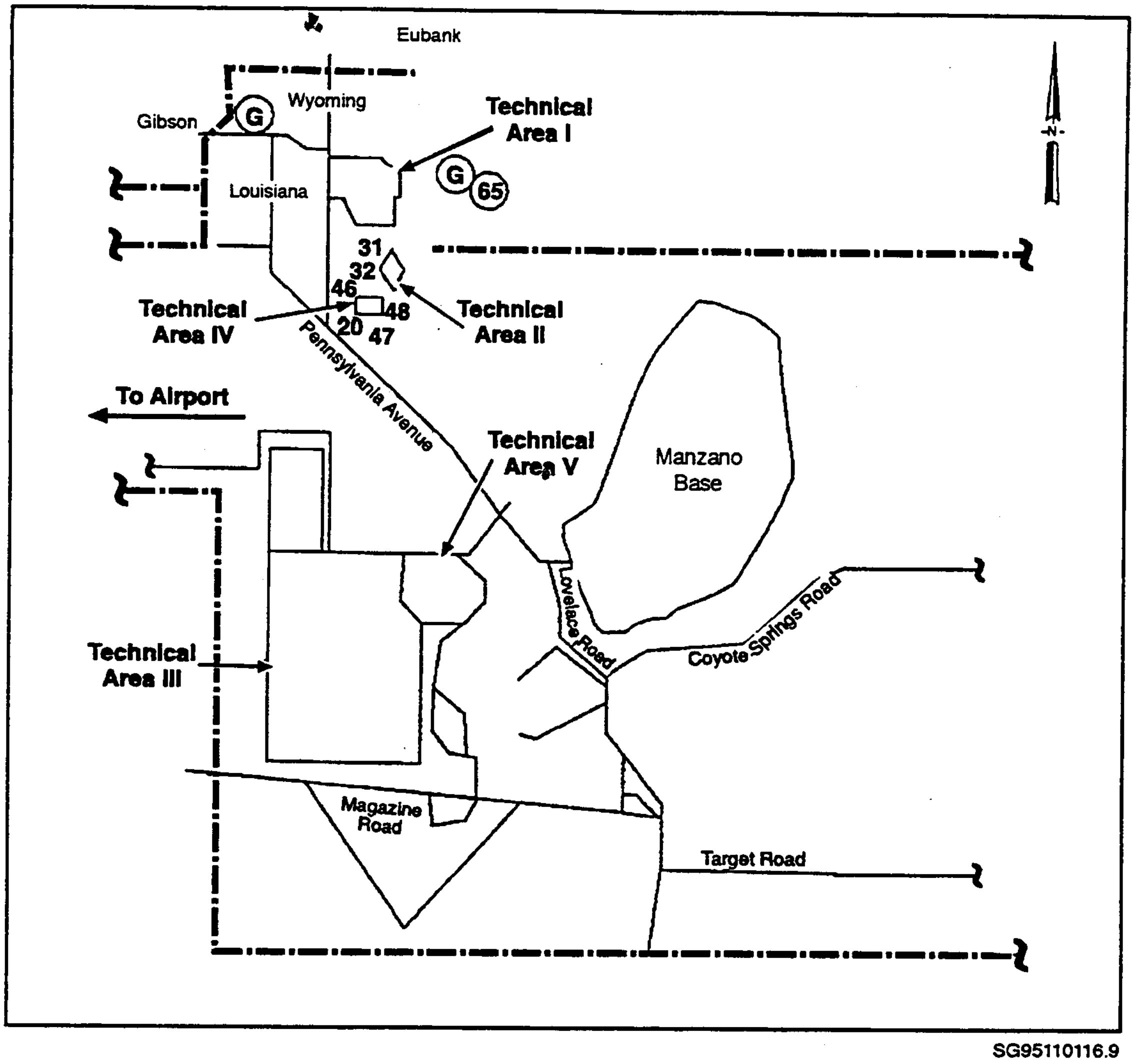

Figure 4-6. Local Transportation Routes Near Sandia National Laboratories/New Mexico

4.1.11.2 Airports and Air Traffic

The Albuquerque International Airport shares runways and other flight facilities with KAFB, forming an integral unit, and consists of all the private and commercial facilities located at the westernmost part of the airfield complex. The airport terminal and maintenance facilities are located 9.3 km (5.8 mi) northwest of the Technical Area V complex, where the activities associated with the proposed action would occur. This area is controlled by civil authorities, and the SNL/NM Emergency Plan provides for proper and timely cooperation with those authorities.

Final isotopic products would be transported by truck from SNL/NM to the airport's air freight area located south of the passenger terminal, across the main east-west runway. Product casks would be transported on KAFB using the Air Force access road south of the main east-west runway. No runways would be crossed because access and perimeter roads would be adequate. The Albuquerque International Airport has a limited number of direct flights (passenger or cargo) to Boston, Chicago, and St. Louis where the medical isotope distributors are located; therefore, shipments would be transported to distribution air freight hubs connecting with each of these cities. Figure 4-5 shows the location of Albuquerque International Airport with respect to the SNL/NM and interconnecting roadways. Air traffic data were not available for the airport and the distribution hubs.

4.1.12 Radiological Public Health and Safety

This section describes radiological exposures to members of the community and to workers at SNL/NM.

4.1.12.1 Current Radiological Environment

An Environmental Radiological Monitoring Program has been maintained at SNL/NM since 1959. The program staff collect soil, arroyo sediment, vegetation, and water samples that are analyzed according to established plans and procedures. In addition to these sampling and monitoring activities, another program that began in 1981 uses thermoluminescent dosimeters to measure ambient levels of external gamma radiation at each major facility. The thermoluminescent dosimeter monitoring locations are also present around the SNL/NM perimeter and at locations in the surrounding community.

The National Emission Standards for Hazardous Air Pollutants (NESHAP) maximally exposed individual was determined to be located at the KAFB Underground Munitions Storage Center facility on KAFB. As shown in Table 4-3, the maximum effective dose equivalent calculated for this location was 0.0016 mrem per year (mrem/yr), or 2% of the 0.1 mrem/yr dose that would require continuous monitoring

Table 4-3. Estimated Public Radiation Exposure from SNL/NM Activities (population within 80 km [50 mi] of SNL/NM)

	1991	1992	1993
*MEI effective dose equivalent	0.0014 mrem	0.0034 mrem	0.0011 mrem
% of 10 mrem/yr dose limit	0.01%	0.03%	0.02%
Total population collective dose from operations	0.018 person-rem	0.020 person-rem	0.027 person-rem
Total population collective dose from natural background	180,000 person-rem	180,000 person-rem	180,000 person-rem
* MEI - Maximally exposed individual			

by NESHAP. The total population dose within the 80-km (50-mi) radius surrounding SNL/NM was calculated to be 0.027 person-rem during 1993 from SNL/NM operations, compared with 57,000 person-~m from external exposure to natural background radiation and 180,000 person-rem from all natural ,urces including radon. The 1990 U.S. Census figures indicate that 385,000 people live within the city limits, and more than 480,000 live in the metropolitan statistical area.

Argon is produced and released from operations of the Annular Core Research Reactor. The maximum reactor power for the Annular Core Research Reactor is estimated at 1.06 x 10^7 MJ/yr. Power production at that rate would release 218 Ci/yr of argon (LATA 1991). Although the Annular Core Research Reactor does not currently operate at maximum capacity, the dose calculated for maximum capacity is less than 0.1 mrem/yr to the maximally exposed individual at the Kirtland Underground Munitions Storage Complex (closest to the source).

Current emissions from the Hot Cell Facility result from disassembling nuclear components. Only gases are released on a routine basis. A potential release is based on a release fraction of 1 x 10^{-6} for bulk solids, 1 x 10^{-3} for particulate, and 1.0 for gaseous materials. For the Hot Cell Facility, it is assumed that all of the fuel material is solid except for gaseous iodine, tritium, and krypton. For maximum capacity, the calculated dose for the maximally exposed individual at the Kirtland Underground Munitions Storage Complex, located 0.62 km (1 mi) northwest of Technical Area V, is 2.1 x 10^{-3} mrem/yr (LATA 1991).

4.1.12.2 Present Radiological Exposures of Workers in Technical Area V

Table 4-4 shows the radiological doses received by personnel working in the Annular Core Research Reactor/Hot Cell Facility area during 1993 and 1994. For comparison, the annual allowable dosages for a 'iological worker are set by DOE at 5 rem and 50 rem for full body and extremity dosages, respectively. .ie SNL/NM has set an administratively controlled limit of 500 mrem/y for a radiation worker.

1 **Table 4-4.** Radiation Doses Received by Personnel Working at the Annular Core Research Reactor/Hot Cell Facility Area During 1993 and 1994 (data from Monthly Exchange Dosimetry Reports, Radiological Protection Department, Dept. 6521, SNL/NM)

1994 Dose (9 months)	**Rem**			**1993 Dose (12 months)**	**Rem**		
13 Workers	**Whole Body**	**Skin**	**Extremity**	**12 workers**	**Whole Body**	**Skin**	**Extremity**
Minimum	0.010	0.010	0.010	Minimum	0.034	0.034	0.096
Maximum	0.519	0.748	1.695	Maximum	0.418	0.677	1.465
Average	0.177	0.231	0.351	Average	0.112	0.182	0.474
4 workers with no dose				1 worker with no dose			

4.1.13 Site Services

Electricity is supplied to SNL/NM and much of southeast Albuquerque through the Public Service Company of the New Mexico switching station on Eubank Boulevard in Albuquerque. Voltage is stepped down through transformers to two subtransmission voltages, 46 kV and 115 kV, for distribution through five subtransmission feeders.

KAFB is responsible for the overall natural gas system for the base. The distribution system is owned by DOE and operated by SNL/NM. Natural gas is purchased from KAFB, which buys it commercially. Fuel oil is stored for refueling remote-site tanks and for emergency supply to the steam plant. The steam plant supplies steam for space heating, hot water converters, absorption chillers, and processes.

The SNL/NM is responsible for the water collection system at its technical areas and in the Coyote Test Field; KAFB is responsible for the system base-wide. The existing resource requirements are summarized in Tables 4-5 and 4-6.

Table 4-5. Existing SNL/NM Utility Resource Requirements

Utility Resources	Average Daily Consumption	Peak Demand	System Capacity
Electricity	548 MWh	34 MW	50 MW
Natural Gas	1,500,000 ft^3	250,000 ft^3/hr	250,000 ft^3/hr
Water (at SNL/NM)	1,000,000 gal	1400 gpm	2800 gpm
Water (in Technical Area V)	2,500 gal	N/A	N/A
Conversions: To convert gallons (gal) to liters (L), multiply by 3.785. To convert cubic feet (ft^3) to cubic meters (m^3), multiply by 0.028317.			

Table 4-6. Existing SNL/NM Chemical Resource Requirements

Chemical Resources	Total Annual Consumption	Storage Capacity
Nitrogen	720,000 gal	72,000 gal
Argon	400,000 gal	46,000 gal
Hydrogen	1,152,000 ft^3	76,000 ft^3
Oxygen	5,330,000 ft^3	533,000 ft^3
Conversions: To convert gallons (gal) to liters (L), multiply by 3.785. To convert cubic feet (ft^3) to cubic meters (m^3), multiply by 0.028317.		

4.1.14 Waste and Spent Nuclear Fuel Management

Each waste management portion of Section 4.0 summarizes the various wastes generated and stored at each of the sites considered in this environmental impact statement. Volume production rates, as well as storage or disposal methods, are addressed. The goal is to provide a general overview of current site conditions, thus providing a foundation upon which impacts can be determined. Categories discussed are spent nuclear fuel, low-level waste, and low-level mixed waste. Waste volume production rates for medical isotope production and the impacts associated with each alternative are addressed in Section 5.14.

4.1.14.1 Introduction

Radioactive waste at SNL/NM is generated in both technical and remote test areas from research, development, and technology activities. Most of the waste consists of contaminated equipment, combustible decontamination materials, and cleanup debris. SNL/NM does not currently generate high-level waste. Radioactive waste is managed by the SNL/NM Radioactive Waste Management Program.

4.1.14.2 Spent Nuclear Fuel

Facilities at SNL/NM currently store and generate relatively small quantities of spent nuclear fuel. These facilities include the Manzano Storage Structures, the Annular Core Research Reactor, the Sandia Pulse Reactor II and III and Critical Assembly, Hot Cell Facility and the Special Nuclear Materials Storage Facility. The SNL/NM reactors operate as needed on a low duty cycle, so the fission product inventories remain low and the fuel loading lasts for the life of the reactor, thus eliminating routine generation of spent nuclear fuel. The quantity of spent nuclear fuel at SNL/NM in 1995 was estimated at 440 kg (heavy metal). Except for a few broken plates that are in storage, the fuel at SNL/NM is still in use in the reactors (DOE 1995g).

4.1.14.3 Low-Level Radioactive Waste

All low-level wastes and mixed wastes at SNL/NM are temporarily stored in DOE-approved containers above ground. All low-level waste packages will be transported by commercial carriers to the Nevada Test Site for disposal. In 1991, SNL/NM generated approximately 15,746 L (4160 gal) of liquid low-level waste and 10 m^3 (13 yd^3) of solid low-level waste (DOE 1993a). SNL/NM currently generates approximately 70.8 m^3 (2500 ft^3) of uncompacted low-level waste each year (Massey and Coats 1995).

4.1.14.4 Low-Level Mixed Waste

Low-level mixed wastes at SNL/NM include radioactively contaminated oils and solvents, radioactively contaminated or activated lead, or other heavy metals. Other mixed wastes may be generated as a result of defense research testing. Completion of the Radioactive and Mixed Waste Management Facility is expected in 1996. This facility will provide a centralized packaging and storage facility for low-level waste and mixed waste. In 1991, SNL/NM generated approximately 1820 L (480 gal) of liquid mixed waste and 3 m^3 (4 yd^3) of solid mixed waste (DOE 1993a). The SNL/NM has an approximate cumulative volume of 66.1 m^3 (86 yd^3) of low-level mixed waste that is made up mostly of radioactive asbestos (DOE 1994b).

4.2 Los Alamos Environment

4.2.1 Overview

Los Alamos National Laboratory (LANL) is located in north-central New Mexico, 97 km (60 mi) north-northeast of Albuquerque, 40 km (25 mi) northwest of Santa Fe, and 32 km (20 mi) southwest of Española in Los Alamos and Santa Fe counties.

Land use in the general region consists of several small communities including Los Alamos and several recreation areas. The surrounding land is largely undeveloped with large tracts of public land north, west, and south of LANL. Nearby recreational areas include Bandelier National Monument and Santa Fe National Forest.

Major public roads used at LANL include state roads 4, 501, 502, and Pajarito Road. The highway route from Albuquerque consists of Interstate 25 to Santa Fe, U.S. Highway 84 from Santa Fe to Pojoaque, and New Mexico State Highway 4 from Pojoaque to Los Alamos. New Mexico state highways 14 and 44 are also significant roadways in the region surrounding LANL.

Technical Area 2 (TA-2), the location of the Omega West Reactor, is located just south of the town of Los Alamos in the bottom of Los Alamos Canyon between two mesas. The north mesa is the location of the Los Alamos townsite, and the south mesa is the location of the main LANL technical area. The bottom of the canyon is wooded and relatively flat. A small ephemeral stream that runs through the bottom of the canyon is normally dry except for short periods during spring snowmelt runoff and after summer thunderstorms. Flash floods from heavy thunderstorms are possible at Los Alamos, especially affecting arroyos, canyons, and low spots.

Approximately 60% of LANL lands have been inventoried for archaeological and historical cultural resources, and over 1500 sites have been recorded. None of these archaeological sites exists in or adjacent to the Omega West Reactor facility. The reactor itself has not been fully evaluated and recorded as a historical structure. The significance of the facility for inclusion in the National Register of Historic Places has not been completed.

Three fault zones are located in the LANL area: the Pajarito, Rendija Canyon, and Guaje Mountain faults. Although all three faults are geologically young, recent investigations of the faults suggest they are capable of producing future earthquakes. Seismic ground motion and shaking could affect the site stability at LANL through the erosional retreat of the cliffs forming mesa rims. During the past 500,000 years, several faults in the Los Alamos area are suspected of having produced seismic events with a magnitude of

6.5 to 7.8 on the Richter scale. Some evidence suggests that a single earthquake with a magnitude close to 5.5 has occurred in the Los Alamos area during the past 150 years.

Air samples are routinely collected from within the laboratory boundary, from nearby residential and community areas, and from the surrounding areas up to 80 km (50 mi) from the laboratory. Tritium and uranium-235 concentrations in 1992 were highest onsite, decreased slightly at the site perimeter, and were lowest at regional locations. Plutonium-238 was not detected away from the site perimeter; while plutonium-239,240 was detected only once out of 12 regional samples, and the maximum concentration was measured onsite. Americium-241 was seen in 40% of the regional samples, but its highest concentration was measured onsite.

The total cumulative mass of spent nuclear fuel (as of 1994) at LANL consists of approximately 86 elements. The total cumulative volume of retrievably stored transuranic waste (as of 1993) was 10,810.9 m^3 (14,134 yd^3) for contact handled and 91.3 m^3 (119 yd^3) for remote handled. Many areas throughout LANL generate liquid low-level waste. LANL has two onsite liquid low-level waste treatment facilities, a chemical treatment and ion-exchange plant, and a chemical treatment plant. As of 1993, the cumulative total of low-level waste onsite was 220,700 m^3.

At LANL, 12 species that may occur that are listed as threatened or endangered by either the U.S. Fish and Wildlife Service or the New Mexico Department of Game and Fish. A total of 12 other species are considered candidates for inclusion on the federal endangered or threatened list or are considered rare by the state of New Mexico.

4.2.2 Land Use

Los Alamos National Laboratory is located in north-central New Mexico, 97 km (60 mi) north-northeast of Albuquerque, 40 km (25 mi) northwest of Santa Fe, and 32 km (20 mi) southwest of Española in Los Alamos and Santa Fe counties.

4.2.2.1 Los Alamos National Laboratory

Los Alamos National Laboratory occupies the southeastern portion of Los Alamos County (Figure 4-7). It is bordered by the Santa Fe National Forest to the north and west, the community of Los Alamos to the north, Bandelier National Monument to the east and south, the San Ildefonso Indian Reservation to the east, and the town of White Rock and the Rio Grande River to the southeast.

4.2.2.2 Technical Area-2

The developed acreage of LANL consists of 30 active technical areas (Figure 4-8). The Omega West Reactor (TA-2) is located in Los Alamos Canyon between two mesas just south of the town of Los Alamos. The reactor is in cold stand-down status with the tank drained and fuel removed. The north mesa is the location of the Los Alamos townsite, and the south mesa is the location of the main LANL technical

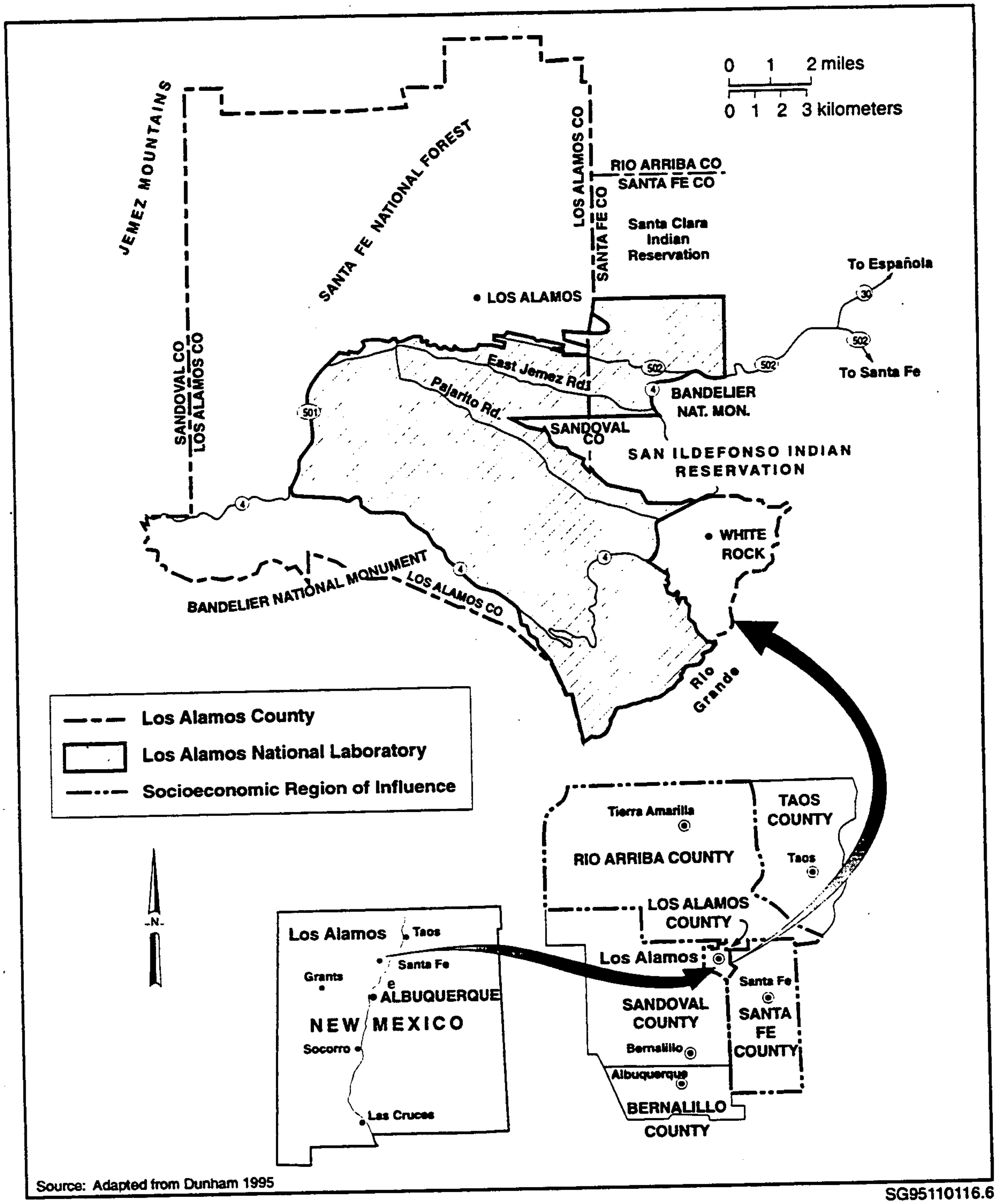

Figure 4-7. Regional Map of Los Alamos National Laboratory and Surrounding Area

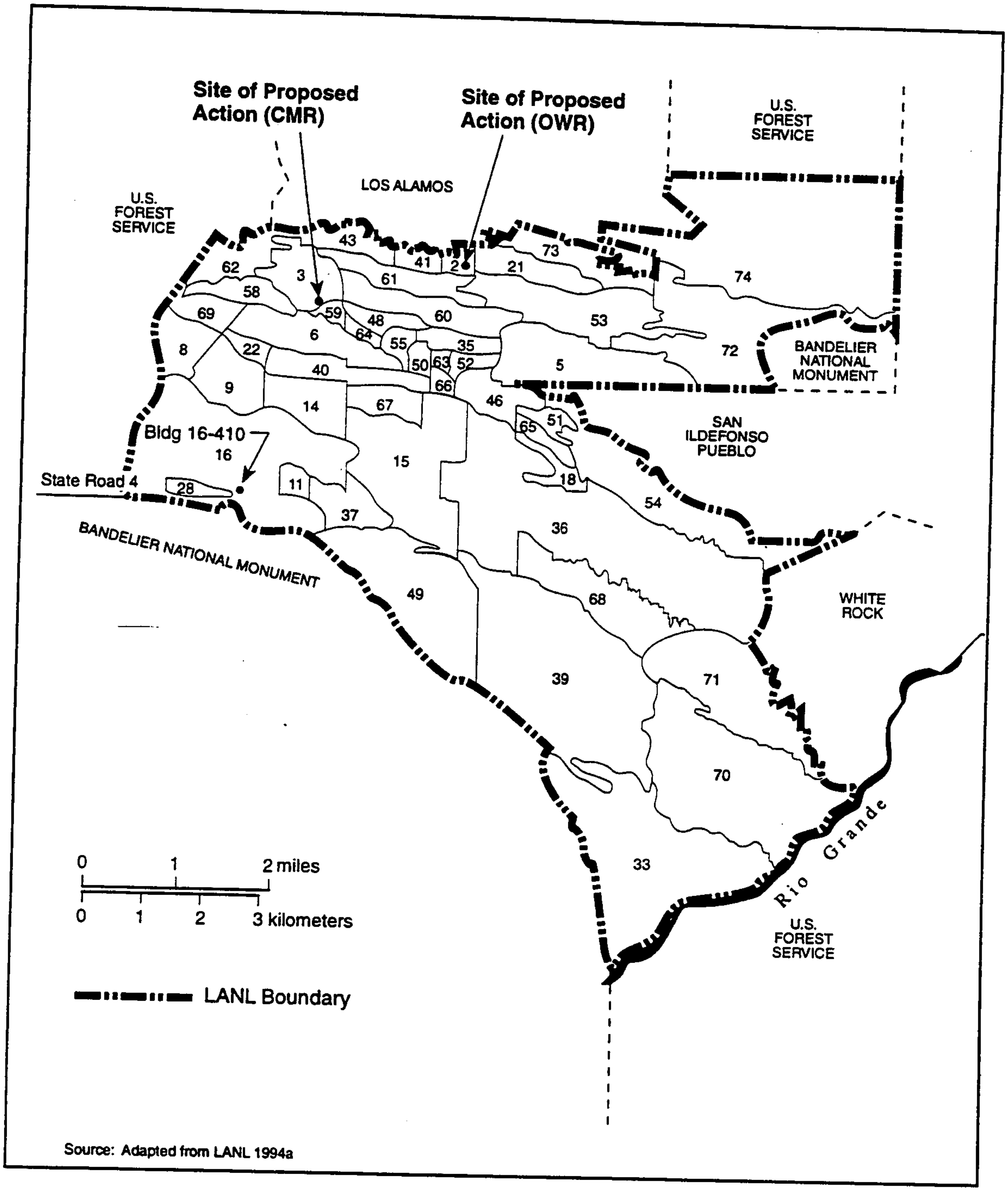

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Figure 4-8. Technical Areas of Los Alamos National Laboratory area. East Jemez Road, the major entry to LANL, runs east-west, about 0.4 km (0.25 mi) south of TA-2, but TA-2 has relatively poor access and is quite isolated.

Los Alamos Canyon at TA-2 is approximately 410 m (1350 ft) wide at the top and 110 m (350 ft) deep. The canyon sides are very rough and rocky and are partially covered by pine trees, particularly on the south side. The bottom of the canyon is wooded and relatively flat for a width of about 60 m (200 ft). A small ephemeral stream that runs through the canyon is normally dry except for short periods during spring snowmelt runoff and after summer thunderstorms when runoff is sometimes transported beyond the site boundary.

Nearby land use includes trailer storage, a cable television facility, and a landfill. A private, mobile home park is located about 0.5 km (0.33 mi) southwest of the site.

4.2.2.3 Technical Area-3

Technical Area-3 (TA-3) of Los Alamos National Laboratory is essentially the *central business district* and is similar, in that respect, to a typical city with the usual sights and problems. These similarities include high density development, parking and traffic congestion, high land value, multi-story construction and redevelopment potential. The dominant land uses within this core area include: administrative and technical services; experimental science; physical support and infrastructure; theoretical and computational sciences; and special nuclear materials. The main part of the city of Los Alamos lies roughly north to northeast of TA-3, which is served by East James Road (501) that runs east-west, and by north-south trending Pajarito Road (See Figure 4.14). Designated as an industrial area, the majority of the elaborate facilities and personnel is located in TA-3, including the Chemistry and Metallurgy Research Facility where a portion of the Mo-99 process would take place. TA-3 is located south of South Mesa and north of Twomile Canyon toward the western end of Sigma Mesa.

The Chemistry and Metallurgy Research Facility is a 51,095 m^2 (550,000 ft^2) reinforced-concrete building aligned in a north-south direction. The building contains a waste assay facility at the loading dock and a special nuclear material (SNM) vault. Wing 9 of this facility would be involved in the production of Mo-99 where target fabrication and post-irradiation hot cell operations to remove the Mo-99 would take place. Refer to Section 3.3.1.6 for more details on production activities.

4.2.3 Socioeconomic Environment

The LANL is located in north-central New Mexico in Los Alamos and Santa Fe counties, 97 km (60 mi) north-northeast of Albuquerque, and 40 km (25 mi) northwest of Santa Fe (Figure 4-7). The LANL Office of Community Relations estimates that 91.6% of the LANL employees reside in the tri-county region of Los Alamos, Santa Fe, and Rio Arriba counties (Massey and Coats 1995).

4.2.3.1 Demographic Characteristics

At the time of the 1990 census, the total population of the Los Alamos region of influence was .51,400. Of the population in the region of influence, 79% is white, with 50.1% having Hispanic background. Native Americans residing in Los Alamos, Rio Arriba, and Santa Fe counties account for 5% of the general population. Extending this region to include Sandoval County increases the percentage of Native Americans to just under 10% of the general population. Of 12 Native American populations near LANL, the closest are the Pueblos of San Ildefonso, Cochiti, Jemez, and Santa Clara.

Some 62.5% of the total population in the tri-county region is between the age of 18 and 65. Approximately 80.7% of this population has completed high school, and 30.5% has attained a baccalaureate degree or higher. A significant difference exists in educational attainment levels within the region.

The 1990 median and per capita income levels of the population in the tri-county region were $30,408 and $14,538. Approximately 15% of the tri-county residents fell below official poverty thresholds.

4.2.3.2 Economic Base

LANL is the largest employer in this tri-county region. For fiscal year 1993, the LANL payroll for the tri-county region was $450 million for 7256 full-time personnel (Massey and Coats 1995). During the same year, LANL spent approximately $220 million in procurement in the tri-county region (Massey and Coats 1995). Therefore, $670 million ($450 + $220) in direct income was available for households and businesses to make additional purchases of products and services within or outside the tri-county region. A description of employment by economic sector within the tri-county region is provided in Table 4-7.

The average annual employment in the tri-county region during calendar year 1993 included 71,776 workers who earned a total of $1.82 billion in wages (New Mexico State Department of Labor 1994). At the sector level, employment and wages were highest in the service, state or federal governments (including LANL), and gross trade sectors of the regional economy. Together these sectors accounted for 76% of the employment and 79% of the wages in the regional economy. The unemployment rate for the tri-county region as a whole was 5.5%. Employment and wages during 1993 were highest in Santa Fe County, followed by Los Alamos and Rio Arriba counties. The unemployment rate in Rio Arriba County during 1993 was nearly three times that of Santa Fe County and more than five times that of Los Alamos County.

In fiscal year 1993, LANL paid $41 million in payroll taxes and $6 million in additional tax payments within the tri-county region.

4.2.4 Cultural Resources

Approximately 60% of LANL lands have been inventoried for archaeological and historical cultural resources, and over 1500 sites have been recorded (LANL 1994a). None of these archaeological sites exists in or adjacent to either the Omega West Reactor Facility or the Chemistry and Metallurgy Research

Table 4-7. Regional Employment Profile (for 1993)

Economic Sectors	Santa Fe	Los Alamos	Rio Arriba	Totals
Agriculture	364	28	59	451
Construction and Mining	3,120	170	382	3,672
Manufacturing	2,016	63	315	2,394
Transportation and Utilities	1,056	66	268	1,390
Trade	12,725	1,236	1,480	15,441
F.I.R.E.[a]	2,311	341	216	2,868
Services	13,520	4,424	2,331	20,275
Government				
Federal	1,510	190	455	2,155
State	9,104	157	493	9,754
LANL	na	7,256	na	7,256
Local	3,613	1,081	1,426	6,120
Totals	49,339	15,012	7,425	71,776
Percent Unemployment	4.3%	1.3%	12.8%	5.5%

(a) F.I.R.E. is finance, insurance, and real estate.
(b) na = not available

Facility in TA-3. The reactor has not been fully recorded and evaluated as a historical structure. Preliminary studies to determine the Omega West Reactor's potential as a historic site have been initiated.

4.2.5 Aesthetic and Scenic Resources

The topography of LANL affords spectacular views of the surrounding landscape of natural beauty, forested mountains, deep canyons, and the Rio Grande Valley. A number of recreational areas are nearby (Figure 4-9). Located immediately south of LANL, Bandelier National Monument is a popular public attraction. The Jemez Mountains rise above Los Alamos to the west and offer a vast array of scenic attractions. This mountainous terrain in the Santa Fe National Forest offers the public opportunities for fishing, hunting, skiing, hiking, swimming, camping, and horseback riding (LANL 1994b).

4.2.6 Geologic Resources

This section summarizes the physiography, geology, and seismic hazards at the Los Alamos National Laboratory. A more detailed summary of these subjects is found in DOE (1979).

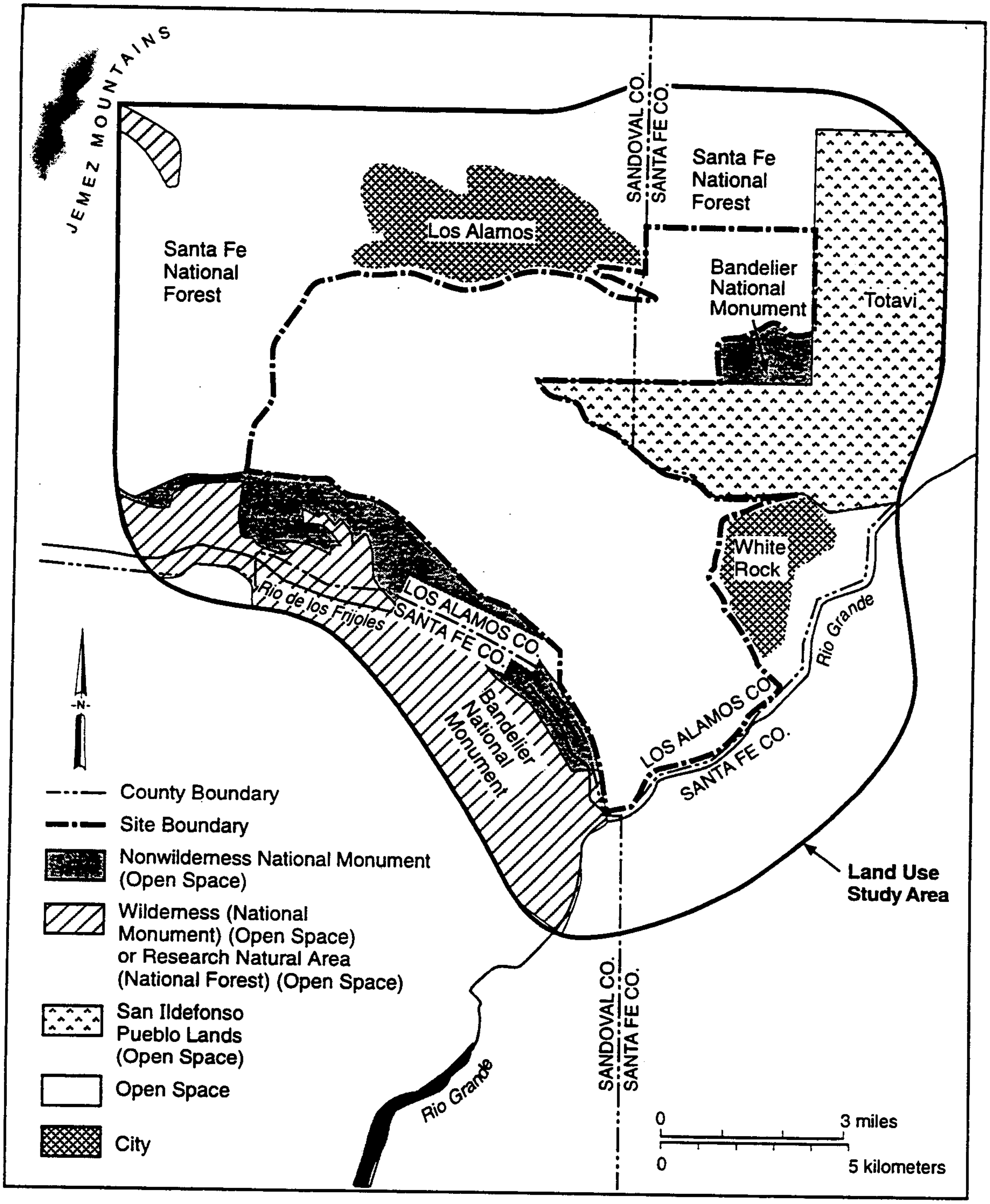

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Figure 4-9. Land Use for Los Alamos National Laboratory and Surrounding Area

4.2.6.1 General Geology

Physiography. LANL encompasses 111 km^2 (43 mi^2) in north-central New Mexico and is located on narrow finger-like mesas, whose tops range in elevation from 2377 m (7800 ft) on the flanks of the Jemez Mountains to approximately 1890 m (6200 ft) at their eastern termination above the Rio Grande Valley. For more information on geology, refer to LANL (1992a).

Geology. The Pajarito Plateau forms a topographically high area along the western margin of the Rio Grande depression (DOE 1979). Sediments eroded from highland masses to the east and west to fill the depression and form the sedimentary rocks of the Miocene-Pleistocene aged Santa Fe Group (Figure 4-10). For more detailed information, refer to DOE (1979), LANL (1992a and 1993a).

The Omega West Reactor is located in Los Alamos Canyon, a deep narrow canyon that separates the laboratory to the south from the community of Los Alamos to the north. The upper part of the Otowi Member of the Bandelier Tuff is poorly exposed in Los Alamos Canyon due to extensive talus and colluvium cover (LANL 1993b). Discontinuous exposures of the Cerro Toledo interval may be observed in the lower slopes of Los Alamos Canyon. The primary unit exposed in the slopes and cliffs of Los Alamos Canyon is the Tshirege Member. Thick sections of the Tshirege are observable at several locations throughout the canyon and can be seen forming most of the spectacular cliffs throughout the Pajarito Plateau.

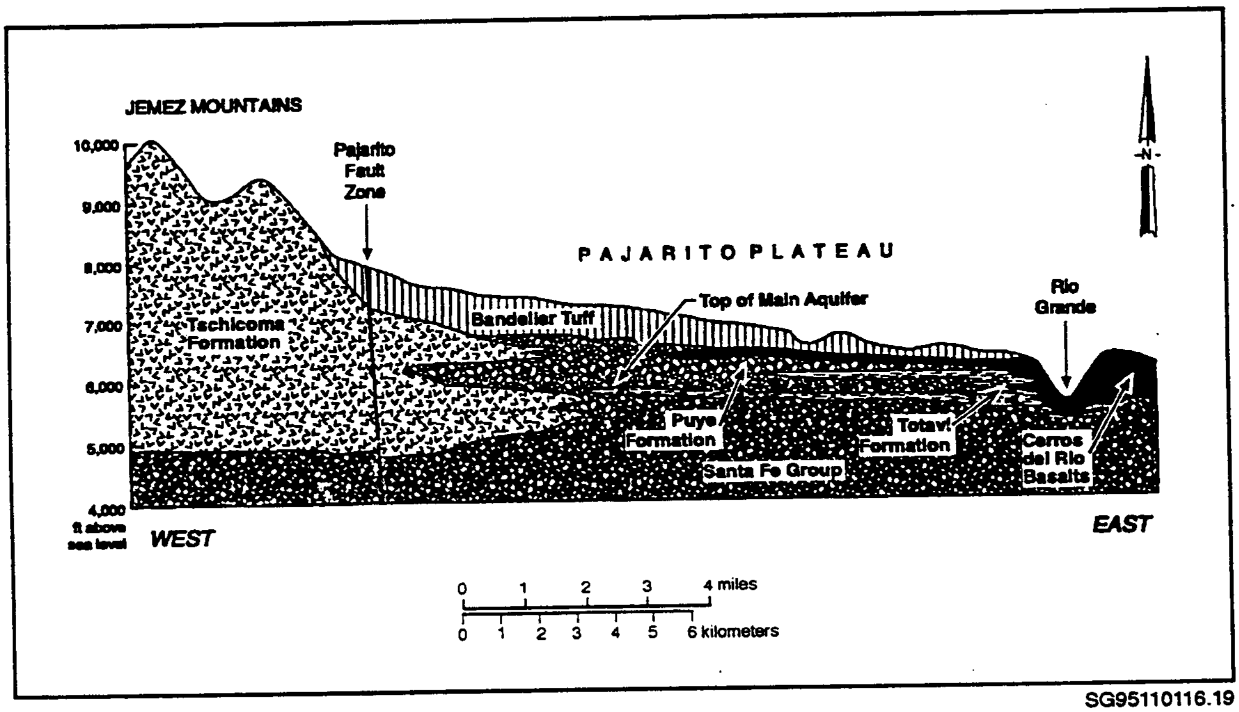

Figure 4-10. Stratigraphy of the Pajarito Plateau (LANL 1993d)

Structure. The geologic structure at LANL is dominated by three fault zones: the Pajarito, Rendija Canyon, and Guaje Mountain faults (Figure 4-11). The Pajarito fault is thought to mark the currently active western boundary of the Espanola Basin (Wong et al 1995). The Rendija Canyon and Guaje Mountain faults are shorter and secondary to the Pajarito fault. Recent investigations of the faults suggests that all three faults are geologically young and are capable of producing future earthquakes. The Guaje Mountain fault passes directly beneath TA-2 (LANL 1993a). The Rendija Canyon and Guaje Mountain faults are exposed just north of Los Alamos Canyon as zones of gouge and breccia up to several meters wide with visible stratigraphic offset. For more detailed information, refer to Wong et al. (1995) and LANL (1993a).

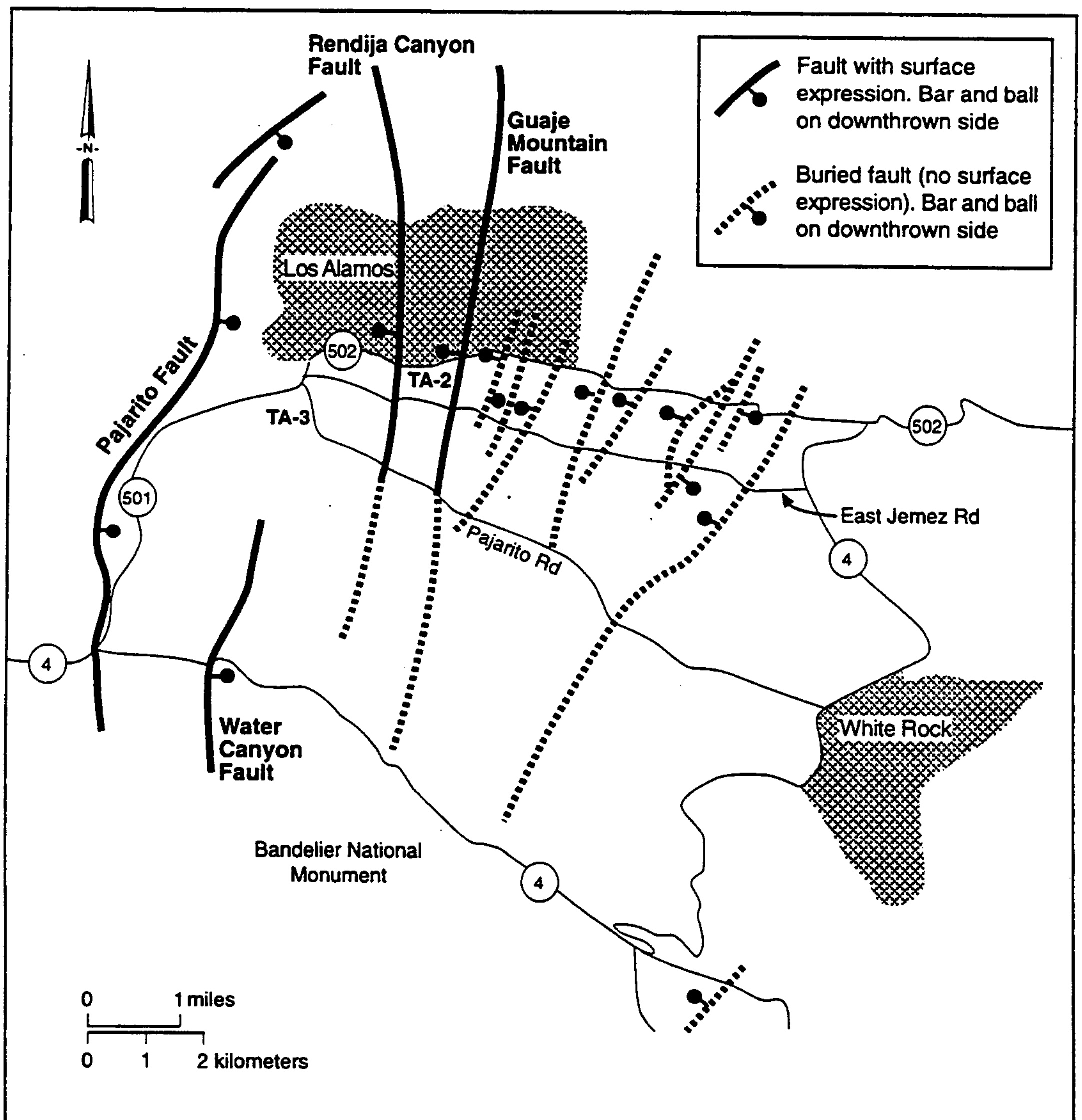

Figure 4-11. Fault Zones Surrounding Los Alamos National Laboratory

Soils. Soils mapped in TA-2 are generally poorly developed and are designated as Typic Ustorthents-rock outcrop complex soils (LANL 1993a). Soil covering TA-3 is primarily the Carjo Loam (LANL 1993c). Also present in TA-3 are the Tocal and Seaby series soils. A detailed description of these soil types can be found in Nyhan et al. (1978).

4.2.6.2 Mineral Resources

Sand, gravel, clay, pumice, and tuff resources are ubiquitous to Los Alamos County and the Pajarito Plateau (DOE 1979). None of these resources is considered unique to the Los Alamos site, and all are available in proximity to the DOE-controlled property.

4.2.6.3 Site Stability

Site stability at LANL could be affected by erosional retreat of cliffs and slopes forming mesa rims and by shaking during seismic ground motion (DOE 1995i). Erosional retreat of vertical cliffs in Los Alamos Canyon near the Omega West Reactor has produced at least 24 separate rockfall incidents from 1944 to 1993, with debris trapped in rock catchers ranging in size from approximately 140 to 9530 kg (300 to 21,000 lbs) (McLin 1993). Along the cliffs bordering the canyon, partially detached landslide blocks show that mass wasting may occur up to 23 m (75 ft) from the mesa edge (LANL 1993c). Single failures of this scale should be considered feasible along the rim of Los Alamos Canyon, particularly during seismic events. Erosional retreat estimates for the cliffs near the Omega West Reactor are on the order of 2 to 3 cm/1000 years (0.8-1.2 in./1000 years) (McLin 1993), suggesting that seismic shaking may be the critical triggering mechanism in major rock falls.

Studies suggest that several faults in the Los Alamos area have produced seismic events with a magnitude of 6.5 to 7.8 on the Richter scale in the past 500,000 years (DOE 1993a). Evidence exists for a single earthquake of Richter scale magnitude 5.5 occurring in the vicinity of Los Alamos over the past 150 years (Massey and Coats 1995). Los Alamos lies on the boundary between Zones 1 and 2 designated by the Uniform Building Code of 1991. LANL facility designs are based on the more restrictive Zone 2 criteria. In the event of an earthquake typical of Zone 2, the buildings would be expected to remain intact, and the distribution systems for water, gas, and other utilities would not be expected to rupture. Evaluating the earthquake risk at Los Alamos is based on the results of a study of seismic hazard for DOE sites (Coats and Murray 1984). The design basis earthquake has a ground surface acceleration of 0.30g and a predicted occurrence of once every 5000 years.

4.2.7 Air Quality

Los Alamos has a semiarid, temperate mountain climate. A brief characterization of the climate is presented in Appendix D.

4.2.7.1 Nonradiological Air Quality

Criteria pollutants, such as nitrogen dioxide (NO_2), carbon monoxide (CO), hydrocarbons, particulate matter, and sulfur dioxide (SO_2) are emitted by facility power plants, steam plants, asphalt plants, and local space heaters (Table 4-8). Toxic and other hazardous pollutants are emitted by some site industrial and laboratory activities (LANL 1994a).

The LANL operated or accessed a network of nonradiological ambient air monitoring devices (LANL 1994a) to routinely evaluate the background concentration of criteria pollutants, beryllium, acid precipitation, and visibility. The measured ambient concentration of all monitored pollutants met all applicable state and federal standards.

Beginning in fiscal year 1995, criteria pollutants were no longer monitored on a routine basis because past observed values were low relative to standards. Measurements are to be made on an as-needed basis for activities with potential for pollution (Jardine 1995).

Table 4-8. Nonradiological Ambient Air Monitoring Results in the Region of Los Alamos National Laboratory (for 1992)

Pollutant	Averaging Time	Unit	New Mexico Standard	Federal Standards		Measured Concentration
				Primary	Secondary	
Sulfur Dioxide[a]	Annual Arithmetic Mean	ppm	0.02	0.03		0.0005
	24 h	ppm	0.10	0.14		
	3 h	ppm			0.05	
	1 h	ppm				0.009
Total Suspended Particulate Matter	Annual Geometric Mean	μg/m³	60			
	30 d	μg/m³	90			
	7 d	μg/m³	110			
	24 h[b]	μg/m³	150[b]			
PM_{10}[a]	Annual Arithmetic Mean	μg/m³		50	50	8
	24 h	μg/m³		150	150	21
Ozone[a]	1 h	ppm	0.06	0.12	0.12	0.076
Nitrogen Dioxide[a]	Annual Arithmetic Mean	ppm	0.05	0.053	0.053	0.002
	24 h	ppm	0.10			
	1 h	ppm				0.02
Lead	Calendar Quarter	μg/m³		1.5	1.5	
Beryllium[c]	30 d	μg/m³	10			0.02
Heavy Metals	30 d	μg/m³	10			

(a) Measurements made at Bandelier Monitoring Compound.
(b) Maximum concentration, not to exceed more than once per year.
(c) Measurement made at Technical Area 52.
Source: LANL 1994a

4.2.7.2 Radiological Air Quality

Los Alamos National Laboratory supports an ongoing environmental surveillance program, as required by DOE Order 5484.1 (DOE 1981) and Order 5400.1. This program maintains routine monitoring for radiation, radioactive materials, and hazardous chemicals at the laboratory and in the surrounding region. Samples of air particulates, gases, waters, soils, sediments, and foodstuffs are collected for analysis from monitoring stations within the laboratory boundary, in nearby residential and community areas, and in surrounding areas up to 80 km (50 mi) from LANL. The samples are used to document compliance with appropriate standards set by DOE and the U.S. Environmental Protection Agency (EPA 1989a, 1989b). Radionuclide concentrations in air samples collected in 1992 from within the LANL boundary, from nearby residential and community areas, and from the surrounding areas up to 80 km (50 mi) from the laboratory are tabulated in Table 4-9.

In general, tritium concentrations were highest onsite, decreased slightly at the site perimeter, and were lowest at regional locations. Average concentrations of uranium-235 followed a similar pattern. The average uranium-238 concentration was highest at regional sampling locations, followed by waste sites, onsite, and perimeter locations, respectively. Plutonium-238 was not detected away from the site perimeter; while plutonium-239,240 was detected only once out of 12 regional samples, and the maximum concentration was measured onsite. Americium-241 was seen in two out of five of the regional air samples, and its highest concentration was measured onsite.

4.2.8 Water Quality

This section summarizes the surface water and groundwater resources at LANL. A more detailed summary can be found in DOE (1979), with site-specific information in LANL (1993a,c).

4.2.8.1 Surface Water

The Rio Grande is the major source of surface water in north-central New Mexico. All surface water drainage and groundwater discharge from the Pajarito Plateau ultimately arrives at the Rio Grande (DOE 1995i). The major canyons that contain reaches of perennial streams inside LANL are the Pajarito, Water, Ancho, and Chaquehui Canyons. Los Alamos, Water, and Pajarito Canyons, and perennial streams originate upstream of LANL facilities or effluent discharge points (LANL 1993d). Currently, it is not well understood how surface water flow affects perched water zones at LANL.

Perennial streams in the lower portions of Ancho and Chaquehui Canyons extend to the Rio Grande without being depleted. In lower Water Canyon, the perennial stream is very short and does not extend to the Rio Grande. In Pajarito Canyon, Homestead Spring feeds a perennial stream only a few hundred meters long, followed by intermittent flows for varying distances, depending on climate conditions (LANL 1993d).

Table 4-9. Selected Radionuclide Concentrations in the Air from and Around the Los Alamos National Laboratory (for 1992)

Radionuclide (Units)	Group Location	Number of Samples	Number Above Detection	Maximum[a]	Minimum[a]	Mean[a]
H-3 (pCi/m^3)	Regional	45	1	3.6 (1.0)	-3.0 (2.3)	0.3 (6.4)
	Perimeter	193	69	11.8 (2.0)	-11.5 (6.9)	2.7 (17.3)
	Onsite	184	80	68.2 (4.5)	-3.7 (1.9)	6.1 (26.4)
	Waste Sites	61	38	685.0 (205)	-1.1 (0.5)	42.8 (34.7)
U-234 (aCi/m^3)	Regional	12	12	82.8 (6.5)	10.8 (6.0)	30.6 (19.2)
	Perimeter	56	53	43.1 (4.7)	2.6 (4.2)	12.8 (43.6)
	Onsite	55	49	52.2 (4.7)	0.0 (6.9)	13.8 (44.9)
	Waste Sites	19	18	32.4 (5.3)	2.1 (5.6)	15.4 (32.4)
U-235 (aCi/m^3)	Regional	12	3	14.2 (2.7)	0.0 (5.2)	0.2 (13.8)
	Perimeter	56	3	4.9 (1.6)	-1.1 (2.3)	0.3 (36.5)
	Onsite	55	5	6.0 (4.3)	-2.3 (3.0)	0.4 (36.1)
	Waste Sites	19	1	4.1 (2.2)	-1.2 (20.2)	0.5 (27.3)
U-238 (aCi/m^3)	Regional	12	12	80.9 (6.4)	7.3 (4.4)	28.8 (16.4)
	Perimeter	56	55	109.0 (7.1)	1.4 (1.9)	18.4 (36.0)
	Onsite	55	53	182.3 (13.0)	2.4 (1.5)	21.1 (38.7)
	Waste Sites	19	19	106.4 (17.3)	4.1 (4.2)	22.6 (25.2)
Pu-238 (aCi/m^3)	Regional	12	0	2.4 (3.3)	-1.1 (4.1	0.6 (3.8)
	Perimeter	56	2	8.4 (4.3)	-2.7 (3.8)	1.0 (3.8)
	Onsite	55	1	3.8 (3.4)	-1.7 (7.4)	0.6 (4.1)
	Waste Sites	20	5	9.7 (3.8)	-5.2 (17.3)	1.4 (4.6)
Pu-239,240 (aCi/m^3)	Regional	12	1	4.3 (2.9)	0.4 (2.6)	1.5 (8.1)
	Perimeter	56	10	79.5 (8.3)	-0.5 (2.3)	5.9 (21.8)
	Onsite	55	7	92.0 (28.0)	-2.7 (1.7)	4.2 (20.4)
	Waste Sites	20	1	3.4 (2.3)	-0.3 (3.2)	1.1 (16.0)
Am-241 (aCi/m^3)	Regional	5	2	3.7 (4.1)	-1.6 (4.4)	1.2 (9.1)
	Perimeter	21	10	4.1 (3.1)	0.6 (4.2)	1.8 (17.9)
	Onsite	24	9	12.6 (4.6)	0.0 (3.6)	2.3 (20.0)
	Waste Sites	12	4	3.7 (6.6)	0.0 (4.8)	1.7 (15.6)
U (pg/m^3)	Regional	12	12	244.0 (19.9)	22.0 (15.4)	87.2 (54.5)
	Perimeter	56	56	325.5 (22.1)	4.6 (6.5)	55.1 (123.3)
	Onsite	55	55	544.1 (39.6)	7.2 (5.2)	63.3 (130.7)
	Waste Sites	19	19	316.5 (61.1)	12.3 (14.9)	68.0 (87.5)
I-131 (aCi/m^3)	Perimeter/Onsite	66	0	5.0 (3)	-40 (70)	1.0 (50)

(a) Uncertainties ($\pm 2\sigma$) are in parentheses.

Springs between 2408 and 2713 m (7900 and 8900 ft) elevation on the eastern slope of the Jemez Mountains supply base flow throughout the year to the upper reaches of Canon de Valle, and to Los Alamos, Pajarito, and Water Canyons. These springs discharge water perched in the Bandelier Tuff and Tschicoma Formation at rates from 0.0001 to 0.0085 m^3/s (0.0045 to 0.30 ft^3/s) (DOE 1995i). The volume of flow from the springs is insufficient to maintain surface flow withing more than the western third of the canyons before it is depleted by evaporation, transpiration, and infiltration into the underlying alluvium (LANL 1993d).

At least 11 drainage areas pass through the LANL eastern boundary (LANL 1992a). Runoff from heavy thunderstorms and heavy snowmelt reaches the Rio Grande several times a year from some drainages (DOE 1995i). Runoff from summer storms on the Pajarito Plateau reaches a maximum discharge in less than 2 h and has a duration generally less than 24 h (LANL 1992b). Brief downpours can cause local flash flooding, especially in canyons, streams, and other low spots. Large-scale flooding is not common in New Mexico and has never been observed in Los Alamos.

In 1993, LANL (1993b) reported an evaluation of the 100-yr, 6-h storm event (that is, probability of occurrence of 1% per year), which represented the worst-case scenario providing a conservative estimate of a 100-yr flood event in Los Alamos Canyon. However, the peak flow for this event was 25 m^3/s (902 ft^3/s), indicating that flooding would not likely reach the finished floor elevation of the Omega West Reactor.

4.2.8.2 Groundwater

Groundwater occurs in three modes in the Los Alamos area: 1) as water in shallow alluvium in some of the larger canyons, 2) as perched water, and 3) as the main aquifer of the Los Alamos area (LANL 1992a).

Perched water at LANL occurs in conglomerates and basalts beneath the alluvium in a limited area in the midreach of the Pueblo Canyon and in a second area near the confluence of lower Pueblo and Los Alamos canyons (LANL 1992a). The horizontal extent of the aquifer is limited. The perched water in these two locations is not known to be hydrologically connected with the main aquifer.

The main aquifer is the only aquifer capable of supplying municipal and industrial water for the LANL area (LANL 1992a). The surface water and groundwater in the alluvium are separated from water in the main aquifer by several hundred feet of unsaturated volcanic tuff and sediments. The major recharge area for the deep aquifer is in the intermountain basins formed by the Valles Caldera (DOE 1979). The saturated sediments and volcanics in the basin are highly permeable and recharge the main aquifer. The movement of the main aquifer is east-southeast toward the Rio Grande.

For more information on groundwater, refer to LANL (1992a) and DOE (1979).

4.2.9 Ecological Resources

The significant diversity of ecosystems at LANL is due partly to the dramatic 1500-m (5000-ft) elevational gradient from the Rio Grande on the east, to the Jemez Mountains 20 km (12 mi) on the west, and to the many canyons with abrupt surface slope changes that dissect the area. Ecological surveys of

LANL were carried out in 1987 and 1992; the latter study was conducted to characterize vegetation. A 1995 study was carried out to document and examine the occurrence of nesting Mexican spotted owls 'Risberg 1995).

4.2.9.1 Terrestrial Resources

Several vegetative community types are found on the Pajarito Plateau and surrounding mountains. Two of them--piñon-juniper woodland and ponderosa pine forest/piñon-juniper woodland--are predominant. Others include fir, fir/aspen, pine-fir, shrub grass-fir, and juniper-grassland (Figure 4-12) (Dunham 1995). For additional information on vegetation, refer to Travis 1992.

Rocky Mountain mule deer (*Odocoileus hemionus*) and Rocky Mountain elk (*Cervus canadensis*) make up the most important and prevalent big game species at LANL. Other large mammals include American black bear (*Ursus americanus*), coyote (*Canis latrans*), and raccoon (*Procyon lotor*). Small mammals include the Mexican woodrat (*Neotoma mexicana*), deer mouse (*Peromyscus maniculatus*), Abert's squirrel (*Sciurus aberti*), and cottontail rabbit (*Sylvilagus nuttalli*) (Dunham 1995). For more information on animal life, refer to White (1981) and Risberg (1995).

4.2.9.2 Aquatic Resources

Aquatic habitats at LANL are limited to the Rio Grande and several springs and intermittent streams in the canyons; detailed descriptions of the physical aspects of the surface waters can be found in DOE (1995h). Los Alamos and Mortàndad canyons have perennial flow in the lower reaches as a result of discharge of treated sanitary waste from wastewater treatment plants. Some base flow in streams in the .jarito and Ancho canyons occurs from spring sources.

The Omega West Reactor (TA-2), located in Los Alamos Canyon, is drained by a stream less than 1 m (3.28 ft) wide that originates in the Jemez Mountains from an impounded high-elevation reservoir (2320 m). The stream channel supports little or no water-borne vegetation. The upper reaches are located in spruce-fir forests, and the lower reaches pass through mixed conifer habitat. The stream bed consists of large rocks, cobble, sand, and gravel. A wastewater outfall empties into the stream below TA-2. No fish were observed in the Los Alamos Canyon stream below the reservoir. For more information refer to Cross (1994).

4.2.9.3 Wetlands

The floodplain areas of LANL have been mapped by the U.S. Fish and Wildlife Service (Figure 4-13). For more information refer to Dunham 1995.

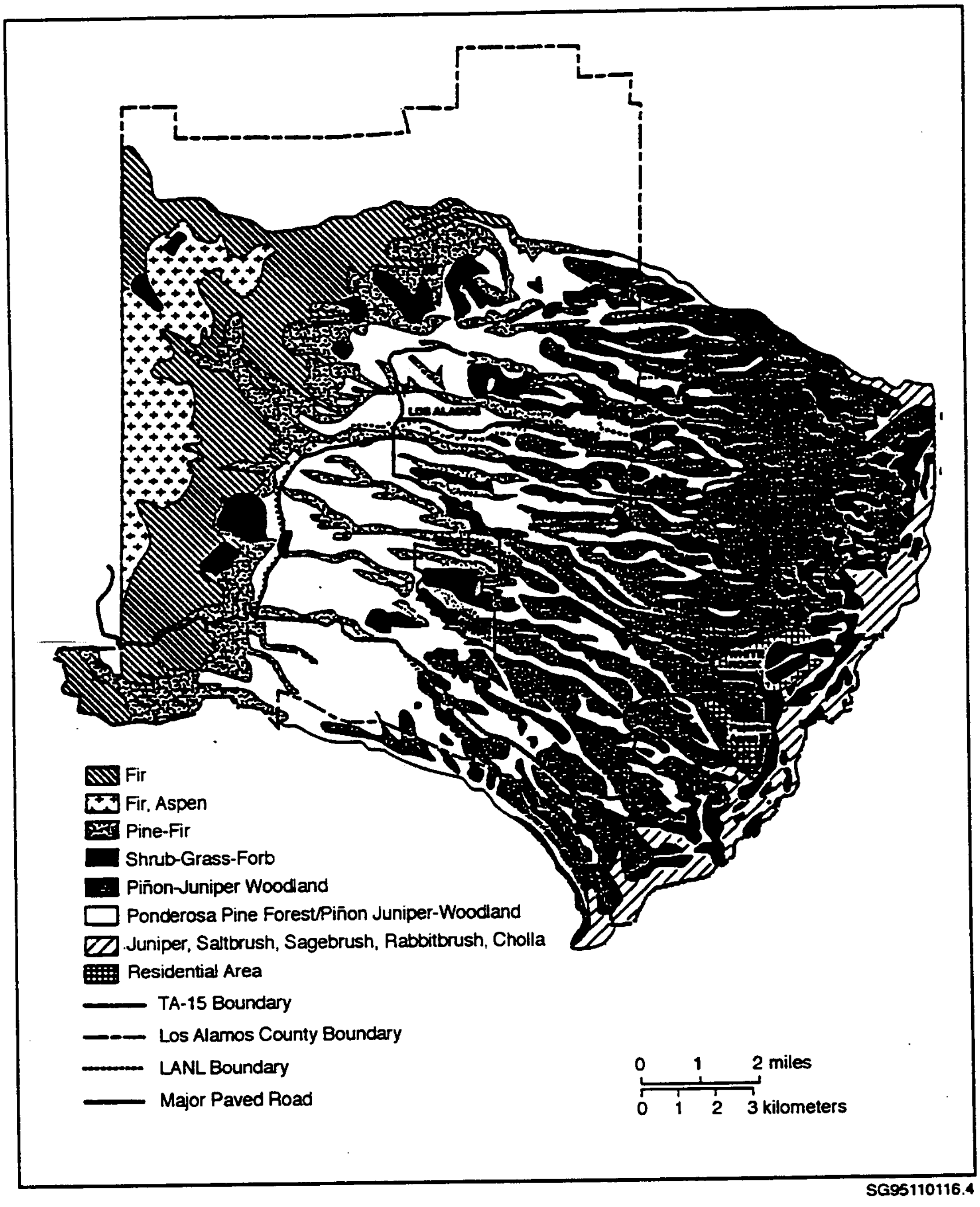

Figure 4-12. Plant Communities on the Pajarito Plateau

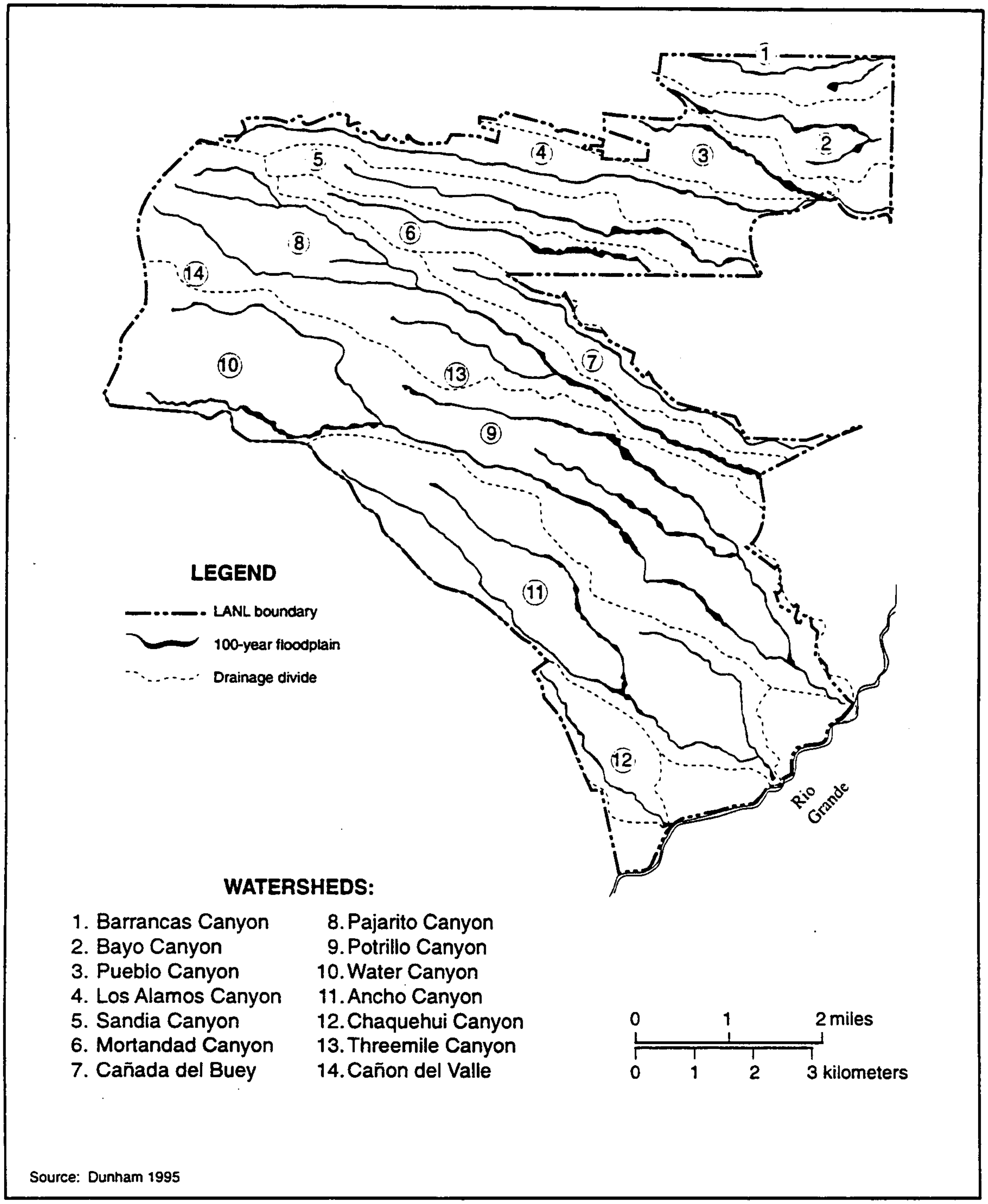

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Figure 4-13. Floodplain Map of Los Alamos National Laboratory

4.2.9.4 Threatened and Endangered Species

The Mexican spotted owl is listed as a federally threatened species, and as a state endangered species in New Mexico. Canyons surrounding TA-15 and at other locations within the LANL boundaries provide nesting, roosting, and foraging habitats for the Mexican spotted owl. These owls were first observed in canyons within TA-15 by a LANL biologist with the Ecological Studies Team in the spring of 1995. These sightings were confirmed in June 1995, and a nest site was found in the TA-15 area. Two young were fledged from this nest during the 1995 breeding season (March 1 to August 31) (Risberg 1995).

A total of 11 other species that may occur at LANL are listed as threatened or endangered by either the U.S. Fish and Wildlife Service or the New Mexico Department of Game and Fish. An additional 12 species are considered candidates for inclusion on the federal endangered or threatened list or are considered rare by the State of New Mexico (Table 4-10) (DOE 1995i). The 1992 biological survey (Risberg 1995) found none of these species within LANL; however, highly suitable habitat exists for many of these species within the vicinity of the proposed project area.

4.2.10 Noise

The Omega West Reactor is located in TA-2 about 200 m from the LANL site boundary and the community of Los Alamos. Background noise levels range from 31 to 35 dB(A) in the more remote areas of the site to 51 dB(A) at the LANL site boundary which is near the community of White Rock (DOE 1995i). The increased noise level is attributed to local automobile traffic.

4.2.11 Transportation

This section describes the regional and local transportation infrastructure affected by the alternatives involving LANL. Included are descriptions of the highway and air transportation infrastructure that would be used to support production of Mo-99 at LANL. No rail shipments are planned to support production of Mo-99.

4.2.11.1 Roadways

Regional and local transportation routes in the vicinity of LANL are illustrated in Figures 4-14 and 4-15. The highway route from Albuquerque consists of Interstate 25 to Santa Fe, US 84/285 from Santa Fe to Pojoaque, and New Mexico State Highway 4 from Pojoaque to Los Alamos. New Mexico State highways 14 and 44 are also significant roadways in the region surrounding LANL.

Estimates of baseline traffic volume for road segments providing access to LANL were not available. Traffic estimates for Los Alamos County, based on traffic surveys and site employee surveys, approximate travel distances per day within the county at 64 km (46 mi). Of this total, LANL employees commuting onsite and to and from work account for approximately two-thirds or 49 km (33 mi) of the total distance.

Table 4-10. Threatened, Endangered, and Candidate Species Potentially Present at Los Alamos National Laboratory

Scientific Name	Common Name	Status	Habitat	Potential for Occurrence
PLANTS				
Fritillaria atropurpurea	Checker lily(a)	SE(d)	Mixed conifer	Low to Moderate
Lilium philadelphicum	Wood lily(a)	SE(d)	Ponderosa to mixed conifer, cliffs 1829 to 3048 m (6000 to 10,000 ft)	Low to Moderate
Mammillaria wrightii	Wright's fishhook cactus(a)	SE(d)	Desert grassland to piñon-juniper 914 to 2134 m (3000 to 7000 ft)	Unlikely to Low(h)
Opuntia viridiflora	Santa Fe cholla(a)	FC(e),SE(d)	Piñon-juniper 2195 to 2438 m (7200 to 8000 ft)	Unlikely to Low(h)
Pediocactus papyracanthus	Grama grass cactus(a,b)	FC(e)	Grasslands, piñon-juniper woodlands 1524 to 2225 m (5000 to 7300 ft)	Unlikely to Moderate(i)
ANIMALS				
Plethodon neomexicanus	Jemez Mountain salamander(b)	FC(e), SE(f)	Densely wooded, shady canyons	Unlikely to Low
Accipiter gentilis	Northern goshawk(a,b,c)	FC(e)	Ponderosa; dense, mature, or old-growth coniferous forest	Low to Moderate
Buteo regalis	Ferruginous hawk(b)	FC(e)	Grasslands	Unlikely to Low(h)
Buteogallus anthracinus	Common black hawk(c)	SE(f)	Riparian with cottonwood	Unlikely(h)
Cynanthus latirostris	Broad-billed hummingbird(a,b)	SE(f)	Riparian woodlands	Unlikely(h)
Empidonax traillii extimus	Southwestern willow flycatcher(a)	FE(e), SE(f)	Riparian woodlands dominated by cottonwoods 1147 to 2759 m (3700 to 8900 ft)	Unlikely(h)
Falco peregrinus	Peregrine falcon(a,b,c)	FE(e), SE(f)	Ponderosa-piñon, streams and lakes	Low
Haliaeetus leucocephalus	Bald eagle(a,b,c)	FE(e), SE(f)	Riparian near streams and lakes	Unlikely to Low(h)
Ictinia mississippiensis	Mississippi kite(a)	SE(g)	Riparian and shelterbelts	Unlikely(h)

Table 4-10. (contd)

Scientific Name	Common Name	Status	Habitat	Potential for Occurrence
Lanius ludovicianus	Loggerhead shrike[(b)]	FC[(e)]	Grasslands, open woodland	Unlikely to Low[(h)]
Plegadis chihi	White-faced ibis[(b)]	FC[(e)]	Streams, marshes, ponds	Unlikely[(h)]
Strix occidentalis lucida	Mexican spotted owl[(a,b,c)]	FT[(e)]	Mixed conifer; mountains and canyons, uneven-aged, multi-storied forest with closed canopy	High
Euderma maculatum	Spotted bat[(a,b,c)]	FC[(e)], SE[(f)]	Ponderosa, piñon-juniper, cliffs and rock crevices	Low
Myotis evotis	Long-eared myotis[(a)]	FC[(e)]	Spruce-fir community	High
Myotis lucifugus *occultus*	Occult little brown bat[(b)]	FC[(e)]	Mountains, caves, and hollow trees	Unlikely[(b)]
Myotis thysanodes	Fringed myotis[(a)]	FC[(e)]	Water bodies at various elevations	High
Myotis volans	Long-legged myotis[(a)]	FC[(e)]	Ponderosa pine and higher elevations, water bodies	High
Myotis yumanensis	Yuma myotis[(a)]	FC[(e)]	Permanent watercourses	High
Ochotona princeps nigrescens	Goat peak pika[(b)]	FC[(e)]	Lava boulders	Unlikely[(b)]
Zapus hudsonius luteus	New Mexican jumping mouse[(b)]	FC[(e)], SE[(f)]	Near streams and vegetation	Low

(a) Source: Dunham 1995.
(b) Source: DOI 1995a.
(c) Source: Risberg 1995.
(d) From New Mexico Energy, Minerals and Natural Resources Department, NMFRCD Rule No. 91-1.
(e) Source: DOI 1995b.
(f) From New Mexico Department of Game and Fish, Regulation #682, 11/30/90.
(g) Until recently, listed as state endangered by the New Mexico Department of Game and Fish.
(h) Suitable habitat for this species does not occur in the proposed project area (Risberg 1995).

Status:
SE: State Endangered: New Mexico-listed species protected as threatened or endangered under the Wildlife Conservation Act.
FC: Federal Candidate "...[any species] for which the USFWS has on file enough substantial information of biological vulnerability and threat, [or] for which other information now in the possession of the USFWS indicates that proposing to list them as threatened or endangered is possibly appropriate..." [Federal Register Vol. 56, No. 255].
FE: Federal Endangered: "...any species that is in danger of extinction throughout all or a significant portion of its range." [Federal Register Vol. 56, No. 255].
FT: Federal Threatened: "...any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range." (Endangered Species Act of 1973).

Table 4-10. (contd)

Potential for Occurrence: Unlikely – Suitable habitat for species does not exist within or near operable unit. Low – Potential for occurrence due to habitat requirements, but not found during field survey or not known to occur in general project area. Moderate – Known to occur in habitat similar to project area or general area of operable unit. High – Species observed during field survey or known populations exist near project area. Note: Potential for occurrence sometimes given as a range, due to variations in findings by different researchers at various times.

4.2.11.2 Airports and Air Traffic

Three airports are located in the vicinity of the LANL: LANL Airport, Albuquerque International Airport (135 km/83.8 mi from LANL), and Santa Fe Airport (32 km/20 mi from LANL). LANL airport is owned by the DOE and managed by the Zia Company (DOE 1979) and is typically used for non-jet traffic. Figure 4-14 shows the locations of Albuquerque International Airport and Santa Fe Airport with respect to LANL and interconnecting roadways.

4.2.12 Radiological Health and Safety

For general information applicable to the four alternatives, refer to Section 3 of this EIS.

4.2.12.1 Current Radiological Environment

Normal operations at LANL produce radioactive air emissions (LANL 1995). Air emissions are routinely sampled from 88 release points. The major source of radioactive emissions is the Los Alamos Meson Physics Facility, which releases short-lived (8-s to 20-min half-life) air activation products and tritium. The quantity released depends on the amount of time the facility is in operation. In 1994, the Los Alamos Meson Physics Facility released 52,000 Ci of tritium and mixed air activation products. The maximally exposed individual, located across a canyon north of the Los Alamos Meson Physics Facility, received an estimated dose of 7.6 mrem in 1994 (LANL 1995).

The total uranium-235 released from LANL as a whole was 0.38 mCi. An individual located about 1000 m (0.6 mi) north of the Chemistry and Metallurgy Research Facility, in Los Alamos townsite, receives a potential annual dose of 2.7×10^{-3} mrem from the Chemistry and Metallurgy Research Facility operations.

Naturally occurring background radiation dose in Los Alamos is 340 mrem/yr. A gamma ray reading (measured using a thermoluminescent detector) on 48th Street, the Los Alamos neighborhood nearest to the Chemistry and Metallurgy Research Facility, was 105 mrem, compared with readings from Santa Fe, Espanola, and Pojoaque that ranged from 92 to 97 mrem (LANL 1994a).

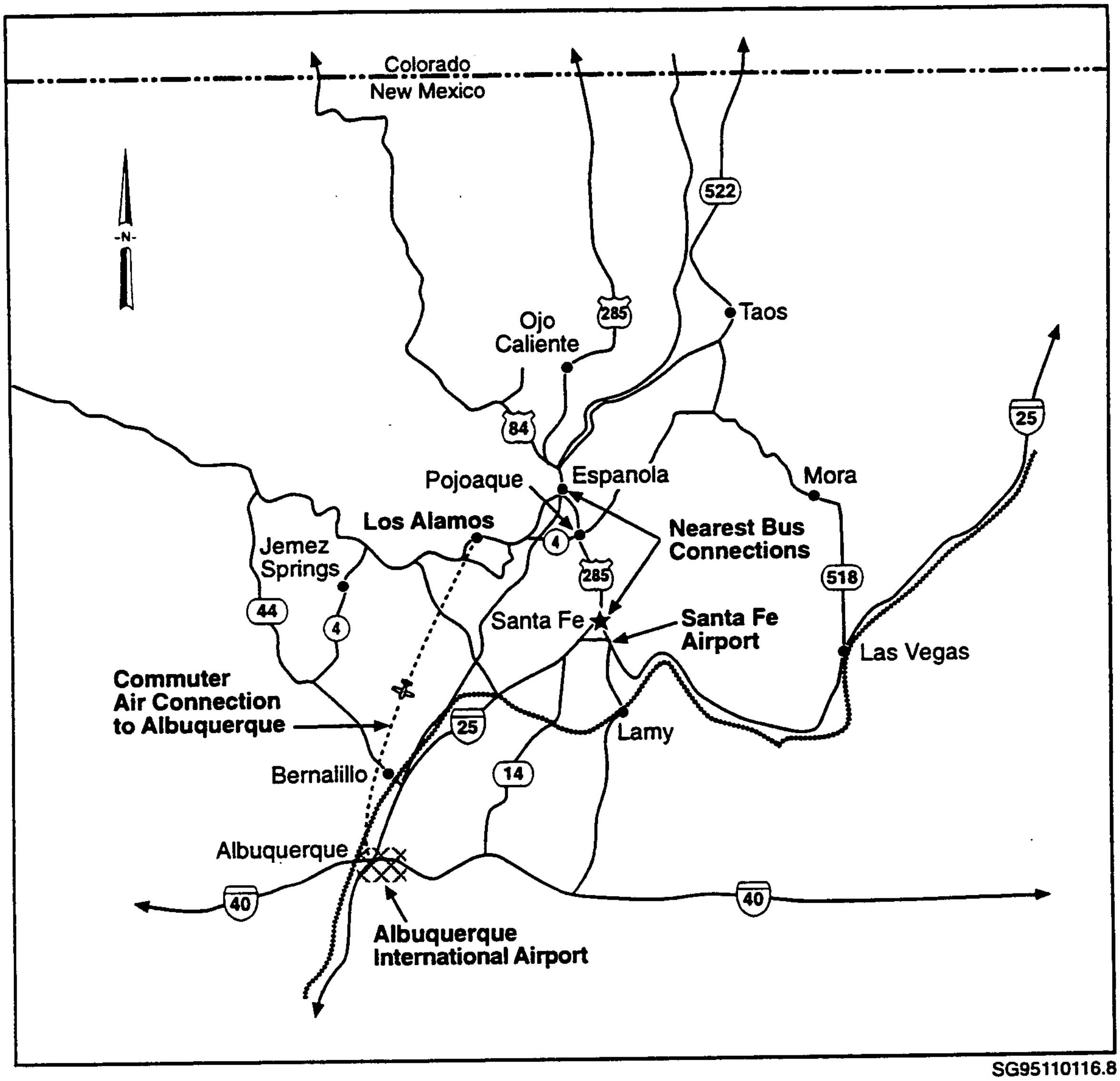

Figure 4-14. Regional Transportation Routes Near Los Alamos National Laboratory

In 1993, the effective dose equivalent to the maximally exposed individual from LANL operations was 5.6 mrem (5.6 x 10^{-5} Sv). This dose includes the contribution from non-point sources. The location of the maximally exposed individual is at a business office 800 m (0.5 mi) north-northeast of the site boundary of TA-53.

The collective dose for workers at the LANL site in 1993 amounted to 239 person-rem. Fewer than one (0.1) latent cancer fatalities are expected from this worker dose. The estimated collective dose for the population within 80 km (50 mi) of the LANL site was 4.0 person-rem for 1994 (LANL 1995). No (0.002) excess latent cancer fatalities are expected from this population dose. The annual collective

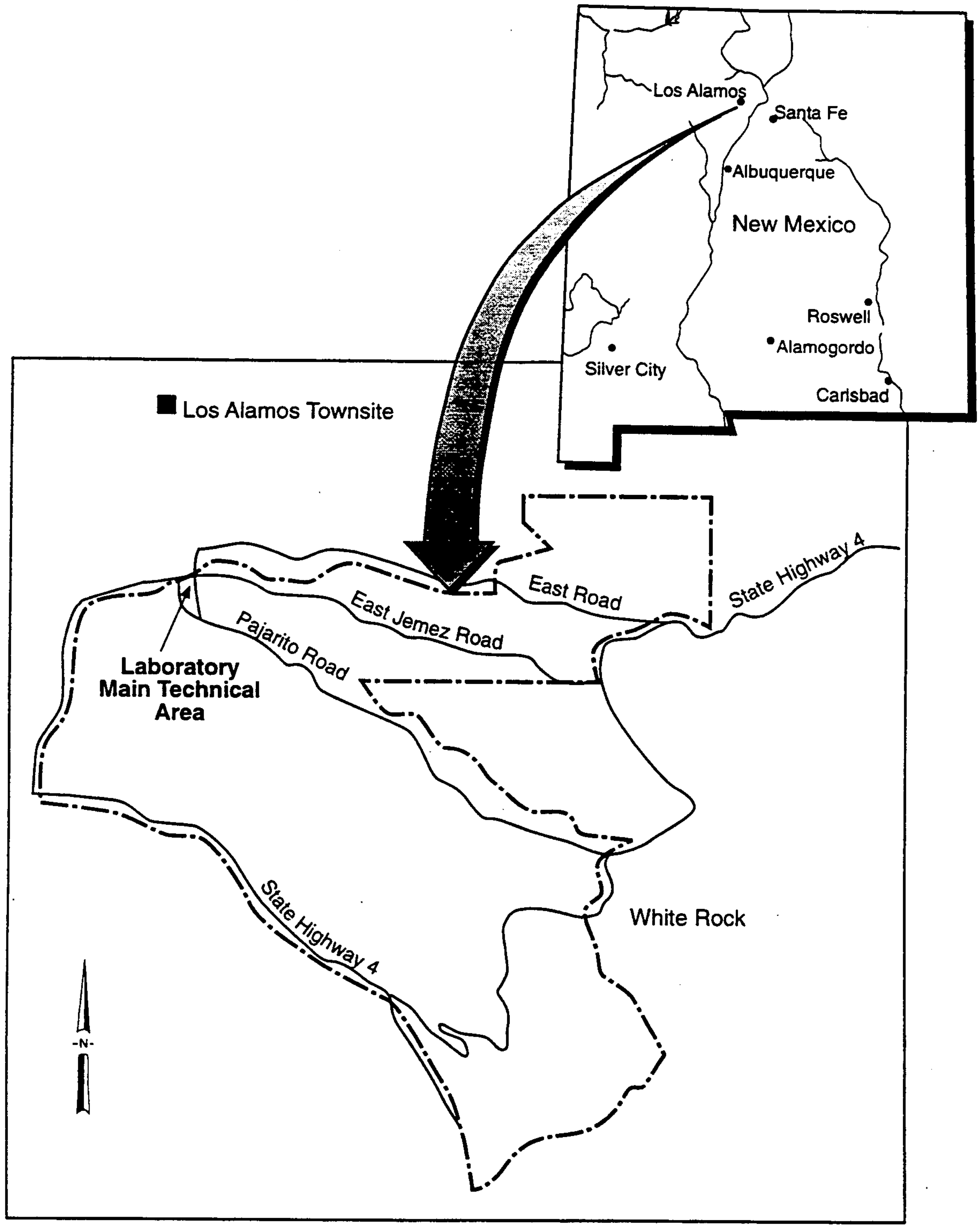

Figure 4-15. Local Transportation Routes Near Los Alamos National Laboratory

population dose for the same population from naturally occurring background radiation would be about 110,000 person-rem/yr (DOE 1995i).

4.2.13 Site Services

The LANL utility system has 640 km (400 mi) of lines that provide electricity, telecommunications, water, sanitary sewer, radioactive liquid waste disposal, and natural gas distribution within the laboratory. Existing resource requirements are summarized in Tables 4-11 and 4-12.

Table 4-11. Existing Los Alamos National Laboratory Utility Resource Requirements

Utility Resources	Average Daily Consumption	Peak Demand	System Capacity
Electricity	1045 MWh	87 MW[a]	120 MW
Natural Gas	4,200,000 ft^3	417,000 ft^3/hr	500,000 ft^3/hr
Water	4,100,000 gal	6600 gpm	6900 gpm

(a) MW is megawatt.
Conversions:
To convert cubic feet (ft^3) to cubic meters (m^3), multiply by 0.028317.
To convert gallons (gal) to liters (L), multiply by 3.785.

Table 4-12. Existing Los Alamos National Laboratory Chemical Resource Requirements

Chemical Resources	Total Annual Consumption	Storage Capacity
Liquid Nitrogen	1,189,000 gal	5500 gal
Argon	11,486,000 ft^3	1,125,000 ft^3
Helium	1,066,000 ft^3	67,000 ft^3
Hydrogen	35,000 ft^3	1100 ft^3
Oxygen	5,057,000 gal	135,000 gal
Carbon Dioxide	686,000 ft^3	96,200 ft^3

Conversions:
To convert cubic feet (ft^3) to cubic meters (m^3), multiply by 0.028317.
To convert gallons (gal) to liters (L), multiply by 3.785.

Electricity is supplied to LANL by a Los Alamos County/DOE power pool over two 115-kV lines (one from Santa Fe and one from Albuquerque). Natural gas used by the laboratory comes from the n Juan Basin in northwest New Mexico. The lines are operated and maintained by the Gas Company of ,w Mexico under contract to DOE. Water for the laboratory and adjacent area (including Los Alamos townsite, White Rock, and Bandelier National Monument) primarily comes from three DOE-operated well fields. The existing LANL sanitary sewer system includes two treatment facilities. In addition, approximately 780 septic tanks are dispersed throughout laboratory areas not served by the existing sanitary sewer system.

4.2.14 Waste and Spent Nuclear Fuel Management

Ongoing activities and operations generate waste from processing effluents, separating isotopes, manufacturing, testing and manufacturing explosives, cleaning chemically contaminated equipment, working with radioactive materials, and through research and development programs in basic and applied chemistry. Waste types generated include radioactive waste (transuranic waste, low-level radioactive waste, and low-level mixed waste), hazardous chemical waste, biological waste, medical waste, and sanitary solid and liquid waste. LANL generates no high-level waste. Some spent nuclear fuel is kept in interim storage. The laboratory has initiated an effort to minimize the generation of radioactive and hazardous chemical waste (DOE 1995k).

4.2.14.1 Spent Nuclear Fuel

Omega West Reactor is currently shut down. The reactor contains no fuel, and all of the 86 elements are in temporary dry storage at the Chemistry and Metallurgy Research Facility. Additional reactor sites facilities at Los Alamos, such as the Fast Burst Reactor and General Purpose Critical Assembly, each contain some radioactive and fissionable materials, but do not routinely produce spent nuclear fuel. The quantity of spent nuclear fuel at LANL in 1995 was estimated as 14 kg (heavy metal) (DOE 1995g).

4.2.14.2 Low-Level Radioactive Waste

Liquid low-level waste is generated from many areas throughout LANL. LANL has two onsite liquid low-level waste treatment facilities, a chemical treatment and ion-exchange plant, and a chemical treatment plant. Solid low-level waste (paper, plastic, glassware, rags) is packaged and transported to an onsite location (at TA-54, Area G) for compaction and burial. In 1991, approximately 21,903,795 L (5,787,000 gal) of liquid low-level waste and 5701 m^3 (7541 yd^3) of solid low-level waste were generated (DOE 1993b). The cumulative volume of low-level waste onsite, as of 1993, is 220,700 m^3 (288,545 yd^3) with a 1993 annual production volume of 2100 m^3 (2746 yd^3) (DOE 1994a).

4.2.14.3 Low-Level Mixed Waste

Low-level mixed waste at LANL includes solvents, pyrophoric substances, spray cans, scintillation vials, miscellaneous reagent chemicals, vacuum pump oil contaminated with mercury, and other contaminated material. LANL does not permanently dispose of low-level mixed waste onsite. The waste is stored at TA-54 and at Areas L and G. All low-level waste mixed packages are planned to be transported by commercial carriers to a permitted, licensed facility. In 1991, LANL generated 34,110 L (9000 gal) of liquid mixed waste and 112 m^3 (148 yd^3) of solid mixed waste (DOE 1993b). As of 1993, LANL had a cumulative volume of 4681.6 m^3 (6121 yd^3) of low-level mixed waste (DOE 1994a).

4.3 Oak Ridge Environment

4.3.1 Overview

The city of Oak Ridge and the Oak Ridge Reservation lie between Roane and Anderson counties in a predominantly rural area in northeastern Tennessee and are situated between the Cumberland and Southern Appalachian mountain ranges (Figure 4-16). The Clinch River borders the city on the south, flowing in a general east-to-west direction, with many streams along the southern boundary of the city. Knoxville is located approximately 40 km (25 mi) southeast of Oak Ridge and is the largest city in the area.

The Oak Ridge Reservation is located on 140 km^2 (54 mi^2) of federally owned land adjoining the city limits of Oak Ridge, Tennessee. Land use activities within the Oak Ridge Reservation consist of three main plant sites: the Y-12 Plant (3.4 km^2/1.3 mi^2), the Oak Ridge National Laboratory (ORNL) (4.7 km^2/1.8 mi^2), and the K-25 site (2.8 km^2/1.1 mi^2). A number of reactors have been built on the Oak Ridge Reservation, including the Oak Ridge Research Reactor that is being considered as an option for the production of Mo-99. The site also supports research into energy conservation, fusion, and other energy technologies.

Land uses bordering the Oak Ridge Reservation are primarily forest and agricultural. Residential and commercial are the only other significant uses of land in the vicinity and occur along the northeast and northwest boundaries of the Oak Ridge Reservation in the city of Oak Ridge. The land areas bordering the Oak Ridge Reservation consist of woodlands, small farms, and rural residences (Figure 4-17).

Although the Oak Ridge area experiences a moderate level of seismic activity, the largest recorded earthquake in this area occurred in Giles County, Virginia, on May 31, 1897, and registered magnitude 5.8 on the Richter scale. The most recent significant earthquake in the Appalachian area occurred on November 30, 1973, at Maryville, Tennessee, 34 km (21 mi) southeast of the Oak Ridge Reservation. This earthquake had a Modified Mercalli Intensity of VII at the epicenter and a Modified Mercalli Intensity of V to VI in the Oak Ridge area.

Of the total federal- and state-listed threatened, endangered, or other special-status species designated by the Endangered Species Act or the state's Nongame and Endangered Species and the Rare Plant Protection and Conservation Laws, 25 species have recent records of occurrence on the Oak Ridge Reservation. The potential occurrence of another 22 species has been determined based on historical records, proximity to geographic ranges, and the migratory nature of species. No animal species listed by the

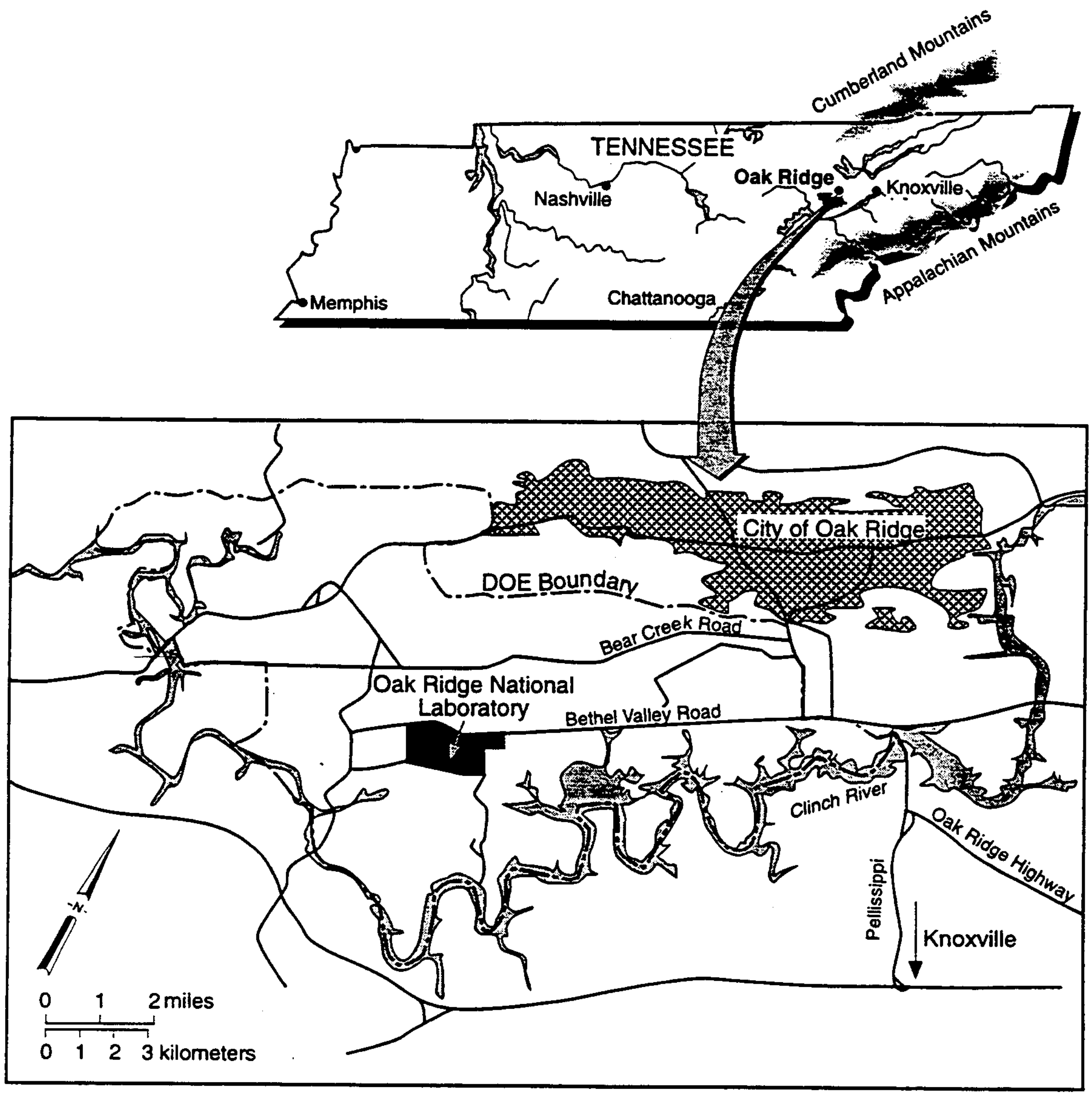

Figure 4-16. Location of Oak Ridge National Laboratory

federal government as threatened or endangered are known to reside on the Oak Ridge Reservation. However, the bald eagle (*Haliaeetus leucocephalus*, federal endangered) is a winter visitor to Watts Bar Lake and Melton Hill Lake. No critical habitat for threatened and endangered species, as defined in the Endangered Species Act, exists on the Oak Ridge Reservation.

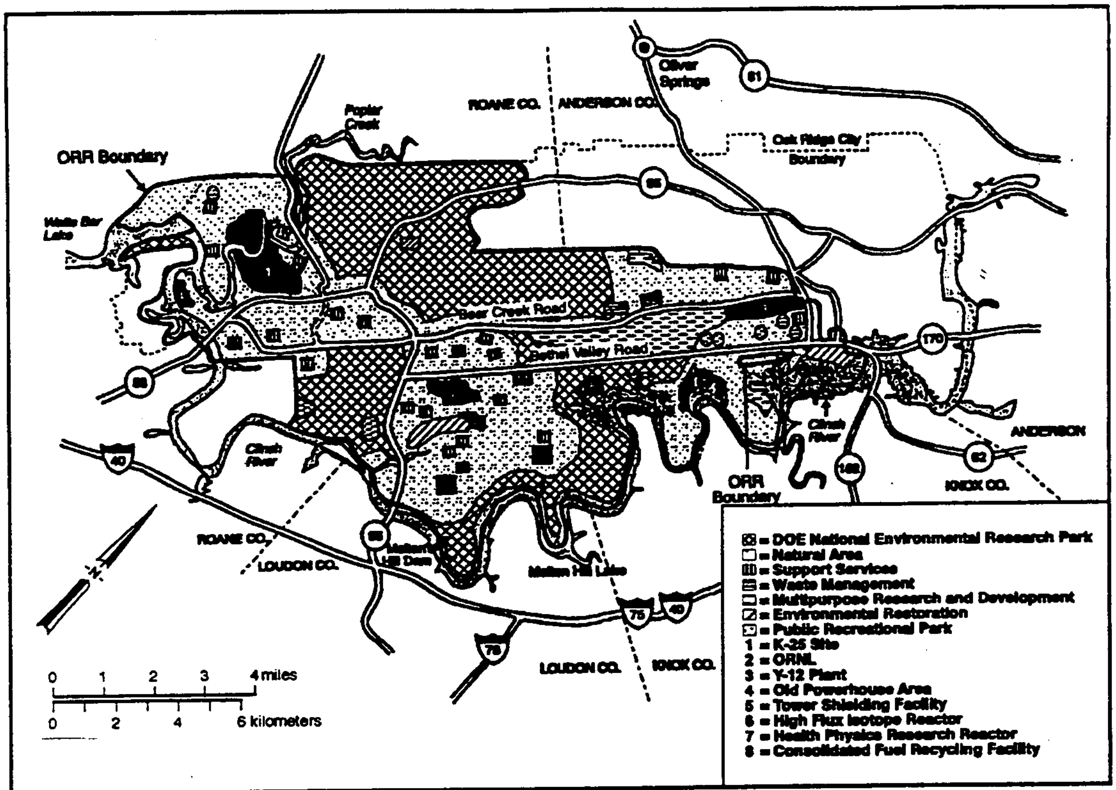

Figure 4-17. Land Use for the Oak Ridge Reservation

The total mass of spent nuclear fuel at ORNL is approximately 21 tons. The total mass of spent nuclear fuel at Y-12 Plant is approximately 3.5 tons. The Y-12 Plant, K-25 site, and the ORNL generate and manage low-level wastes. The total cumulative volume of low-level waste disposed of through 1993 was 442,000 m^3 (577,874 yd^3).

4.3.2 Land Use

4.3.2.1 Oak Ridge Reservation

The Oak Ridge Reservation is located on approximately 140 km^2 (54 mi^2) of federally owned land adjoining the city limits of Oak Ridge, Tennessee (MMES 1989a). Land use activities at the Oak Ridge Reservation have historically occurred within the boundaries of three main plant sites. These are the Y-12 Plant (3.4 km^2/1.3 mi^2), the ORNL (4.7 km^2/1.8 mi^2), and the K-25 site (2.8 km^2/ 1.1 mi^2) (Figure 4-17). Other Oak Ridge Reservation lands were used for waste storage in the mid-1940s and for environmental research in the 1950s. A forestry management program was initiated in 1964, and the first comprehensive forest management program was released in 1965. The Oak Ridge Reservation has been used by research institutions, universities, and government agencies as a site for the study of terrestrial ecology, aquatic ecology, forestry, and agriculture. In 1980, the DOE designated approximately 54 km^2 (21 mi^2) of undeveloped Oak Ridge Reservation land as a National Environmental Research Park (see Figure 4-17) 'at provides protected land areas for research and education in the environmental sciences (MMES .989a).

Land use outside the three main plant sites falls into seven general categories: multipurpose research and development, support services, waste management, environmental restoration, natural areas, public recreational park, and national environmental research park (Figure 4-17). Approximately 58% of the land on the Oak Ridge Reservation (8121 ha/20,059 ac or 80 km^2/31 mi^2) can be classified as undeveloped (MMES 1994).

4.3.2.2 Oak Ridge National Laboratory

The ORNL is located in the southern portion of the Oak Ridge Reservation, just south of Bethel Valley Road, about 0.5 mi east of State Route 95. ORNL is surrounded by a natural area, with sites and facilities dedicated to environmental restoration and nearby support services. Approximately 5 km (3 mi) south of the ORNL is the Melton Hill Dam, which controls the flow of the Clinch River near the Oak Ridge Reservation. The primary function of Melton Hill Dam is power generation; flood control is a secondary function (Figure 4-18) (DOE 1995l).

Land use at the ORNL site is dedicated to the mission of the laboratory. ORNL has a number of reactors, including the Oak Ridge Research Reactor under consideration as an option for the production of Mo-99. The site also supports research in energy conservation, fusion, and other energy technologies, as 'vell as research in the physical and life sciences (DOE 1994c).

4.3.3 Socioeconomic Environment

The region of influence for the Oak Ridge Reservation has been well-established in numerous previous environmental assessments and environmental impact statements for site facilities, and includes the counties of Anderson, Knox, Loudon, Morgan, and Roane and the major cities located in those counties. This region of influence is defined as the region in which most of the direct and indirect socioeconomic effects of the proposed Oak Ridge Research Reactor could be expected to impact local populations and institutions. It was estimated that about 92% of Oak Ridge Reservation employees commute to the Oak Ridge Reservation from residences in these counties. It was assumed that whatever resources and utilities are needed to modify and operate the Oak Ridge Research Reactor for production of Mo-99 are available within this region of influence (DOE 1995m).

4.3.3.1 Demographic Characteristics

The population of the region of influence was almost 500,000 at the time of the 1990 census. Between 1980 and 1990, the population grew by 4.0%. The city of Oak Ridge has been losing population since 1970, and Anderson County, in which Oak Ridge is predominately located, is expected to decline slightly

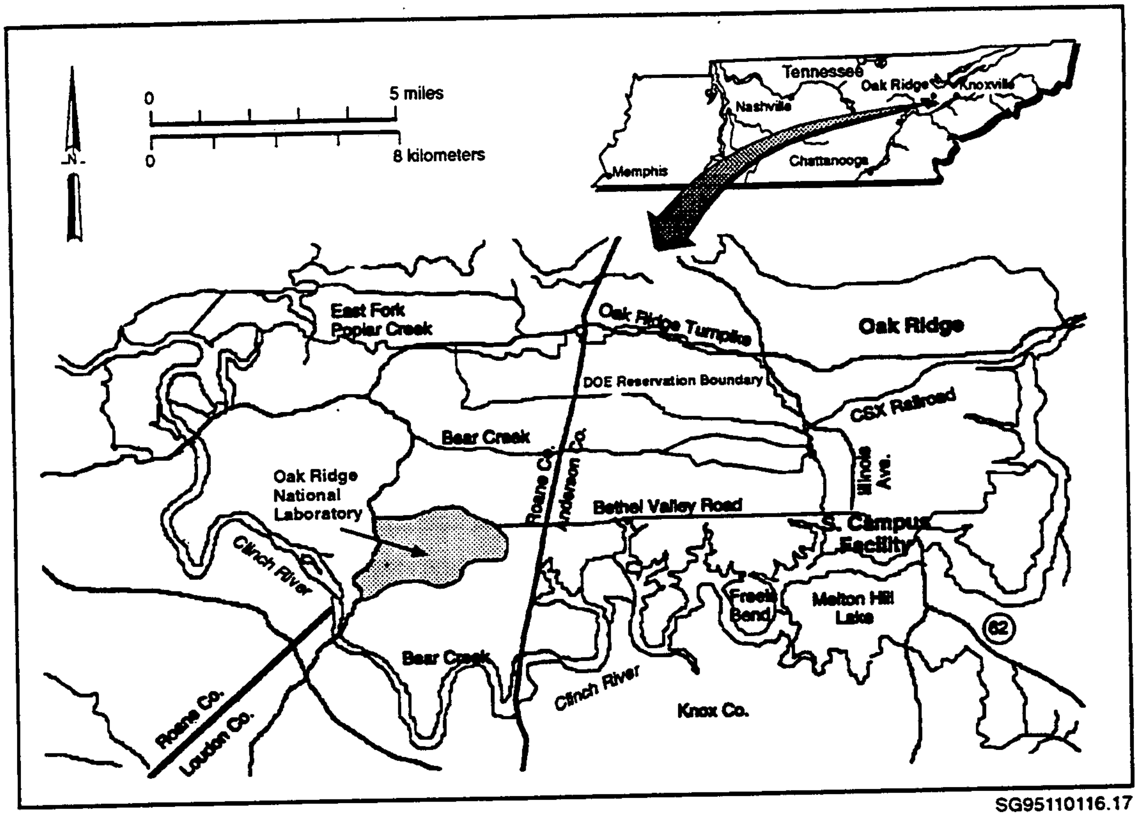

Figure 4-18. ORNL and Surrounding Area (DOE 1995m)

in population between 1990 and 2000. The East Tennessee Development District is forecasting a 3.1% growth for the region of influence between 1990 and 2000 (East Tennessee Development District 1995a). This forecast reflects, in large measure, the current and projected reduction in activities and work force at various Oak Ridge facilities by DOE and its contractors.

On average, compared with the state of Tennessee, the region of influence has a smaller proportion of its population under 18 years and a larger proportion of its population under 65 years. The dependency ratio, which indicates approximately how many dependents each 100 persons in the productive years must support, is somewhat lower for the region of influence than the state as a whole, largely due to Knoxville's higher proportion of working age persons in its population.

The racial and ethnic composition of the region of influence differs markedly from the state of Tennessee, with 92% white in the region of influence versus 83% for the state. The Hispanic population, at 0.6%, is quite low compared with the state as a whole (University of Tennessee - Knoxville 1994).

Population in the region of influence is on average more highly educated than the average state population. This situation reflects the high educational attainment of the Oak Ridge Reservation labor force and the presence of Knoxville in the region of influence. Median household incomes and per capita personal income are higher in both Anderson and Knox counties than for the state of Tennessee. Except for Morgan and Roane counties, the region of influence has a lower percentage of persons living below the poverty level than is true for the state as a whole.

4.3.3.2 Economic Base

The total 1994 labor force in the region of influence was 287,491, a 13.9% increase since 1991 (East Tennessee Development District 1995b). Unemployment declined during that period from 12,913 persons to 10,400 persons, for a 19.5% decline. Using different sources, Table 4-13 shows employment by industry in 1990 and 1993 for the five counties, and the region of influence and the state of Tennessee. The unemployment rate declined from 5.1% to 3.6% during that period. In 1993, the region of influence had 317,809 employed workers who earned $8.3 billion in wages, an increase from 299,238 employed in 1990 who earned $6.7 billion in wages (DOC 1995). The largest gains in employment between 1990 and 1993 occurred in three industry sectors: agricultural services (17.3%), construction (17.7%), and services (15.5%). Total employment, earnings, and per capita income for the region of influence (minus Morgan County) are projected to increase 5.6%, 5.9%, and 10.5% respectively between 1995 and 2000. In the city of Oak Ridge, the percentage of workers in the three occupational categories of executive/administrative/managerial, professional, and technicians/related support substantially exceeded the proportions represented in the state of Tennessee (Oak Ridge Chamber of Commerce 1995).

Annual retail sales in the region of influence increased 13.9% between 1992 and 1994, from $4.5 billion to $5.1 billion dollars. Similar gains were experienced in each of the five component counties in the region of influence (East Tennessee Development District 1995c).

DOE-related employment associated with the Oak Ridge Field Office totaled 18,565 employees with a total payroll of $841.4 million as of December 1994 (DOE 1995n). The region of influence contains 92.2% of the DOE employees at the Oak Ridge Reservation, and Anderson and Knox counties account for 78.5%.

The important economic issue for the region of influence is how current programmatic cutbacks in the DOE are likely to impact these employment and payroll levels in the area. Although little uncertainty is present about the impending cuts in level of employment at the Oak Ridge Reservation, the magnitude and timing of these cuts remains very uncertain.

4.3.4 Cultural Resources

Aboriginal occupation of the region extends back several millennia. No known archaeological or Native American traditional properties are adjacent to the Oak Ridge Research Reactor. The reactor itself has not been recorded as a historic property and has not been evaluated for its eligibility to the National Register of Historic Places.

Table 4-13. Employment by Industry for the Oak Ridge Region of Influence, by County, and for the State of Tennessee, 1990 and 1993

Economic Characteristic	Anderson County	Knox County	Loudon County	Morgan County	Roane County	Region of Influence	State of Tennessee
Employment by Industry (1990)							
Farm	569	1,673	1,526	462	662	4,892	110,538
Agriculture Services	156	1,366	131	17	72	1,742	19,186
Mining	242	623	14	102	122	1,103	9,155
Construction	2,044	12,123	561	313	762	15,803	145,755
Manufacturing	11,998	25,860	3,458	1,562	5,968	48,846	532,217
Transportation and Public Utilities	973	10,036	641	226	495	12,371	136,311
Wholesale Trade	672	15,333	228	60	280	16,573	139,308
Retail Trade	(D)	41,488	1,648	419	(D)	43,555	463,867
Finance, Insurance, and Real Estate	1,590	12,584	649	124	510	15,457	164,483
Services	(D)	59,281	2,456	691	(D)	62,428	669,967
Government	5,167	35,896	1,405	1,389	3,775	47,632	385,929
Total Employment	40,084	216,263	12,717	5,365	24,809	299,238	2,776,716
Employment by Industry (1993)							
Farm	541	1,567	1,350	424	630	4,512	103,406
Agriculture Services	203	1,569	182	14	75	2,043	20,833
Mining	132	497	11	93	(D)	733	7,261
Construction	3,370	13,289	776	311	858	18,604	154,218
Manufacturing	12,061	25,052	3,177	1,178	5,938	47,406	541,218
Transportation and Public Utilities	1,525	9,224	715	186	679	12,329	146,629
Wholesale Trade	562	15,461	254	82	356	16,715	143,310
Retail Trade	(D)	40,677	1,938	447	(D)	43,062	492,104
Finance, Insurance, and Real Estate	1,685	12,470	675	116	517	15,463	160,366
Services	(D)	68,559	2,783	746	(D)	72,088	752,748
Government	5,263	37,499	1,579	1,526	3,903	49,770	393,234
Total Employment	46,897	225,864	13,440	5,123	26,485	317,809	2,915,827

(D) Data withheld to avoid disclosure. Incomplete data due to disclosure.
Sources: DOC 1995.

4.3.5 Aesthetic and Scenic Resources

The view surrounding the Oak Ridge Reservation consists mainly of sparsely populated rural land. The city of Oak Ridge, along the northeast portion of the site, is the only adjacent urban area. Views of

DOE facilities from areas surrounding the reservation include those from public roadways, such as interstate highways 40 and 75, U.S. Route 70, and state routes 62, 162, and 95. The reservation can also : viewed from the south bluffs along the Clinch River. Numerous local, state, and national public .ecreation areas are near the Oak Ridge Reservation. Federal outdoor recreation facilities include the Great Smoky Mountains National Park, the Cherokee National Forest, the Cumberland Gap National Historic Park, the Big South Fork National River and Recreation Area, and the Obed Wild and Scenic River. In general, views are limited by the rolling terrain, heavily forested vegetation, and hazy atmospheric conditions.

4.3.6 Geologic Resources

This section summarizes the physiography, geology, and seismic hazards at ORNL. A more detailed summary of these subjects can be found in DOE (1995b) and MMES (1989b), with site-specific information in Boyle et al. (1982).

4.3.6.1 General Geology

Physiography. ORNL is located on 36 km^2 (13 mi^2) in the south central portion of the 140 km^2 (55 mi^2) Oak Ridge Reservation (Figure 4-18). The Oak Ridge Reservation is located in the Bethel and Melton valleys about 32 km (20 mi) west of Knoxville, Tennessee, in the western portion of the Valley and Ridge Province. For a more detailed description of the ORNL geology, refer to MMES (1989b).

Geology. The Oak Ridge Reservation is part of the Southern Appalachian fold and thrust belt area ~d is characterized by a succession of northeast-trending thrust faults that structurally stack and duplicate ; Paleozoic rocks in the area (MMES 1989b). As a result of thrusting and subsequent differential erosion, a series of ridges consisting of relatively resistant rocks (sandstone, shale, and dolomite) and valleys developed in more easily eroded material (for example, less resistant carbonate and shale). Most of the units dip steeply toward the south-southeast. The rocks of the Valley and Ridge Province in eastern Tennessee are Early Cambrian to Early Mississippian in age. Most of the Oak Ridge Reservation is underlain by the Rome Formation and Conasauga, Knox, and Chickamauga groups (Figure 4-19) (Hatcher et al. 1992), and sedimentary rocks of Cambrian and Ordovician age. Refer to MMES (1989b) and Hatcher et al. (1992) for more details.

Structure. The Oak Ridge Reservation is located in a foreland fold and thrust belt (MMES 1989b). As a result, the geology is strongly influenced by structural features at all scales, including regional thrust faults, local thrust and tear faults, local folding, and widespread fracture development. The Copper Creek Fault lies south of the main plant area of Haw Ridge. All faults in the vicinity of Oak Ridge Reservation have been inactive since the late Paleozoic period (DOE 1993b). For more detail, refer to MMES (1989a) and DOE (1993a).

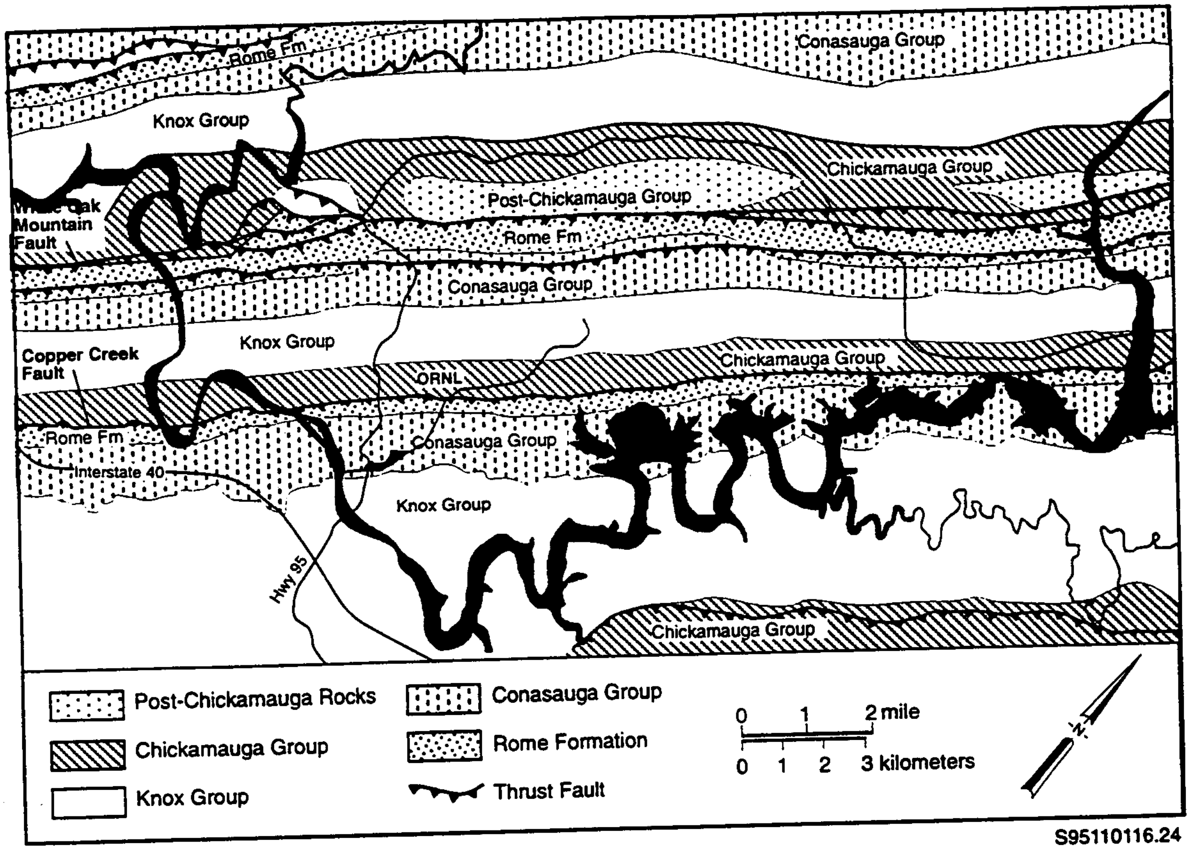

Figure 4-19. Regional Geologic Map of the Oak Ridge Reservation (MMES 1989b)

Soils. The majority of soils found at the Oak Ridge Reservation are residual, either formed in place on rocky substrate or derived from alluvium (ANL 1991). Soils are predominantly clay, although chert and quartz are also present. For more detail on the soil of Oak Ridge Reservation, refer to Boyle et al. (1982), Hatcher et al. (1992), and ANL (1991).

4.3.6.2 Mineral Resources

The known resources of the geologic units exposed on the Oak Ridge Reservation are limited to industrial minerals, including quarry rock and clay. These industrial minerals are of low unit value and can be found elsewhere. Land has been leased by major oil companies west and northwest of the Oak Ridge Reservation; no exploratory wells have been drilled, and the status of oil and gas resources underlying the Oak Ridge Reservation is unknown at this time (Butz 1984).

4.3.6.3 Site Stability

The Oak Ridge Reservation area lies at the boundary between Seismic Zones 1 and 2A (DOE 1993b). The largest recorded earthquake in this zone occurred in Giles County, Virginia, 349 km (217 mi) from

Oak Ridge, on May 31, 1897, and registered magnitude 5.8 on the Richter scale. The most recent significant earthquake to occur in the Appalachian area occurred on November 30, 1973, at Maryville, ·nnessee, 34 km (21 mi) southeast of the Oak Ridge Reservation (Beavers et al. 1982). This earthquake ..ad an estimated Modified Mercalli Intensity of VII at the epicenter and a Modified Mercalli Intensity of V to VI in the Oak Ridge area.

Although the Oak Ridge area experiences a moderate level of seismic activity, no deformation of recent surface deposits has been detected at Oak Ridge Reservation, and seismic shocks from the surrounding, more seismically active areas are dissipated by distance from the epicenters (Boyle et al. 1982). A maximum horizontal ground surface acceleration of 0.19 g at Oak Ridge Reservation is estimated to result from an earthquake that could occur once every 2000 years (DOE 1994d).

4.3.7 Air Quality

Climatologically, the Oak Ridge Reservation is situated near the boundary between a "humid subtropic" and a "humid continental warm summer climate" (Critchfield 1974). A brief characterization of the climate is presented in Appendix D. Airborne discharges from the DOE Oak Ridge Facilities are subject to regulations issued by the U.S. Environmental Protection Agency and the Tennessee Department of Environment and Conservation Air Pollution Control Board, as well as by DOE Orders. Radioactive emissions are regulated by U.S. Environmental Protection Agency Region IV under the Clean Air Act (CAA) NESHAP, 40 CFR 61, Subpart H. DOE regulations governing airborne emissions are established in DOE Orders 5400.1 and 5400.5.

4.3.7.1 Nonradiological Air Quality

The Oak Ridge Reservation is located in Anderson and Roane counties, in the Eastern Tennessee-Southwestern Virginia Interstate Air Quality Control Region 207 (DOE 1995b). As of 1993, the areas within this air quality control region were designated as attainment with respect to all National Ambient Air Quality Standards (40 CFR 81.329).

One Prevention of Significant Deterioration ambient air quality Class I area can be found in the vicinity of Oak Ridge Reservation. That is the Great Smoky Mountains National Park, located approximately 48 km (30 mi) southeast of the Oak Ridge Reservation. Since the promulgation of the Prevention of Significant Deterioration regulations, no such permits have been required for any emissions source at the Oak Ridge Reservation.

Ambient air quality within and near the Oak Ridge Reservation was monitored until August 1990 (MMES 1993) for total suspended particulates, particulate matter less than 10 microns in diameter (PM_{10}), fluorides, lead, and sulfur dioxide.

4.3.7.2 Radiological Air Quality

Of the ambient air monitoring stations on the perimeter of the Y-12 Plant, 12 stations routinely monitor total suspended uranium particulate. The ORNL perimeter monitoring network consists of four stations that monitor radiation parameters (that is, gross alpha, gross beta, iodine, and gamma-emitting radionuclides). Samples of atmospheric tritium are also collected monthly at selected perimeter stations.

Annual data summaries are presented in Table 4-14 (MMES 1992). The data are divided into three groups. The ORNL perimeter air monitor stations are designed to collectively assess the specific impact of ORNL on the local air quality. The reservation perimeter air monitoring stations assess the impact of the entire Oak Ridge Reservation on air quality. Comparing these two data sets provides insight into the relative impact of ORNL upon the local air quality, as compared with other facilities on the reservation. The regional air monitor stations provide information on reference concentrations of isotopes and gross parameters for the region. It is highly unlikely that radionuclide concentrations at the regional air monitor stations are impacted by the operations at ORNL or the Oak Ridge Reservation. The net impact of ORNL and the Oak Ridge Reservation upon the regional air quality can be assessed by comparing the ORNL and Oak Ridge Reservation data with the regional air monitor station data. Only those values determined significantly different from zero were included in the data calculation.

4.3.8 Water Quality

This section summarizes the surface water and groundwater resources at ORNL. A more detailed summary can be found in DOE (1995b) and Solomon et al. (1992), with site-specific information in Boyle et al. (1982).

4.3.8.1 Surface Water

The Clinch River is the major surface water source receiving discharges from the Oak Ridge installations (DOE 1995b). Four Tennessee Valley Authority reservoirs influence the flow or water levels of the lower Clinch River: Norris and Melton Hill Reservoirs on the Clinch River, and Watts Bar and Fort Loudon lakes on the Tennessee River. The Oak Ridge Reservation is bounded on the south and west by a 63-km (39-mi) stretch of the Clinch River. Melton Hill Dam is located at Clinch River kilometer 37.2 (river mile 23), forming the Melton Hill Reservoir and several major embayments that bound the Oak Ridge Reservation. Both groundwater and surface water are drained from the Oak Ridge Reservation by a network of small tributaries of the Clinch River. Surface water at each of the three DOE facilities affects a different subbasin of the Clinch River. The ORNL drains into White Oak Creek and the Melton Branch, with all water that drains from the Oak Ridge Reservation entering the Clinch River and, subsequently, the Tennessee River (MMES 1989b). Heavy precipitation in the area causes localized flooding, primarily in the city of Oak Ridge (MMES 1994) and along the Clinch River. Stream flow on the Oak Ridge Reservation varies primarily with seasonal precipitation (MMES 1994). Precipitation varies throughout

Table 4-14. 1992 Radionuclide Concentrations in the Air Around Oak Ridge National Laboratory

Area	Radionuclide	Number Detected/Number of Samples	Concentration (10^{15} uCi/mL) of Detected Values				
			Max	Min	Avg	Standard Error	DCG (%)
ORNL PAMs	I-131	1/97	5.5	5.5	5.5		<0.01
	I-133	9/97	25	4.7	8.3	2.1	<0.01
	I-135	5/97	71	28	50	8.8	0.011
	Pb-212	3/97	150	22	67	44	<0.01
	H-3	13/13	64000	4500	19000	4900	0.019
	Cm-244	2/4	0.030	0.021	0.025	0.0048	0.064
	Cs-137	2/4	0.090	0.029	0.060	0.030	<0.01
	Pu-239	1/4	0.0028	0.0028	0.0028	(a)	0.014
	Th-228	4/4	0.041	0.011	0.030	0.0067	0.074
	Th-230	4/4	0.053	0.036	0.042	0.0037	0.11
	Th-232	4/4	0.043	0.019	0.027	0.0054	0.39
	Total Sr	1/4	0.070	0.070	0.070	(a)	<0.01
	U-234	4/4	0.044	0.022	0.033	0.0053	0.037
	U-235	2/4	0.0060	0.0048	0.0054	0.00062	<0.01
	U-238	4/4	0.021	0.015	0.018	0.0014	0.018
ORR PAMs	H-3	27/31	650000	2400	51000	24000	0.051
	Cm-244	1/8	0.050	0.050	0.050	(a)	0.13
	Co-60	4/8	0.15	0.062	0.10	0.018	<0.01
	Pu-238	1/8	0.0040	0.0040	0.0040	(a)	0.013
	Th-228	7/8	0.016	0.0050	0.0089	0.0014	0.022
	Th-230	8/8	0.023	0.011	0.017	0.0016	0.042
	Th-232	8/8	0.011	0.0052	0.0072	0.00066	0.10
	Total Sr	1/8	0.072	0.072	0.072	(a)	<0.01
	U-234	8/8	0.21	0.0050	0.063	0.025	0.07
	U-235	5/8	0.052	0.0047	0.016	0.0091	0.016
	U-238	8/8	0.032	0.0094	0.017	0.0026	0.017
RAMs	H-3	4/6	190000	4400	53000	47000	0.053
	Cs-137	1/2	0.048	0.048	0.048	(a)	<0.01
	Pu-238	1/2	0.0044	0.0044	0.0044	(a)	0.015
	Th-228	1/2	0.0084	0.0084	0.0084	(a)	0.021
	Th-230	2/2	0.021	0.010	0.015	0.0054	0.038
	Th-232	2/2	0.0047	0.0029	0.0038	0.00093	0.055
	Total Sr	1/2	0.10	0.10	0.10	(a)	<0.01
	U-234	2/2	0.034	0.027	0.030	0.0036	0.034
	U-235	2/2	0.0050	0.0029	0.0040	0.0011	<0.01
	U-238	2/2	0.011	0.0074	0.0092	0.0018	<0.01

Note: DCG = Derived Concentration Guidelines; ORNL = Oak Ridge National Laboratory; PAM = perimeter air monitor; ORR = Oak Ridge Reservation; RAM = regional air monitor

(a) Detected in only one sample; standard error not calculated.

the year, with the highest rainfall in the winter months and July. Five-year cycles of wet and dry seasons are also evident. Precipitation is lost through evaporation, vegetation uptake, runoff to streams, and to groundwater recharge through the soil.

The Clinch River supplies most of the water to the Oak Ridge Reservation, the city of Oak Ridge, and other cities along the river (MMES 1994). Major surface water uses in the Oak Ridge area include withdrawals for industrial and public water supplies, commercial and recreational navigation, and other recreational activities, such as fishing, boating, and swimming.

4.3.8.2 Groundwater

Groundwater beneath the Oak Ridge Reservation is heavily influenced by the site geologic structure (Solomon et al. 1992). Geologic units of the Oak Ridge Reservation are assigned to two broad hydrologic groups: 1) the Knox aquifer in which flow is dominated by solution conduits in limestone that stores and transmits relatively large volumes of water, and 2) the Oak Ridge Reservation aquitards that are made up of sandstones, siltstones, and shales in which flow is controlled by fractures. Aquitards may store fairly large volumes of water, but they transmit only limited amounts (DOE 1995b). For more details on groundwater, refer to Solomon et al. (1992) and DOE (1993b).

4.3.9 Ecological Resources

4.3.9.1 Terrestrial Resources

Because of the greater continuity of forests and a lack of human disturbance over much of the Oak Ridge Reservation, wildlife species that are affected by forest fragmentation offsite may find an abundance of suitable habitat on the Oak Ridge Reservation. Thus, the Oak Ridge Reservation may serve as a refuge for wildlife and a source of wildlife migration (ORNL 1988).

The vegetation of the Oak Ridge Reservation has been categorized into seven plant communities that are characteristic of the intermountain regions of central and southern Appalachia (Figure 4-20) (Parr and Pounds 1987). The pine and pine-hardwood forest is one of the most extensive plant communities on the Oak Ridge Reservation. Important species of this community type include loblolly pine (*Pinus taeda*), shortleaf pine (*Pinus echinata*), and Virginia pine (*Pinus virginiana*) (Parr and Pounds 1987). Another abundant plant community is the oak-hickory forest, which is commonly found on ridges throughout the Oak Ridge Reservation. For more information on vegetation, refer to ORNL (1988), Parr and Evans (1992), Pounds et al. (1993), and Cunningham and Pounds (1991).

Animals commonly found on the Oak Ridge Reservation include the American toad (*Bufo americanus*), eastern garter snake (*Thamnophis sirtalis*), Carolina chickadee (*Parus carolinensis*), northern cardinal (*Cardinalis cardinalis*), white-footed mouse (*Peromyscus leucopus*), and raccoon (*Procyon lotor*). Raptors, such as the red-shouldered hawk (*Buteo lineatus*) and great horned owl (*Bubo virginianus*), and

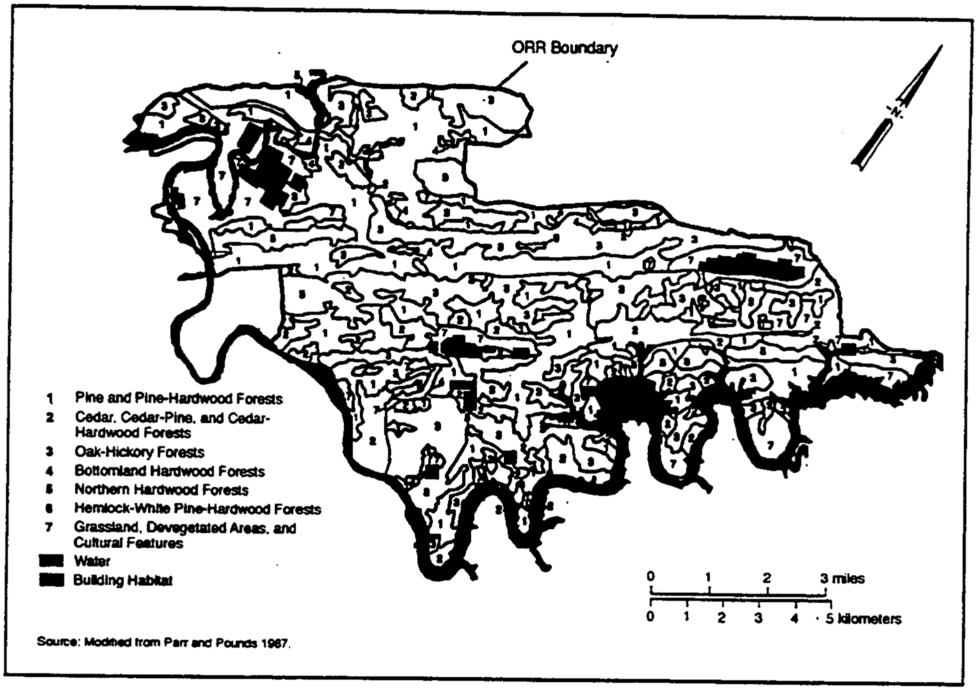

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Figure 4-20. Plant Communities on the Oak Ridge Reservation

carnivores, such as the gray fox (*Urocyon cinereoargenteus*) and mink (*Mustela vison*), are ecologically important groups on the Oak Ridge Reservation (Loar et al. 1981).

4.3.9.2 Aquatic Resources

Aquatic habitats on or adjacent to the Oak Ridge Reservation range from small, free-flowing streams in undisturbed watersheds to larger streams with altered flow patterns because of dam construction. These aquatic habitats include tailwaters, impoundments, reservoir embayments, and large and small perennial streams. Further information can be found in DOE (1995l) and Loar (1994).

4.3.9.3 Wetlands

Wetlands on the Oak Ridge Reservation have recently been evaluated based on National Wetland Inventory maps and field surveys of vegetation (Cunningham and Pounds 1991). Soils and hydrology were not specifically considered in this survey. Wetlands on the Oak Ridge Reservation include emergent, scrub/shrub, and forested wetland located in embayments of the Melton Hill and Watts Bar reservoirs that border the Oak Ridge Reservation; along all the major streams, including East Fork Poplar Creek, Poplar Creek, Bear Creek, and their tributaries; in old farm ponds; and around groundwater seeps. For further detail, refer to Cunningham and Pounds (1991) and DOE (1995l).

4.3.9.4 Threatened and Endangered Species

Federal- and state-listed threatened, endangered, or other special-status species designated by the Endangered Species Act or the state's Nongame and Endangered Species and the Rare Plant Protection and Conservation Laws that have a reasonable potential for occurrence on the Oak Ridge Reservation are listed in Table 4-15. The table indicates that 25 of these species have recent records of occurrence on the Oak Ridge Reservation. The potential occurrence of the other 22 species listed is due to historical record, proximity to geographic ranges, and migratory nature of species. No animal species listed as threatened or endangered by the federal government are known to reside on the Oak Ridge Reservation (Kroodsma 1987); however, the bald eagle (*Haliaeetus leucocephalus*, federal, endangered) is a winter visitor to Watts Bar Lake and Melton Hill Lake. No critical habitat for threatened and endangered species, as defined in the Endangered Species Act (DOI 1992), exists on the Oak Ridge Reservation.

Rare and endangered plants include the purple fringeless orchid (*Platanthera peramoena*), which occurs in a natural area in Oak Ridge Reservation (Pounds et al. 1993) and pink lady's-slippers (*Cypripedium acaule*), which is expected to occur throughout the Pine Ridge area. Preferred habitat at some sites indicates a greater potential for occurrence of the barn owl (*Tyto alba*), black vulture (*Coragyps atratus*), Cooper's hawk (*Accipiter cooperii*), red-shouldered hawk, and sharp-shinned hawk (*Accipiter striatus*). Surveys of these sites would be required to verify the presence of these and other plant and animal species.

Although not all of the Oak Ridge Reservation has been surveyed for rare species, 33 different areas harboring rare plant species (federal or state listed) have been designated by DOE as National Environmental Research Park Natural Areas (Pounds et al. 1993). The plant species listed in Table 4-15 are scattered among these natural areas, but are not excluded from other areas on the Oak Ridge Reservation. These natural areas are designated to provide protection for rare plant and animal species. The designated areas include river and creek bluffs, calcareous (chalky) barrens, mesic forests, flood plains, and wetland cover classes.

4.3.10 Noise

The Oak Ridge Research Reactor is located approximately 4 km (2.5 mi) from the closest boundary of the Oak Ridge Reservation in a rural area with a higher level of public dispersed housing adjacent to the site. In rural areas and at residences removed from the influence of traffic, noise levels ranged from 35 to 50 dB(A) (DOE 1995l). Suburban areas near the site typically have sound levels in the range of 53 to 62 dB(A).

4.3.11 Transportation

The information in the following section was taken from Volume 1, Appendix F, of DOE (1995l).

Table 4-15. Federal- and State-Listed Threatened, Endangered, and Other Special-Status Species That Potentially Occur on or in the Vicinity of the Oak Ridge Reservation[a]

Common Name	Scientific Name	Status[b]	
		Federal	State
Plants			
Appalachian bugbane[c]	*Cimicifuga rubifolia*	C2	T
Butternut	*Juglans cinerea*	C2	T
Canada (wild yellow) lily[c]	*Lilium canadense*	NL	T
Carey's saxifrage[c]	*Saxifraga careyana*	NL	S
Fen orchid[c]	*Liparis loeselii*	NL	E
Ginseng[c]	*Panax quinquefolius*	NL	T
Golden seal[c]	*Hydrastis canadensis*	NL	T
Gravid sedge[c]	*Carex gravida*	NL	S
Lesser lady's tresses[c]	*Spiranthes ovalis*	NL	S
Michigan lily	*Lilium michiganense*	NL	T
Mountain witch alder[c]	*Fothergilla major*	NL	T
Northern bush honeysuckle[c]	*Diervilla lonicera*	NL	T
Nuttall waterweed[c]	*Elodea nuttallii*	NL	S
Pink lady's-slipper[c]	*Cypripedium acaule*	NL	E
Purple fringeless orchid[c]	*Platanthera peramoena*	NL	T
Spreading false foxglove[c]	*Aureolaria patula*	C1	T
Tall larkspur[c]	*Delphinium exaltatum*	C2	E
Tubercled rein-orchid[c]	*Platanthera flava* var. *herbiola*	NL	T
Virginia spiraea	*Spiraea virginiana*	T	E
Fish			
Flame chub	*Hemitremia flammea*	NL	D
Tennessee dace[c]	*Phoxinus tennesseensis*	NL	D
Amphibians			
Green salamander	*Aneides aeneus*	NL	D
Hellbender[c]	*Cryptobranchus alleganiensis*	C2	D
Tennessee cave salamander[d]	*Gyrinophilus palleucus*	C2	T
Reptiles			
Cumberland turtle	*Chrysemys scripta troosti*	NL	D
Eastern slender glass lizard	*Ophisaurus attenuatus longicaudus*	NL	D
Northern pine snake	*Pituophis melanoleucus*	C2	T
Six-lined racerunner[d]	*Cnemidophorus sexlineatus*	NL	D

Table 4-15. (contd)

Common Name	Scientific Name	Status[b] Federal	Status[b] State
Birds			
Bachman's sparrow	*Aimophila aestivalis*	C2	E
Bald eagle[c]	*Haliaeetus leucocephalus*	E	E
Barn owl[c]	*Tyto alba*	NL	D
Bewick's wren	*Thyromanes bewickii altus*	C2	T
Black-crowned night heron[c]	*Nycticorax nycticorax*	NL	D
Black vulture[c]	*Coragyps atratus*	NL	D
Cooper's hawk[c]	*Accipiter cooperii*	NL	T
Grasshopper sparrow	*Ammodramus savannarum*	NL	T
Northern harrier	*Circus cyaneus*	NL	T
Osprey[c]	*Pandion haliaetus*	NL	E
Peregrine falcon	*Falco peregrinus*	E	E
Red-shouldered hawk[c]	*Buteo lineatus*	NL	D
Redheaded woodpecker	*Malanerpes erythrocephalus*	NL	D
Sharp-shinned hawk[c]	*Accipiter striatus*	NL	T
Mammals			
Eastern woodrat	*Neotoma floridana magister*	C2	D
Gray bat	*Myotis grisescens*	E	E
Indiana bat	*Myotis sodalis*	E	E
Smoky shrew	*Sorex fumeus*	NL	D
Southeastern shrew	*Sorex longirostris*	NL	D

(a) Sources: Barclay (1990, 1992); Bay (1991); Cunningham et al. (1993); Hardy (1991), Hardy et al. (1992); Kitchings and Story (1984); Kroodsma (1987); ORNL (1981); ORNL (1988); TDEC (1992a, 1992b, 1992c, 1992d); TWRC (1991); U.S. DOI (1990, 1991, 1992).

(b) Status codes:
C1 = Federal Candidate - Category 1 (probably appropriate to list)
C2 = Federal Candidate - Category 2 (possibly appropriate to list, more study required)
D = species deemed in need of management
E = endangered
NL = not listed
S = species of special concern
T = threatened, more study required.

(c) Recent record of species occurrence on the Oak Ridge Reservation.
(d) Species collected on the Oak Ridge Reservation in 1964 (ORNL 1988).
(e) Observed near Oak Ridge Reservation on Melton Hill and Watts Bar lakes.

4.3.11.1 Roadways

Regional and local transportation routes in the vicinity of the Oak Ridge Reservation are illustrated in ıgures 4-21 and 4-17. Primary roads on the Oak Ridge Reservation include Tennessee state routes 95, 62, 162, 170 (Bethel Valley Road), and Bear Creek Road. All these roads are public highways, except Bear Creek Road. The remaining roads on the Oak Ridge Reservation are private.

4.3.11.2 Airports and Air Traffic

McGhee Tyson Airport in Knoxville, 64 km (40 mi) from the Oak Ridge Reservation, receives jet air passenger and cargo services from both national and international air carriers. The closest air transportation facility to Oak Ridge Reservation is Atomic Airport in Oliver Springs. Numerous other private airports are located in the region within 24 km (15 mi) of Oak Ridge Reservation.

4.3.12 Radiological Health and Safety

For general information applicable to the four alternative sites being considered, refer to Section 3.0.

Characterization of the radiological consequences of radionuclides released to the air from Oak Ridge Reservation operations during 1992 was accomplished by calculating, for each operating area and for the

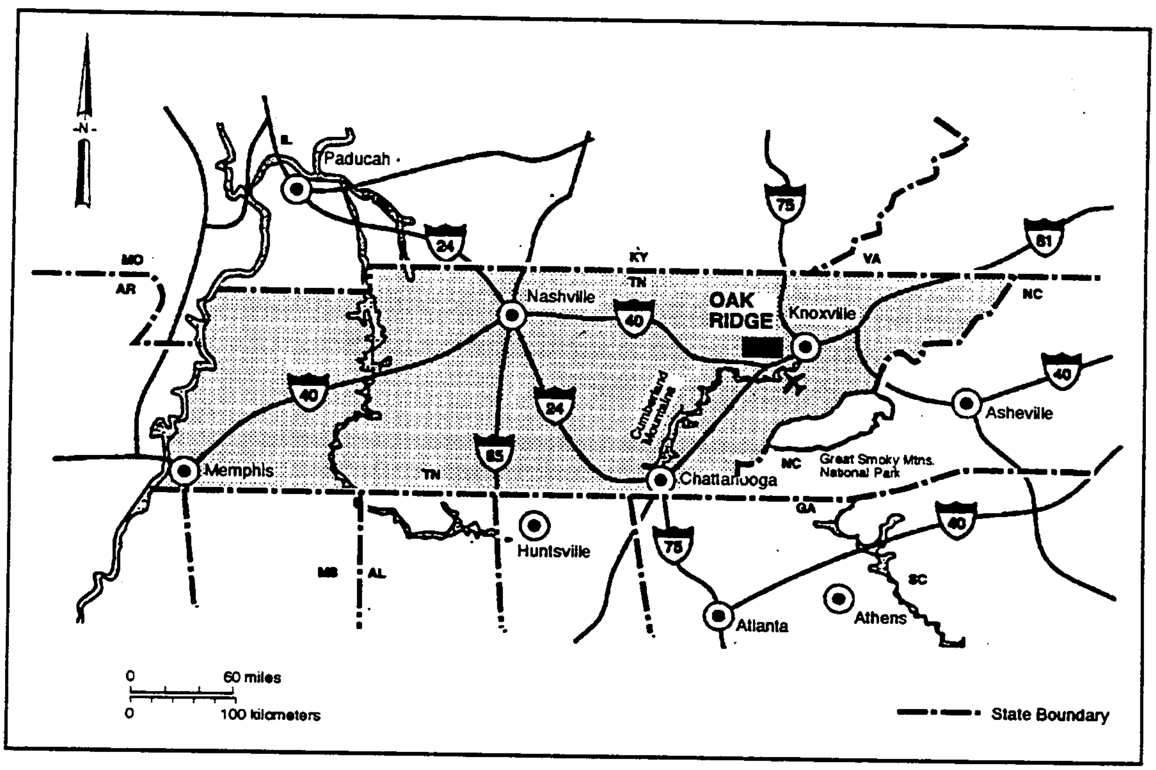

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Figure 4-21. Highway System for the Oak Ridge Reservation entire Oak Ridge Reservation, effective dose equivalents to the MEI and to the entire population residing within 80 km (50 mi) of the site. The dose calculations were made using the CAP-88 package of computer codes (Beres 1990), which contains the most recent approved version of the AIRDOS-EPA and DARTAB computer codes and the ALLRAD88 radionuclide data file (Kornegay et al. 1993). The calculated effective dose equivalents to the MEI from the Oak Ridge Reservation are listed in Table 4-16 and the collective effective dose equivalents to the public are shown in Table 4-17. The calculated effective dose equivalent to the MEI is below the 10-mrem National Emission Standards for Hazardous Air Pollutants standard and well below the 300 mrem the average individual receives from natural sources. The calculated collective effective dose equivalent to the population (43 person-rem) is 0.02% of the 264,000 person-rem the population could receive from natural sources of radiation. The expected latent cancer fatalities are much less than one (0.0172) for the population of 879,546 (Kornegay et al. 1993).

Table 4-16. Summary of Effective Dose Equivalents to the Maximally Exposed Individual from Oak Ridge Reservation Operations During 1992 (from Kornegay et al. 1993)

Operating Area	Total Effective Dose Equivalents (mrem)	
	Operating Area Max	Oak Ridge Reservation Max
Oak Ridge National Laboratory[a]	0.1	0.05
K-25 Site[b]	0.6	0.2
Y-12 Operating Area[c]	1.2	1.2
Entire Oak Ridge Reservation[d]	NA	1.4

(a) The MEI is located 4970 m (3.1 mi) SW of the 3039 stack and 5160 m (3.2 mi) WSW of the 7911 stack.
(b) The MEI is located 5180 m (3.2 mi) WSW of the K-1435 stack.
(c) The MEI is located 1080 m (0.7 mi) NNE of the Y-12 Operating Area release point.
(d) The MEI for the entire Oak Ridge Reservation is the same as the Y-12 Operating Area MEI.

Table 4-17. Summary of Collective Effective Dose Equivalents to the Public from Oak Ridge Reservation Operations During 1992 (from Kornegay et al. 1993)

Operating Area	Effective Dose Equivalents (person-rem)[a]
Oak Ridge National Laboratory	3
K-25 Site	29
Y-12 Operating Area	11
Oak Ridge Reservation	43

(a) The collective effective dose equivalents to the 879,546 persons residing within 80 km (50 mi) of the Oak Ridge Reservation.

External gamma radiation measurements were made at 5 of 10 ambient air monitoring stations at the ORNL and reservation perimeter. The average value was 7.6 μR/h, and the values ranged from 11 to μR/h. The standard deviation of the mean was 0.13 μR/h (Kornegay et al. 1993). Typical values for cities in the contiguous United States usually range from 5 to 20 μR/h. The median exposure rate identified by the U.S. Environmental Protection Agency for U.S. cities during 1989 was 9.3 μR/h (Eastern Environmental Radiation Facility 1989).

The total annual baseline worker dose from normal Oak Ridge Reservation operations is about 48 person-rem (DOE 1995l). The latent cancer fatalities expected for this occupational dose is less than 1 (0.024).

4.3.13 Site Services

Electrical power is procured from the Tennessee Valley Authority. Several 161-kV overhead radial feeders are located on the site to supply power to the reactors and other plants on the site. See Table 4-18.

The source of water for some onsite reactors is Clinch River water impounded by the Melton Hill Dam. A filtration plant, with its 26,495,000-L (7-million-gal) storage reservoir, is a source of treated water on the site. The treated water supplies the fire protection system, process operations, sanitary requirements, and boiler feed at the steam plant. Heating and process steam is supplied by the main steam plant that houses four boilers.

Chemical needs include industrial gases (argon, helium, hydrogen, nitrogen, and oxygen) delivered in an aboveground distribution system. For current consumption, see Table 4-19.

Table 4-18. Existing Oak Ridge Reservation Utility Resource Requirements

Utility Resources	Average Daily Consumption	Peak Demand	System Capacity
Electricity	1320 MWh	70 MW	300 MW
Water	7,000,000 gal	5000 gpm	17,000 gpm
Conversion: To convert gallons (gal) to liters (L), multiply by 3.785.			

4.3.14 Waste and Spent Nuclear Fuel Management

Within the Oak Ridge Reservation are three primary complexes: the Y-12 Operating Area (a manufacturing and developmental engineering plant), the K-25 site (formerly the Oak Ridge Gaseous Diffusion Plant), and the ORNL. These facilities are used for research, development, and production. This section summarizes the management of waste products from these three primary complexes.

Table 4-19. Existing Oak Ridge Reservation Chemical Resource Requirements

Chemical Resources	Total Annual Consumption	Storage Capacity
Nitrogen	4,027,770,000 gal	46,083,000 gal
Argon	90,000,000 ft^3	3,430,000 ft^3
Helium	4,464,000 ft^3	707,000 ft^3
Hydrogen	5,464,000 ft^3	76,000 ft^3
Oxygen	44,886,000 gal	533,000 gal
Conversion: To convert gallons (gal) to liters (L), multiply by 3.785. To convert cubic feet (ft^3) to cubic meters (m^3), multiply by 0.028317.		

Ongoing nuclear-related activities at Oak Ridge Reservation have resulted in the generation of spent nuclear fuel, transuranic, low-level, mixed low-level, hazardous, and industrial solid waste categories. Facilities at the Y-12 Operating Area are used to manage low-level radioactive, hazardous (Resource Conservation and Recovery Act hazardous/mixed polychlorinated biphenyl and polychlorinated biphenyl/uranium), and nonhazardous solid wastes. Facilities at the K-25 site are used to manage low-level radioactive, hazardous, and mixed wastes. Nonhazardous solid wastes are disposed of at the Y-12 sanitary landfill. Facilities at the ORNL are used to manage transuranic, low-level radioactive, hazardous, and mixed waste.

Note that 1995 waste generation rates presented in this section are a representation of the annual generation rates for operations until the year 2035. The total amount of waste generated and disposed of at Oak Ridge has been reduced and continues to be reduced through waste minimization activities. The information presented in this section is directly from the SNF PEIS (DOE 1995l), unless otherwise noted.

4.3.14.1 Spent Nuclear Fuel

The Oak Ridge Reservation currently maintains spent nuclear fuel in various storage facilities, several shut down reactors, and one operating research reactor (the High Flux Isotope Reactor). The quantity of spent nuclear fuel at the Oak Ridge Reservation in 1995 was estimated as 650 kg (heavy metal) (DOE 1995b).

4.3.14.2 Low-Level Radioactive Waste

The Y-12 Operating Area, K-25 site, and the ORNL generate and manage low-level wastes. The total cumulative volume of low-level waste disposed of through 1993 was 441,700 m^3 (577,482 yd^3) (DOE 1994b).

4.3.14.3 Low-Level Mixed Waste

All three complexes at the Oak Ridge Reservation generate and manage mixed low-level wastes. They .ianage non-Resource Conservation and Recovery Act wastes (polychlorinated biphenyls, beryllium, and asbestos) contaminated by low-level radioactive materials as dangerous substances and include them with the Resources Conservation and Recovery Act-regulated radionuclide-contaminated materials as mixed wastes. The cumulative volumes of low-level mixed waste are as follows:

ORNL	4082.6 m^3 (5339.8 yd^3)
Y-12 Operating Area	12,043.1 m^3 (15,751.8 yd^3)
K-25 Site	30,572.9 m^3 (39,987.9 yd^3).

4.4 Idaho Falls Environment

4.4.1 Overview

The Idaho National Engineering Laboratory (INEL) is located in southeastern Idaho, about 44 km (27 mi) west of Idaho Falls (Figure 4-22). The northern and western borders of the INEL site are roughly formed by the Bitterroot, Lemhi, and Lost River mountain ranges

The INEL site encompasses 2312 km^2 (893 mi^2) in Butte, Bingham, Jefferson, Bonneville, and Clark counties, Idaho. About 145 km (90 mi) of paved public highways run through the INEL site, including ˙ S. highways 20 and 26, and state routes 22, 28, and 33. Other transportation routes include Interstate and U.S. highways 93A and 191.

The Power Burst Facility is located in the southern portion of INEL, adjacent to the Waste Experimental Reduction Facility, and within 8 km (5 mi) of three other INEL facilities: the Auxiliary Reactor Area, the Idaho Chemical Processing Plant, and the Central Facilities Area. The Power Burst Facility is approximately 5 km (3 mi) northeast of the intersection of U.S. highways 20 and 26.

No known Native American traditional properties would be impacted by use and upgrading of the Power Burst Facility. Construction of the Power Burst Facility began in 1965 and was completed by 1972. The facility itself has not been recorded as a historic facility, and has not been formally evaluated for eligibility to the National Register of Historic Places.

The INEL is in seismic Zone 2B, where destructive earthquakes may occur. However, based on the historical record, the Eastern Snake River Plain has been seismically quiet. In October 1983, a Richter magnitude 7.3 earthquake known as the Borah Peak earthquake occurred along the central portion of the Lost River fault 24 km (15 mi) northwest of Mackay, Idaho. The Power Burst Facility is located approximately 113 km (70 mi) from the epicenter of that earthquake.

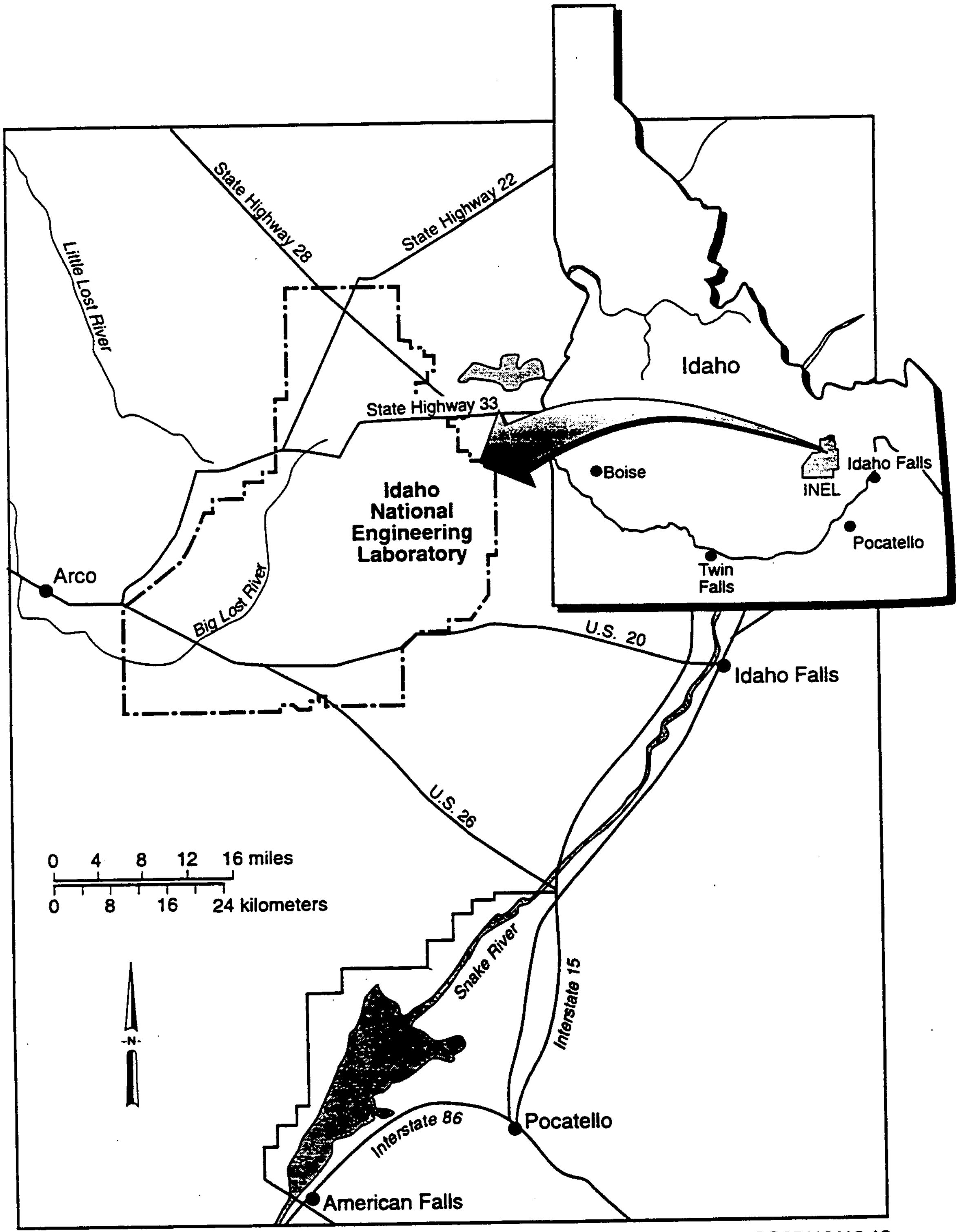

Figure 4-22. Location of Idaho National Engineering Laboratory

Radioactive emissions from INEL facilities include noble gases (argon, krypton, and xenon) and iodine; particulate fission products such as rubidium, strontium, and cesium; radionuclides formed by neu-'on activation, such as tritium, carbon-14, and cobalt-60; and very small quantities of heavy elements, ,uch as uranium, thorium, plutonium, and their decay products.

Spent nuclear fuel currently is received from, and is expected to continue being received from, the Naval nuclear program and the Advanced Test Reactor at INEL. Spent nuclear fuel is stored in water-filled, fuel storage basins at various facilities throughout INEL. Some dry storage is also available. The total mass of spent nuclear fuel at INEL is estimated to be >458 tons.

As of 1993, INEL had approximately 147,000 m^3 (192,189 yd^3) of low-level waste with a projected 1995 annual generation volume of 4270 m^3 (5583 yd^3).

At present, DOE accepts only mixed low-level waste generated at the INEL for treatment and disposal at the INEL. DOE stores mixed low-level waste generated at the INEL at interim storage facilities until treatment systems become available or operational. A total of 1800 m^3 (2400 yd^3) of mixed low-level waste interim storage capacity is available at the INEL.

4.4.2 Land Use

4.4.2.1 Regional Area

The INEL is located in southeastern Idaho with Mud Lake to the east; Arco, Butte City, and Howe to *he west; and Atomic City to the south. The larger communities of Idaho Falls, Rexburg, Blackfoot, catello, and Chubbock are to the east and southeast of the INEL site. The Fort Hall Indian Reservation is to the southeast of the INEL. The Bitterroot, Lemhi, and Lost River mountain ranges border the INEL site on the north and west (DOE 1995o).

4.4.2.2 Idaho National Engineering Laboratory

The INEL site encompasses 2310 km^2 (893 mi^2) in Butte, Bingham, Jefferson, Bonneville, and Clark counties in Idaho.

Categories of land use at the INEL include facility operations, grazing, general open space, and infrastructure, such as roads. Most (98%) of the INEL is open space. Some of this open space serves as a buffer zone between INEL facilities and other land uses. The U.S. Department of the Interior's Bureau of Land Management (BLM) grants and administers rights-of-way and grazing permits for the INEL. Figure 4-23 shows selected land uses at the INEL and in the surrounding region (DOE 1995o).

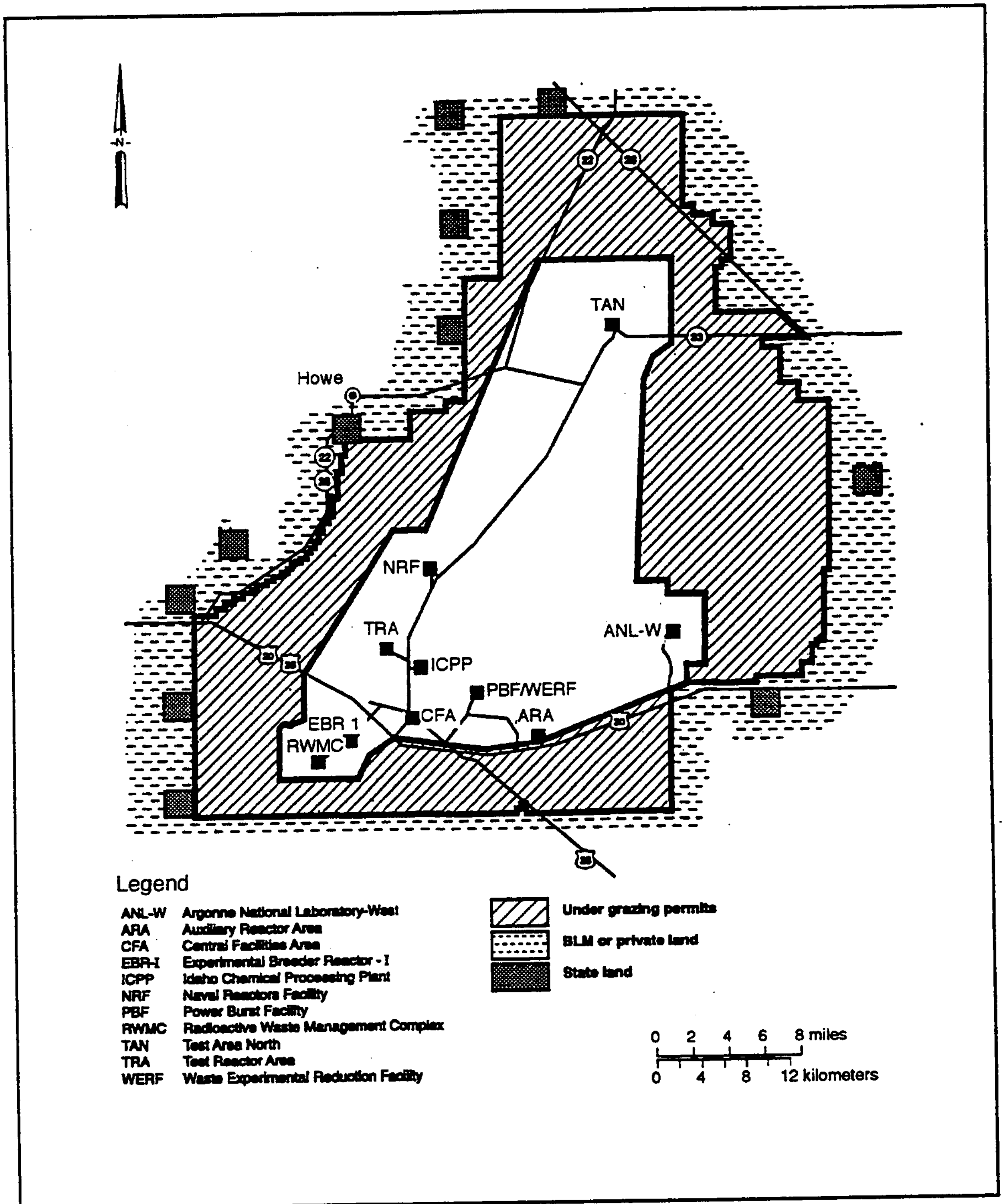

Figure 4-23. Selected Land Uses for the Idaho National Engineering Laboratory Region

The INEL site is within the Medicine Lodge Resource Area (approximately 569 km^2/220 mi^2) in the eastern and southern portions of the INEL site and the Big Butte Resource Area (approximately 1743 km^2 · 673 mi^2) in the central and western portions; the Bureau of Land Management administers both of these .eas.

4.4.2.3 Power Burst Facility

The Power Burst Facility is located in the southern portion of INEL, adjacent to the Waste Experimental Reduction Facility, and within 8 km (5 mi) of three other INEL facilities: the Auxiliary Reactor Area, the Idaho Chemical Processing Plant, and the Central Facilities Area. The Power Burst Facility is approximately 5 km (3 mi) northeast of the intersection of U.S. highways 20 and 26 (Figure 4-23).

4.4.3 Socioeconomic Environment

Approximately 97% of the INEL workforce lived in a 7-county area of southeastern Idaho in 1991 (DOE 1995o). This area, referred to as the region of influence, includes the counties of Bingham, Bonneville, Butte, Clark, Jefferson, Bannock, and Madison (see Figure 4-24). The region also includes the Fort Hall Indian Reservation and Trust Lands (home of the Shoshone-Bannock Tribes) in Bannock, Bingham, Caribou, and Power Counties.

4.4.3.1 Demographic Characteristics

The predominant population in the region of influence is white non-Hispanic, 94.8% of the total (DOC 1994b). Total minority percentage for the region of influence (excludes white non-Hispanic) is 8.5%, npared to a minority population of 7.8% for Idaho State and of 24.2% for the U.S. In the region, Native Americans make up 2.2% of the population, persons classified as *other* make up 3.0% of the population, and persons classified as black or Asian make up less than 1% each. About 5.2% of the population is Hispanic.

Approximately 55.7% of the total population in the region of influence is between the ages of 18 and 65, slightly less than Idaho as a whole, where 57.4% of the population is between 18 and 65. Of the population age 25 and over, 82.3% has received a high school degree (ranging from 74.7% to 87.6% by county) and 19.0% has received a baccalaureate degree (ranging from 11.8% to 23.2% by county). For comparison, 79.7% of the population in Idaho has received a high school degree and 17.7% has received a baccalaureate degree (DOC 1994b).

The 1989, median household income level for the region ranged from $23,000 to $30,462 and the per capita income level for the region was $10,550 (ranging from $7385 to $12,123). For the state of Idaho, the median household income was $25,257 and the per capita income was $11,457. At the time of the 1990 census, estimates indicated that 14.4% of the residents in the region of influence fell below official poverty thresholds, compared to 13.3% for the residents in Idaho and 13.1% of the persons in the U.S. (DOC 1994b).

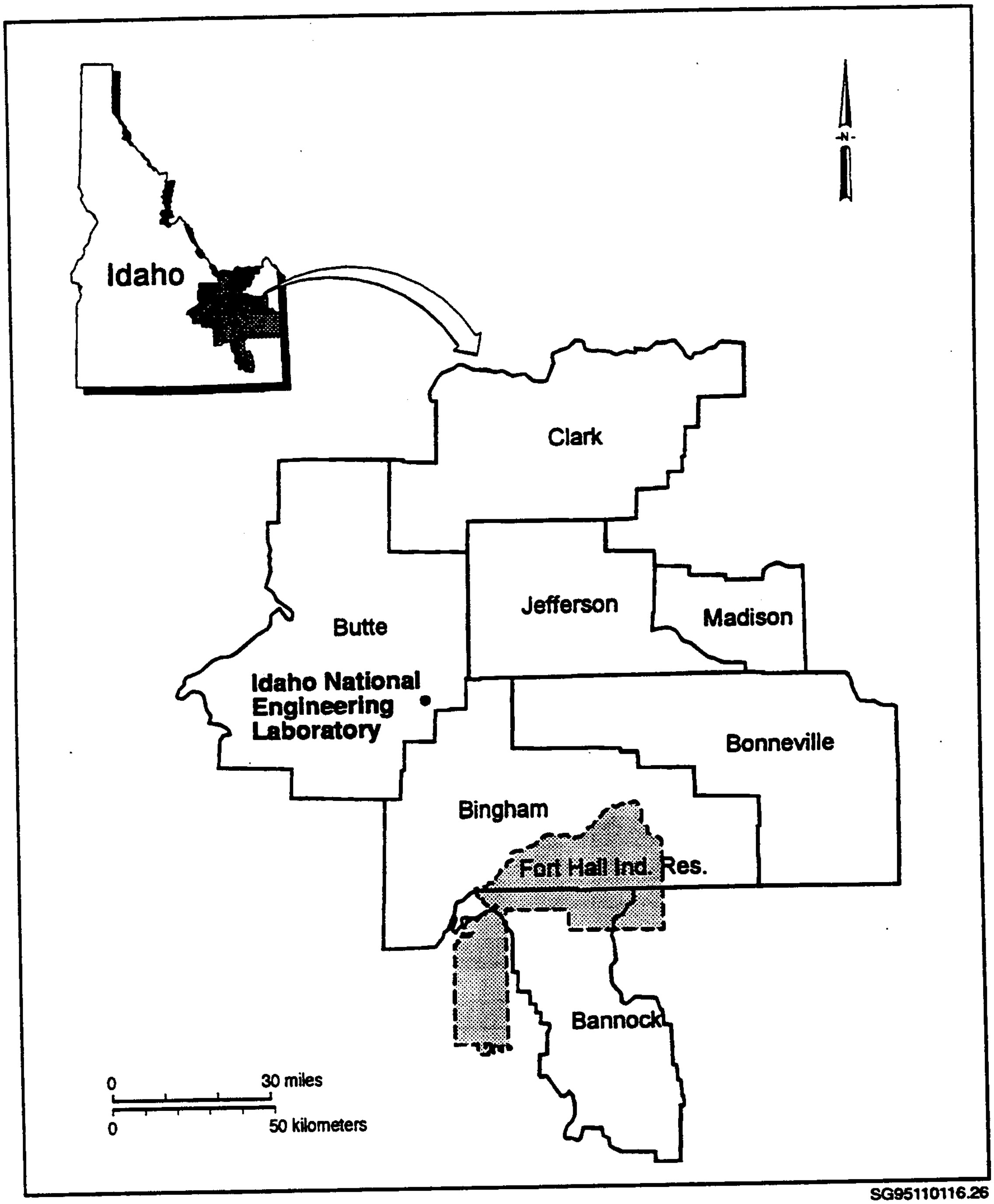

Figure 4-24. Region of Influence for Idaho National Engineering Laboratory

4.4.3.2 Economic Base

INEL plays a substantial role in the regional economy. During fiscal year 1992, INEL directly employed approximately 11,600 personnel (DOE 1995b), accounting for about 10% of total regional employment. The major employers at INEL are DOE-Idaho, DOE-Idaho contractors, Argonne National Laboratory-West, and the Naval Reactors Facility. Projections, as of January 1995, indicate the total number of jobs at INEL will decrease to approximately 8620 in fiscal year 1995 and to approximately 7250 in fiscal year 2004 (DOE 1995o). Projected decreases in INEL employment are primarily related to contractor consolidation, which accounts for 64% of the projected losses between fiscal year 1994 and fiscal year 2004, and to reduced activities at the Naval Reactors Facility, which accounts for 33% of the projected job losses (DOE 1995o).

Wages and salaries paid to INEL employees in fiscal year 1992 totaled nearly $477 million. An additional $113.9 million in procurements were made in the region. As employment decreases, total INEL payroll is expected to decrease from $373 million in fiscal year 1995 to approximately $314 million by fiscal year 2004 (DOE 1995j).

In 1992, INEL employees paid an estimated $60 million in federal withholding tax and $24 million in state withholding tax (DOE 1995o).

The average annual employment in the region of influence during calendar year 1993 was 115,872 workers, who earned a total of $2.69 billion in wages (DOC 1994a) (see Table 4-20). At the

Table 4-20. 1993 Employment Profile in the Idaho National Engineering Laboratory Region of Influence (in number of jobs)

Economic Sectors	Bannock	Bingham	Bonneville	Butte	Clark	Jefferson	Madison	Total
Agriculture	253	691	551	29	42	674	(D)	2,240
Mining	32	86	28	(D)	(D)	15	(D)	161
Construction	1,885	857	3,190	(D)	(L)	580	432	6,944
Manufacturing	2,395	2,706	2,318	1,541	(D)	808	1,221	10,989
Transportation and Public Utilities	2,409	460	1,243	20	12	162	236	4,542
Trade	9,061	3,965	12,384	250	69	1,179	2,829	29,737
Finance, Insurance, and Real Estate	2,323	575	2,339	52	12	224	437	5,962
Services	7,501	3,544	14,194	4,464	27	778	3,558	34,066
Government	7,921	3,108	5,482	1,439	148	1,119	1,478	20,695
Total	33,780	15,992	41,729	7,839	475	5,539	10,518	115,872

(D) Not shown to avoid disclosure of confidential information.
(L) Less than 10 jobs. Estimates are included in totals.
Source: DOC 1994b.

sectoral level, employment and wages were highest in the service, government, and trade sectors of the regional economy. Together these sectors accounted for 73% of the employment and 68% of the wages in the regional economy.

4.4.4 Cultural Resources

The INEL site contains a rich and varied inventory of cultural resources. Previous archaeological surveys for the area of the Power Burst Facility indicated the area is archaeologically sensitive (Homer et al. 1987). However, none of these archaeological sites would be impacted by proposed modifications to the reactor. No known Native American traditional properties would be impacted by use and upgrading of the Power Burst Facility.

4.4.5 Aesthetic and Scenic Resources

Most of the INEL site consists of open undeveloped land, covered predominantly by large sagebrush and grasslands. Pasture and irrigated farmland border much of the INEL site. The Craters of the Moon National Monument is about 24 km (15 mi) southwest of the INEL site western boundary. The monument is located in a designated wilderness area, which must maintain Class I (very high) air quality standards or minimal degradation, as defined by the Clean Air Act (42 USC 7401, 40 CFR 50; 40 CFR 51). Under Section 169a of the Clean Air Act, air quality includes visibility and scenic view considerations (DOE 1995o).

The Craters of the Moon National Monument, Hell's Half Acre Wilderness Study Area, Black Canyon Wilderness Study Area, Camas National Wildlife Refuge, Market Lake State Wildlife Management Area, North Lake State Wildlife Management Area, Yellowstone National Park, Grand Teton National Park, Jackson Hole Recreation Complex, and Targhee and Challis National Forests are in the general vicinity of INEL.

Features of the natural landscape have special significance to the Shoshone-Bannock Tribes. The environment of the INEL site is within the visual range of Fort Hall Reservation (DOE 1995o).

4.4.6 Geologic Resources

This section summarizes the physiography, geology, and seismic hazards at the INEL. A more detailed summary of these subjects can be found in DOE (1991b) with site-specific information in DOE (1993a).

4.4.6.1 General Geology

Physiography. The INEL is located on the western edge of the Eastern Snake River Plain, northwest of Idaho Falls (Figure 4-22). The INEL occupies 2300 km^2 (890 mi^2) of remote desert in southern Idaho.

The Eastern Snake River Plain is bounded on the north and south by mountains and valleys of the Basin and Range Province and on the northeast by the Yellowstone Plateau (DOE 1995b). For further details, ·fer to DOE (1990) and LLNL (1990).

Geology. The Eastern Snake River Plain forms a broad northeast-trending, crescent-shaped trough consisting primarily of surface basaltic lava flows formed 1.2 million to 2100 years ago (DOE 1995b) (Figure 4-25). The topography of the INEL is flat and consists of basaltic lava flows interbedded with

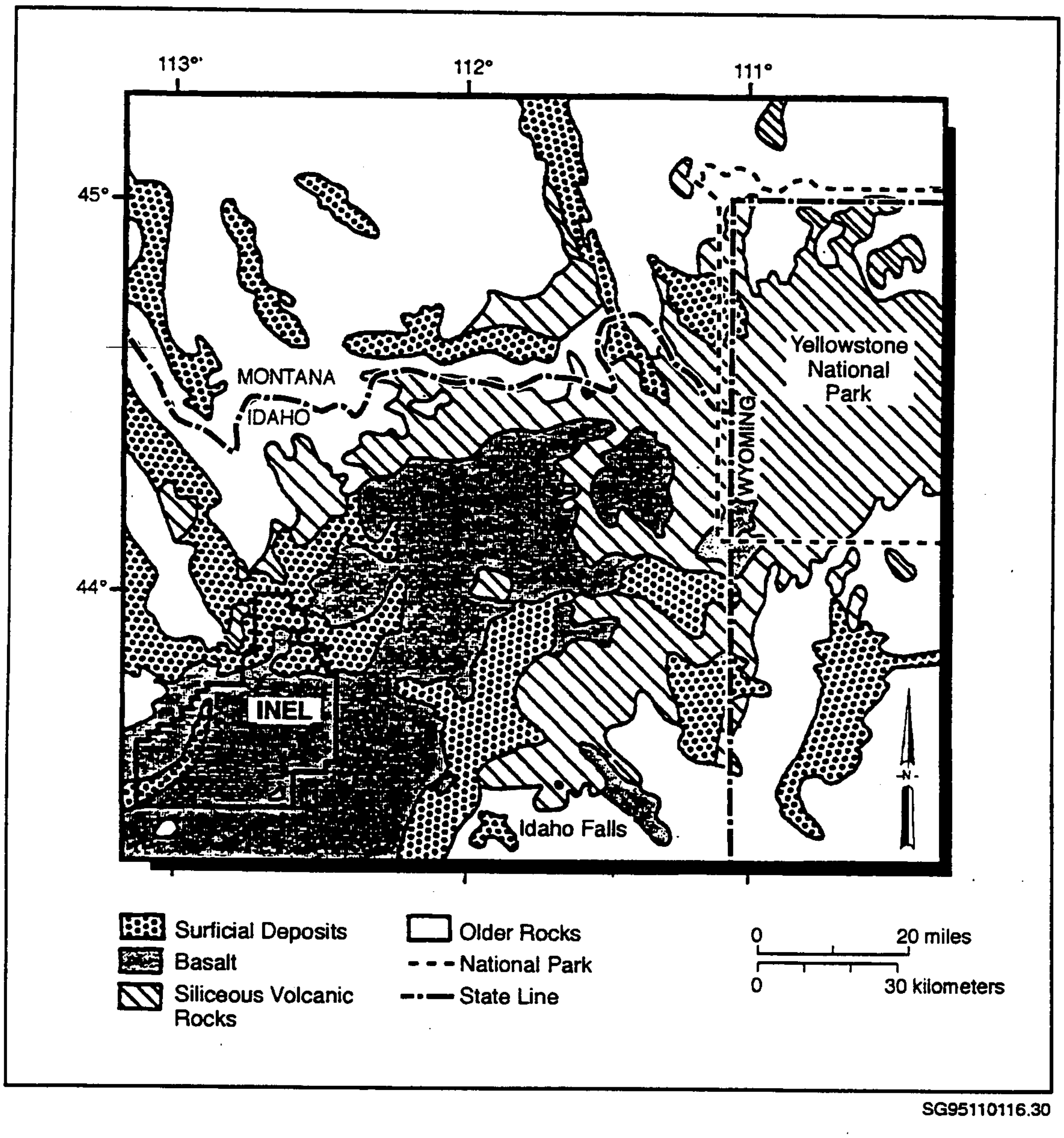

Figure 4-25. Geology of the Eastern Snake River Plain

sedimentary strata. The sequence is underlain by an unknown thickness of rhyolitic and pyroclastic flow materials formed 1.2 to 3.0 Ma (Kuntz et al. 1990). Refer to Kuntz et al. (1990) for further detail.

Structure. Vents for basaltic volcanism are concentrated in volcanic rift zones and along the central axis of the Snake River Plain (Figure 4-26). The rift zones are northwest trending features 2 to 20 km (1.2 to 12.4 mi) wide and 20 to 95 km (12.4 to 59 mi) long, characterized by alignments of basaltic vents, fissures, normal faults, and grabens produced by shallow dike injection (Wong et al. 1992). Further information can be found in LANL (1990) and Hackett and Smith (1992).

Soils. Soils at the INEL include loam, clay, loess, and lacustrine sediments. Soil depth and water-holding capacity vary considerably around the INEL (DOE 1990). The U.S. Fish and Wildlife National Wetlands Inventory identified more than 130 areas inside the INEL with potential wetlands characteristics.

4.4.6.2 Mineral Resources

Southeastern Idaho State mineral resources include crushed basalt, clays for alumina, fluorspar, and vanadium-producing phosphate rock. Mineral resources at INEL include several quarries or pits that supply sand, gravel, pumice, silt, clay, and aggregate for road construction and maintenance, new facility construction and maintenance, waste burial activities, and ornamental landscaping cinders (DOE 1995b). These industrial minerals are of low unit value and are not considered exclusive to INEL.

4.4.6.3 Site Stability

The INEL is in seismic Zone 2B, which is defined by the Uniform Building Code as an area where destructive earthquakes may occur. Based on the historical record, the Eastern Snake River Plain has been seismically quiescent, while the surrounding Basin and Range Province has a fairly high rate of seismicity (Wong et al. 1992; DOE 1995b). Detailed earthquake monitoring by the INEL seismic network from 1972 to 1990 suggests the Eastern Snake River Plain is characterized by very infrequent and small-magnitude microearthquakes.

Potential seismic sources considered most significant to INEL, based on past and current studies, include the Basin and Range faults immediately north to northwest of the INEL, including the Lemhi fault; the Eastern Snake River Plain volcanic rift zone; the Eastern Snake River Plain Basin and Range boundary zone, and random earthquakes (Wong et al. 1992). Three major Basin and Range normal faults approach the northwest margin of the Eastern Snake River Plain adjacent to INEL: the Lost River fault, the Lemhi fault, and the Beaverhead fault (Figure 4-27). In October 1983, a Richter magnitude 7.3 earthquake known as the Borah Peak earthquake occurred along the central portion of the Lost River Fault 24 km (15 mi) northwest of Mackay, Idaho (Wong et al. 1992, DOE 1990). The Power Burst Facility is located approximately 113 km (70 mi) from the epicenter of that earthquake. No damage was reported in the vicinity.

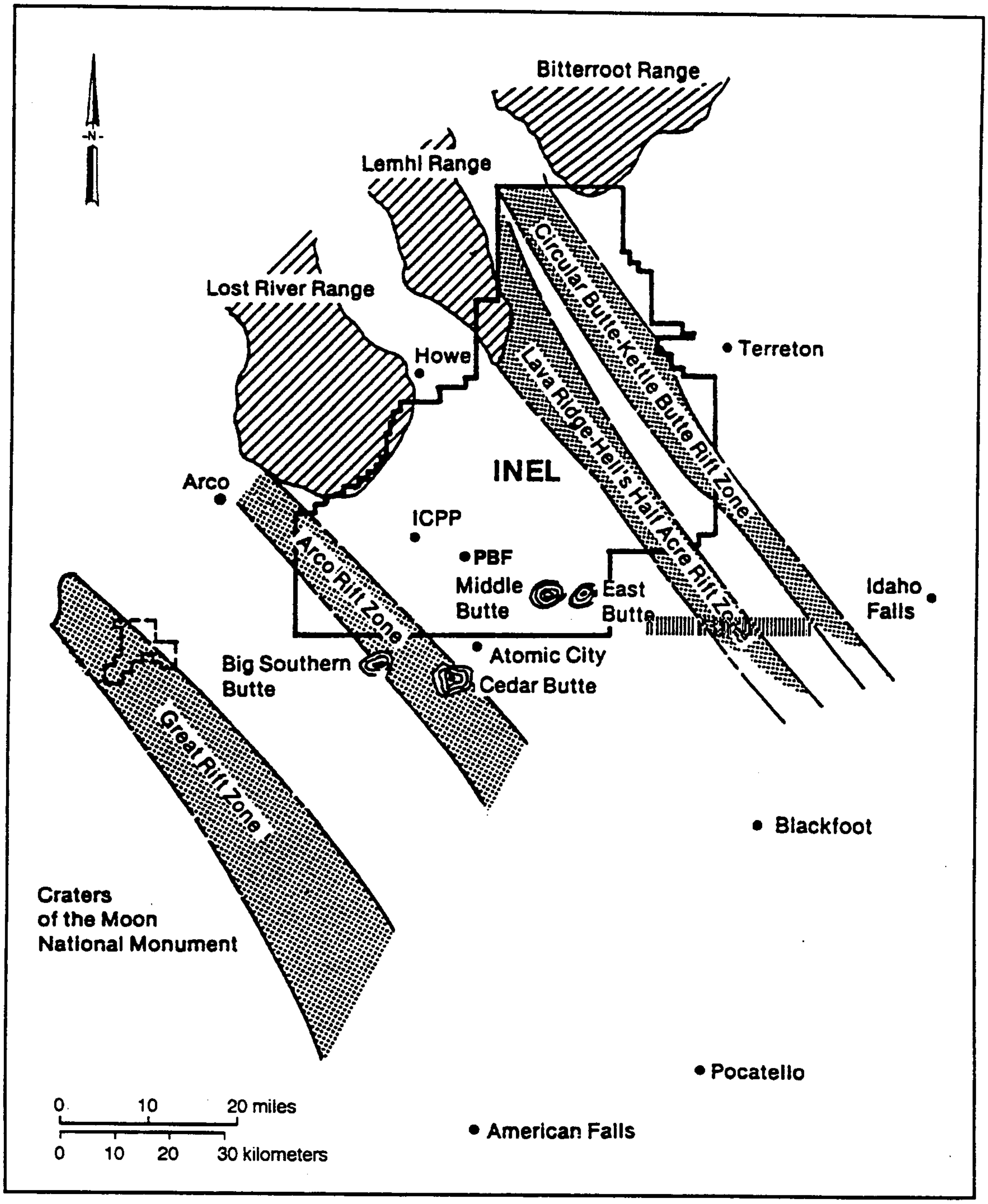

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Figure 4-26. Rift Zones and Volcanic Structures Near the Idaho National Engineering Laboratory (EG&G 1987)

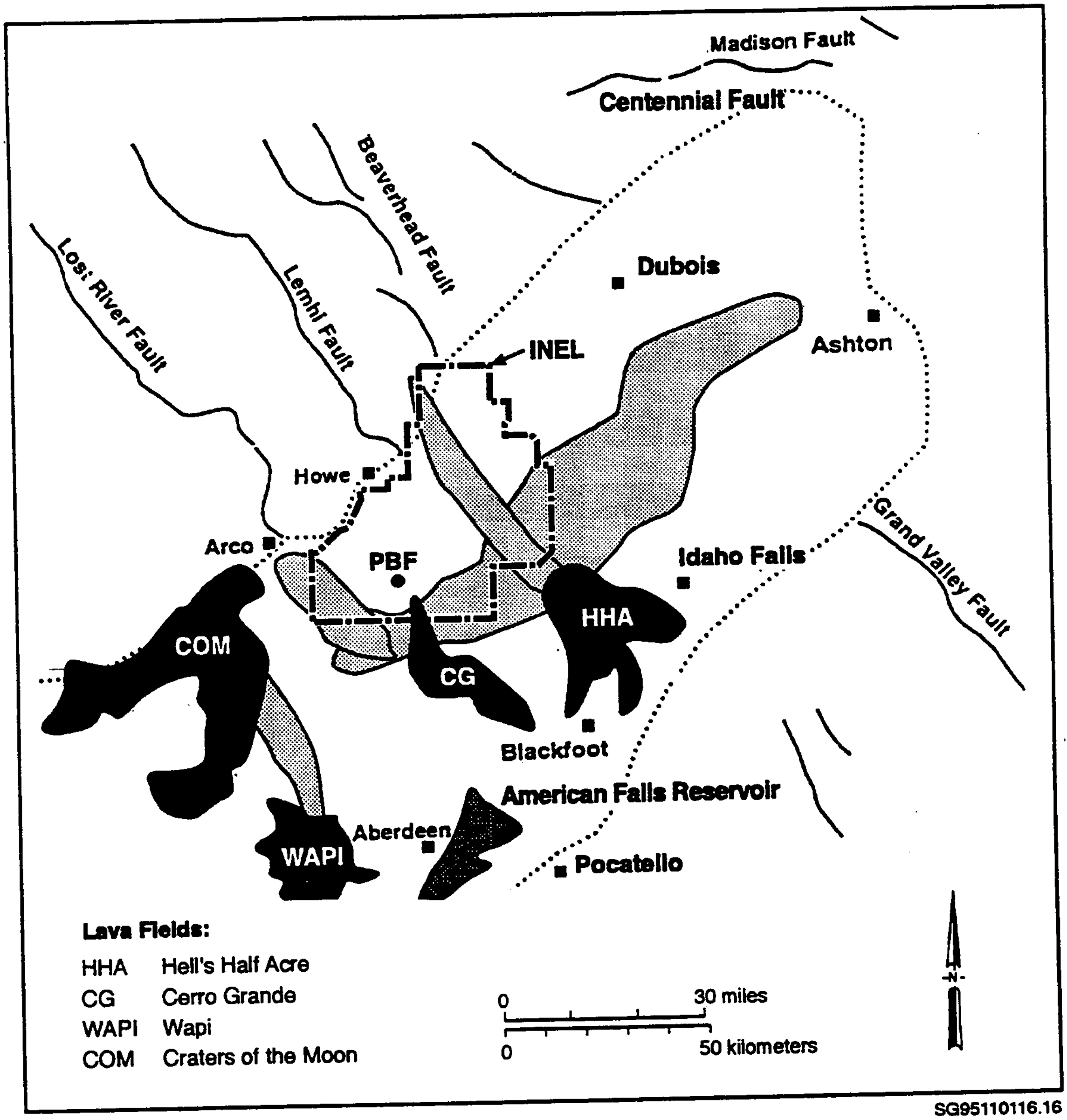

Figure 4-27. Major Volcanic and Tectonic Elements Near the Idaho National Engineering Laboratory

Three volcanic zones occur within the boundaries of the INEL: the Arco and Lava Ridge-Hell's Half Acre rift zones and the axial volcanic zone. Although no seismicity has been observed in the vicinity of these volcanic zones, the potential exists for seismicity associated with dike injection (Wong et al. 1992).

Despite the observation indicating the historical seismicity of an area may not reflect potential seismic hazards, the historical quiescence of the Eastern Snake River Plain probably is a reflection of low differential stresses within this plain (Wong et al. 1992). In general, geologic evidence indicates the area has been relatively stable for a long period of time.

..4.7 Air Quality

The INEL site is in the semiarid steppe region of the Eastern Snake River Plain (DOE 1987). A brief characterization of the climate is presented in Appendix D.

4.4.7.1 Nonradiological Air Quality

The INEL is in the Eastern Idaho Intrastate Air Quality Control Region. Atmospheric contaminant levels that result from operations at INEL or from nearby communities are low. In addition, atmospheric dispersion at INEL is not constrained by topography, and the site is well-ventilated. Nonradioactive airborne effluents originate from calcination of high-level radioactive liquid waste at the New Waste Calcining Facility, combustion of coal for steam generation at the Coal-Fired Steam-Generating Facility, combustion of fuel oil for heating at all INEL facilities, motor vehicle exhausts, and fugitive dusts from waste burial and construction activities (Rope et al. 1993). Neither INEL nor most of the surrounding counties are designated as nonattainment areas (40 CFR 81.313) for the National Ambient Air Quality Standards (40 CFR 50). The exceptions are portions of Bannock and Power counties, within about 80.5 km (50 mi) of INEL, which are designated as nonattainment areas for PM_{10}. Ambient air quality data monitored in the vicinity of INEL indicate the site is in compliance with applicable air quality standards (DOE 1991b).

4.4.7.2 Radiological Air Quality

The major source of radiation exposure in the Eastern Snake River Plain is from natural background radiation sources, such as cosmic rays; radioactivity naturally present in soil, rocks, and the human body; and airborne radionuclides of natural origin (such as radon). Sources of radioactivity related to INEL operations include research and training reactors, spent nuclear fuel testing and stabilization, irradiated material and fuel examination, nuclear waste treatment and storage, and depleted uranium armor production.

The DOE evaluates proposed new and modified sources of emissions at INEL to determine the net emissions increase of all pollutants. For radionuclides, major sources are defined as facilities where emissions would result in an offsite dose of 0.1 mrem per year or greater.

Radioactive emissions from INEL facilities include noble gases (argon, krypton, and xenon) and iodine; particulate fission products such as rubidium, strontium, and cesium; radionuclides formed by neutron activation such as tritium, carbon-14, and cobalt-60; and very small quantities of heavy elements such as uranium, thorium, plutonium, and their decay products. Table 4-21 summarizes radioactive emissions from the Power Burst Facility and the INEL site in 1991.

Table 4-21. Summary of Radioactive Emissions to the Atmosphere from the Power Burst Facility and the Idaho National Engineering Laboratory Site (total in curies) (DOE 1995o)

Facility	H-3/C-14	Mixed Fission and Activation Products	U/Th/ Transuranics
Power Burst Facility/ Waste Experimental Reduction Facility	4.9×10^{1}	1.3×10^{0}	9.8×10^{-3}
Idaho National Engineering Laboratory Total	2.1×10^{3}	5.6×10^{0}	1.0×10^{-2}

Historically, the radionuclide with the highest emission rate was the noble gas krypton-85, which was released primarily by the chemical reprocessing of spent nuclear fuel at the Idaho Chemical Processing Plant (DOE 1995o). Reactor operations release noble gas isotopes with short half-lives, including argon-41 and isotopes of xenon. Other activities at the INEL, including waste management operations, result in very low levels of airborne radionuclide emissions. Radionuclide emissions from the INEL during 1994 included about 550 Ci of tritium, 2100 Ci of noble gases, less than 1 micorcurie of transuranics, and about 10 Ci of other mixed fission and activiation products. Emissions from the Power Burst Facility and surrounding area amounted to less than 1 microcurie of mixed fission products during that time (DOEq). Gross alpha and gross beta in air concentrations at perimeter and distant locations are similar to locations within the INEL boundary, (see Tables 4-22 and 4-23).

Table 4-22. Gross Alpha Activity in Air (1993) Around Idaho National Engineering Laboratory (taken from Mitchell 1994)

Group Location	Number of Samples	Range of Samples ($\times 10^{-12}$ Ci/m^3)	Annual Mean ($\times 10^{-12}$ Ci/m^3)
Distant	103	0.1 - 2.5	1.5 ± 0.1
Boundary	101	0.3 - 4.1	1.8 ± 0.2
INEL	164	0.2 - 4.4	1.6 ± 0.1

Table 4-23. Gross Beta Activity in Air (1993) Around Idaho National Engineering Laboratory (taken from Mitchell 1994)

Group Location	Number of Samples	Range of Samples (x 10^{-12} Ci/m^3)	Annual Mean (x 10^{-12} Ci/m^3)
Distant	198	7 - 87	25 ± 2
Boundary	356	8 - 104	26 ± 2
INEL	612	5 - 117	28 ± 1

Ambient air quality standards for Idaho are the same as the National Ambient Air Quality Standards, but include total suspended particulates and fluorides. The Idaho Department of Health and Welfare also has ambient concentration limits for hazardous and toxic air pollutants.

4.4.8 Water Quality

This section summarizes the surface water and groundwater resources at INEL. A more detailed summary can be found in DOE (1995b), with site-specific information in DOE (1990) and Holdren et al. (1994).

4.4.8.1 Surface Water

The INEL is in the Pioneer Basin, a closed drainage basin. Surface waters at the INEL consist of three 'ermittent streams, the Big Lost River, the Little Lost River, and Birch Creek. The drainages do not .onnect to the Snake River (the largest major river in the region). The Power Burst Facility is located approximately 5 km (3.5 mi) southeast of the Big Lost River channel. During episodes of high flow, surface water is presently diverted into a series of spreading areas (DOE 1990) and is not a threat to the Power Burst Facility. In 1984, the dikes were raised to enable the flood control system to contain floods with an average return period of 300 years. In most years, all surface waters in the Little Lost River and Birch Creek watersheds are diverted to irrigation before entering the site.

4.4.8.2 Groundwater

The regional Snake River Plain aquifer occurs at various depths across the site. In northern INEL the aquifer is about 60 m (200 ft) beneath the surface. At the southwestern boundary, groundwater is at a depth of approximately 180 m (600 ft) (Holdren et al. 1994). Groundwater recharge zones to the aquifer are to the north and northeast, with gradients in southerly and southwesterly directions. Flow rates range from less than 0.3 m (1 ft) per day to about 4 m (12 ft) per day. The aquifer near the Power Burst Facility is approximately 137 m (450 ft) below ground surface. Perched water has been found locally at depths ranging from 12 to 115 m (40 to 377 ft) (DOE 1990). These features are short-lived, resulting from subsurface discharge of large volumes of process water. The perched water zones are highly localized and not of significance in contaminant transport (Holdren et al. 1994).

4.4.9 Ecological Resources

4.4.9.1 Terrestrial Resources

Vegetation on the INEL site is primarily of the shrub-steppe type and is a small fraction of the 450,000 km^2 (173,745 mi^2) of this vegetation type in the Intermountain West. The 15 vegetation associations on the INEL site range from primarily shadscale-steppe vegetation at lower altitudes through sagebrush- and grass-dominated communities to juniper woodlands along the foothills of the nearby mountains and buttes (Rope et al. 1993; Kramber et al. 1992; Anderson 1991). These associations can be grouped into six basic types: juniper woodland, grassland, shrub-steppe (which consists of sagebrush-steppe and salt desert shrubs), lava, bareground-disturbed, and wetland vegetation. See Rope et al. (1993), Kramber et al. (1992), and Anderson (1991) for further information.

The INEL site supports animal communities characteristic of shrub-steppe vegetation and habitats. More than 270 vertebrate species occur, including 46 mammal, 204 bird, 10 reptile, 2 amphibian, and 9 fish species (Arthur et al. 1984; Reynolds et al. 1986). Common small-mammal genera include mice (*Reithrodontomys* spp. and *Peromyscus* spp.), chipmunks (*Tamias* spp.), jackrabbits (*Lepus* spp.), and cottontails (*Sylvilagus* spp.). See Arthur et al. (1984), Reynolds et al. (1986), and DOE (1995o) for further information.

4.4.9.2 Aquatic Resources

Of the three natural surface water drainages that enter INEL (Big Lost River, Little Lost River, and Birch Creek), only the Big Lost River is close to the proposed facility. The Big Lost River drains approximately 3755 km^2 (1450 mi^2) of land before reaching the site. The river is dammed upstream from the site, and most water is diverted for irrigation. Water reaching the site disappears into the ground by natural infiltration basins, and no water flows off of the site.

Although general aquatic data are available in the INEL EIS (DOE 1995b), no data are available concerning the communities of algae or macroinvertebrates occurring in the Big Lost River near the proposed site. The lack of data is due, in part, to the absence of aquatic life in the Big Lost River during normal years. Fish, including kokanee salmon (*Oncorhynchos nerka*), rainbow trout (*Oncorhynchos mykiss*), and mountain whitefish (*Prosopium williamsoni*) occur on the INEL site only when the Big Lost River flows onto the site as a result of heavy rain or snowfall in the mountains to the northwest during years of exceptional runoff. These fish are not permanent residents (DOE 1995o).

4.4.9.3 Wetlands

The U.S. Fish and Wildlife Service National Wetlands Inventory has identified more than 130 areas .ıside INEL boundaries that might possess wetlands characteristics. Surveys conducted in the fall of 1992 indicate these possible wetlands cover about 1.4% (33 km^2/12.8 mi^2) of the INEL site (Hampton et al. 1993). Approximately 70% of these possible wetlands areas occur near the Big Lost River and its spreading areas and playas, near the Birch Creek Playa, and in an area north of and in the general vicinity of Argonne National Laboratory-West. These playas are approximately 4.8 to 6.4 km (3 to 4 mi) from the Test Area North and about 27.5 km (17 mi) from the Power Burst Facility. Limited riparian (riverbank) communities with mature trees along the Big Lost River reflect the intermittent flow in the river (1986 and 1993 were the last 2 years with flow reported on the site). The remainder of the possible wetlands are scattered throughout the INEL site. In 1994, INEL began evaluating these potential wetlands to determine if they meet the U.S. Army Corps of Engineers definition of jurisdictional wetlands (COE 1987). Approximately 20 wetlands are near facilities and are mostly man-made (such as, industrial waste and sewage treatment ponds, borrow pits, and gravel pits).

4.4.9.4 Threatened and Endangered Species

State and federal regulatory agency lists, the Idaho Department of Fish and Game Conservation Data Center list, and information from site surveys provided the information to identify federal- and state-protected, candidate, and sensitive species that potentially occur on the INEL. This information identified two federal endangered (bald eagle and peregrine falcon) and nine Federal Category 2 candidate species as animals that potentially occur on the INEL site (Table 4-24). Five animal species listed by the state as species of special concern occur on the site. See Chowlewa and Henderson (1984) for further information.

4.4.10 Noise

The Power Burst Facility is located about 13 km (8 mi) from the INEL site perimeter and from Atomic City. Ambient noise measurements are not available, but should be similar to background levels at Hanford, which range from 30 to 49 dB(A).

4.4.11 Transportation

Roads provide the primary access to and from the INEL site. Commercial shipments are transported via truck and plane; some bulk materials are transported via rail; waste is transported by road and rail. This section discusses the existing transportation infrastructure for the INEL site, including traffic volumes and transportation routes. The information in this section was taken from DOE (1995o).

4.4.11.1 Roadways

Figure 4-22 shows the existing regional highway system. Two interstate highways serve the regional area. Interstate 15 (I-15), a north-south route that connects several cities along the Snake River, is

Table 4-24. Threatened and Endangered Species, Special Species of Concern, and Sensitive Species That May Be Found on the Idaho National Engineering Laboratory

	Name	Status[a]	Comments
Birds	Northern goshawk *(Accipiter gentilis)* Burrowing owl *(Athene cunicularia)* Ferruginous hawk *(Buteo regalis)* Swainson's hawk *(Buteo swainsoni)* Great egret *(Casmerodius albus)* Merlin *(Falco columbarius)* Peregrine falcon *(Falco peregrinus)* Gyrfalcon *(Falco rusticolus)* Common loon *(Gavia immer)* Bald eagle *(Haliaeetus leucocephalus)* Long-billed curlew *(Numenius americanus)* American white pelican *(Pelecanus erythrorhynchos)* White-faced ibis *(Plegadis chihi)*	C2, SSC, FS, BLM C2, BLM C2, SSC, BLM BLM SSC SSC, BLM E BLM SSC, FS E SPS, BLM SSC C2	The **ferruginous hawk** nests on and migrates through the INEL. This species is found throughout the INEL, but is observed more frequently in juniper woodlands. The **peregrine falcon** has been observed rarely in winter, but has not been observed during other seasons. The last sighting was in 1993 (Morris 1993). It is not known to nest on the INEL and is not commonly observed near facilities. The **bald eagle** is a winter resident and is locally common in the far north end and on the western edge of the INEL near Howe. It is not known to nest on the INEL and is not commonly observed near facilities. The **white-faced ibis**, which uses aquatic and riparian habitats, is an uncommon migrant at the INEL. The **long-billed curlew** is known to nest on the north end of the INEL near agricultural lands. The **northern goshawk** is a casual migrant through the INEL.
Mammals	Merriam's shrew (*Sorex merriami*) Pygmy rabbit *(Brachylagus (Sylvilagus) idahoensis)* California myotis *(Myotis californicus)* Fringed myotis *(Myotis thysanodes)* Western pipistrelle *(Pipistrellus hesperus)* Townsend's western big-eared bat *(Plecotus townsendii)* Long-eared myotis (*Myotis evotis*) Small-footed myotis (*Myotis subulatus*)	SPS C2, BLM, SSC SSC SSC SSC, BLM C2, SSC, FS, BLM C2 CS	The **pygmy rabbit** is common on the INEL, but its distribution is patchy (Reynolds et al. 1986). Roosts and hibernation caves for **Townsend's western big-eared bat** occur on the INEL. All are over 7 km (3 mi) from facilities. Brood caves might exist on the site but have not been located.
Plants	Lemhi milkvetch *(Astragalus aquilonius)* Painted milkvetch *(Astragalus ceramicus var. apus)* Winged-seed evening primrose *(Camissonia pterosperma)* Nipple cactus *(Coryphantha missouriensis)* Spreading gilia *(Ipomopsis (Gilia) polycladon)* King's bladderpod *(Lesquerella kingii var. cobrensis)* Tree-like oxytheca *(Oxytheca dendroidea)* Sepal-tooth dodder (*Cuscuta denticulata*)	BLM, FS, INPS 3c, INPS-M BLM, INPS-S INPS-M BLM, INPS-2 INPS-M INPS-S INPS-1	The eight plant species identified as sensitive, rare, or unique that are known to occur on the INEL occur primarily at a distance from INEL facilities and are uncommon on the INEL because they require unique microhabitat conditions.
Insects	Idaho pointheaded grasshopper *(Acrolophitus pulchellus)*	C2, BLM	Occurs just north of the INEL.

(a) Key:
C2 = Federal Category 2 species.
INPS-S = Idaho Native Plant Society sensitive.
FS = U.S. Forest Service monitored.
E = Federal and state endangered species.
INPS-1 = Idaho Native Plant Society State Priority 1.
SPS = State protected species.
BLM = Bureau of Land Management monitored.
3c = No longer considered for federal listing.
INPS-M = Idaho Native Plant.
INEL = Idaho National Engineering Laboratory.
SSC = State species of special concern.
INPS-2 = Idaho Native Plant Society State Priority 2.

approximately 40 km (25 mi) east of the INEL site. Interstate 86 intersects I-15 approximately 64 km (40 mi) south of the INEL site, and provides a primary linkage from I-15 to points west. I-15 and U.S. Highway 91 are the primary access routes to the Shoshone-Bannock Reservation. U.S. Highway 20 and U.S. Highway 26 are the main access routes to the southern portion of the INEL site. Idaho state routes 22, 28, and 33 pass through the northern portion of the INEL; State Route 33 provides access to the northern INEL site facilities. Table 4-25 lists the baseline (1991) traffic for several of these access routes.

Table 4-25. Baseline Traffic for Selected Highway Segments[a] on the Idaho National Engineering Laboratory

Route	Average Daily Traffic	Peak Hourly Traffic[b]
U.S. Highway 20-Idaho Falls to INEL	2290	344
U.S. Highway 20/26-INEL to Arco	1500	225
U.S. Highway 26-Blackfoot to INEL	1190	179
State Route 33 West from Mud Lake	530	80
Interstate 15-Blackfoot to Idaho Falls	9180	1380

(a) Source: DOE 1995o.
(b) Estimated as 15% of average daily traffic.

The level of service of these segments is currently designated free flow, defined as "operation of vehicles is virtually unaffected by the presence of other vehicles."

The INEL has developed an onsite road system of approximately 140 km (87 mi) of paved surface, including about 29 km (18 mi) of service roads that are closed to the public. Most of the roads are adequate for the current level of normal transportation activity and could handle some increased traffic volume. The DOE plans to reconstruct several deteriorating INEL roads built in the 1950s that have been and will continue to be used to transport heavier-than-normal loads.

Approximately 4000 DOE and contractor personnel administer and support INEL work at offices in Idaho Falls. DOE shuttle vans provide hourly transport between in-town facilities. One of the busiest intersections is Science Center Drive and Fremont Avenue, which serves Willow Creek Building, Engineering Research Office Building, INEL Electronic Technology Center, and DOE office buildings. This intersection is congested during peak weekday hours, but it is designed for the current traffic.

Four major modes of transit use the regional highways, community streets, and INEL site roads to transport people and commodities: DOE buses and shuttle vans, DOE motor pool vehicles, commercial trucks, and personal vehicles. Table 4-26 summarizes the baseline miles for INEL-related traffic.

Table 4-26. Baseline Annual Vehicle Miles Traveled for Idaho National Engineering Laboratory-Related Traffic[a]

Mode of Travel and Transportation	Vehicle Miles Traveled[b]
DOE Buses	6,068,200
Other DOE Vehicles	9,183,100
Commercial Trucks	56,000
Personal Vehicles on Highways to INEL	7,500,000
Total	22,807,300

(a) Source: DOE 1995o.
(b) To convert miles to kilometers, multiply by 1.61.

4.4.11.2 Airports and Air Traffic

Commercial airlines provide Idaho Falls with jet aircraft passenger and cargo service, as well as commuter service to the Idaho Falls and Pocatello airports. In addition, local charter service is available in Idaho Falls, and private aircraft use the major airport and many other fields in the area. Total landings at the Idaho Falls airport for 1991 and 1992 were 5367 and 5598, respectively. The Idaho Falls and Pocatello airports collectively record nearly 7500 landings annually.

Non-DOE air traffic over the INEL site is limited to altitudes higher than 305 m (1000 ft) over buildings and populated areas, and non-DOE aircraft are not permitted to use the site. The primary air traffic at the INEL site is DOE helicopters, which are used for security and emergency purposes. These helicopters have specific operations stations and duties.

4.4.12 Radiological Health and Safety

For general information applicable to the four alternatives, refer to Section 3.0.

Radioactivity released to the air can result in human exposure through a number of pathways, including inhalation, external exposure, and ingestion. The DOE conducts physical measurements and uses calculation techniques to assess existing levels of radiation in and near the INEL site and to assess radiological doses to workers and the surrounding population.

The estimated potential population dose was 0.3 person-rem (3×10^{-3} person-Sv) to a population of approximately 121,500 within 80 km (50 mi) of the site. No (0.00015) latent cancer fatalities are expected from this population dose. Using the CAP-88 code and the MESODIF code, the maximally exposed individual was calculated to receive 0.011 mrem and 0.03 mrem, respectively, from 1993 INEL operations (Mitchell 1994). The MESODIF results are tabulated in Table 4-27.

Table 4-27. Maximum Individual Effective Dose Equivalent from 1993 Idaho National Engineering Laboratory Emissions to the Air (taken from Mitchell 1994)

Radionuclide	Maximum Effective Dose Equivalent	
	mrem	**mSv**
Iodine-129	2.6×10^{-2}	2.6×10^{-4}
Argon-41	1.4×10^{-3}	1.4×10^{-5}
Krypton-88 + D[a]	2.9×10^{-4}	2.9×10^{-6}
Strontium-90 + D[a]	1.4×10^{-4}	1.4×10^{-6}
Cesium-137 + D[a]	1.4×10^{-4}	1.4×10^{-6}
Xenon-135	1.3×10^{-3}	1.3×10^{-5}
Xenon-133	3.2×10^{-5}	3.2×10^{-7}
Krypton-85	3.1×10^{-5}	3.1×10^{-7}
Xenon-138 + D[a]	2.2×10^{-5}	2.2×10^{-7}
Hydrogen-3	1.9×10^{-5}	1.9×10^{-7}
Krypton-85m	1.1×10^{-5}	1.1×10^{-7}
Total	2.9×10^{-2}	2.9×10^{-4}

(a) The D notation indicates decay products are included in this dose equivalent.

Workers at major INEL facilities may receive radiological exposures. The largest fraction of the occupational dose received by INEL workers is from external radiation. The maximum dose received by a worker, from the air pathway, at any onsite area is about 4.3 mrem per year (DOE 1995o). This dose value of 4.3 mrem per year includes the maximum projected operation of the Portable Water Treatment Unit at the Power Burst Facility area. However, operation of that facility would be temporary (expected to last 1 to 2 years) and is not representative of a permanent increase on the baseline. If this facility were not included, the baseline dose to workers would be about 0.2 mrem per year (DOE 1995o).

From 1987 to 1991, the average occupational dose to individuals who had received measurable doses was 0.156 rem per year, resulting in an average collective dose of about 300 person-rem. The resulting number of expected excess health effects would be less than one for each year of operation (DOE 1995o).

4.4.13 Site Services

Major utility systems on the INEL site include water and sanitary sewer pipelines. A system of about 30 wells, with pumps and storage tanks, provides the water supply for the INEL site. Because of the distance between site facility areas, the water supply system for each facility is independent. The site uses no natural surface water. The city of Idaho Falls water supply system, which includes about 16 wells, provides water to DOE and contractor facilities in the city.

A Water Rights Agreement between DOE and the state of Idaho regulates groundwater use at the INEL site. Under this agreement, INEL has claim to 2300 L per second (36,000 gal per minute) of groundwater, not to exceed 43 billion L (11 billion gal) per year (Teel 1993). The DOE has not measured the total pumping rate from the aquifer, which would depend on the number of pumps operating. A slight possibility exists that the site could exceed the regulated pumping rate for very short periods, such as during recovery from an extended power outage when many pumps would run to refill depleted storage tanks.

For 1987 through 1991, the average water consumption by the INEL site was 7.4 billion L (1.9 billion gal) per year, based on the cumulative volumes of water withdrawn from the wells (Teel 1993). The projected baseline usage for 1995 will be about 6.5 billion L (1.7 billion gal). The estimated average water consumption of Idaho Falls facilities is 300 million L (80 million gal) per year.

The Antelope substation supplies commercial electric power to the INEL site through two feeders to the federally owned Scoville substation. The Scoville substation supplies electric power directly to the INEL electric power distribution system. The contract with Idaho Power Company to supply electric power to the INEL site provides "up to 45,000 kW monthly" at 13.8 kV (IPC/DOE 1986). Hydroelectric generators along the Snake River in southern Idaho and the Bridger and Valmy coal-fired thermal electric generation plants in southwestern Wyoming and northern Nevada, respectively, generate the electric power supplied by Idaho Power.

The rated capacity of the INEL site power transmission loop line is 124 MW. The peak demand on the system from 1990 through 1993 was about 40 MW, and the average usage was slightly less than 217,000 MWh (Table 4-28). This usage rate should decrease by about 4% by 1995.

The INEL facilities in Idaho Falls receive electric power from the city of Idaho Falls, which operates four hydroelectric power generation plants on the Snake River along with substation and distribution facilities. The Bonneville Power Administration, which operates hydroelectric plants on the Columbia River system, supplies supplemental power to the city of Idaho Falls. In 1993, Idaho Falls facilities used 31,500 MWh of electricity.

Fuels consumed at the INEL site include several liquid petroleum fuels, coal, and propane. All fuel is transported to the site for storage and use. Natural gas is the only reported fuel consumed at the INEL

Table 4-28. Existing Idaho National Engineering Laboratory Utility Resource Requirements

Utility Resources	Average Annual Consumption	Peak Demand	System Capacity
Electricity	217,000 MWh	40 MW	300 MW
Water	1.94 billion gal	5000 gpm	17,000 gpm
Conversion: To convert gallons (gal) to liters (L), multiply by 3.785.			

Idaho Falls facilities; the Intermountain Gas Company provides this fuel through a system of underground lines. Fuel storage is provided at each facility, and inventories are restocked as necessary. No fossil fuel shortage has ever occurred at the INEL site. See Table 4-29 for average annual fuel consumption at the INEL site from 1990 through 1993.

Table 4-29. Existing Idaho National Engineering Laboratory Fuel Resource Requirements

Utility Resources	Average Annual Consumption
Fuel Oil	2,795,000 gal
Diesel Fuel	1,500,000 gal
Propane Gas	150,000 gal
Coal	9,000 tons
Conversion: To convert gallons (gal) to liters (L), multiply by 3.785.	

4.4.14 Waste and Spent Nuclear Fuel Management

The INEL is a multipurpose facility supporting efforts in nuclear safety, reactor development, reactor operations and training, waste management, technology development, and technology transfer programs. These activities have resulted in the generation of radioactive, hazardous, and mixed waste.

This section summarizes the management of materials and wastes (high-level, transuranic, mixed low-level, low-level, hazardous, industrial and commercial solid wastes, and hazardous materials) at the INEL and Idaho Falls facilities and presents an overview of the current status of the various waste types generated, stored, and disposed of at the INEL.

The total amount of waste generated and disposed of has been reduced through waste minimization and treatment. The INEL attains waste minimization by reducing or eliminating waste generation, by recycling, and by reducing the volume, toxicity, or mobility of waste before storage or disposal. In addition, the site has achieved volume reduction of radioactive wastes through more intensive surveying, waste segregation, and use of administrative and engineering controls.

The information presented in this section is taken directly from the SNF-PEIS (DOE 1995o), unless otherwise noted.

4.4.14.1 Spent Nuclear Fuel

Spent nuclear fuel currently is received from, and will continue to be received from, the Naval nuclear program and the Advanced Test Reactor on the INEL. Fuel currently stored at INEL has come from these sources, other government and university research reactors, and special-case commercial reactors. Upon implementation of the SNF PEIS record of decision, INEL may receive additional spent nuclear fuel from other DOE sites.

Spent nuclear fuel is stored in water-filled, fuel storage basins at various facilities throughout INEL. Some dry storage is also available. The facilities in which most of the spent nuclear fuel is stored are the Idaho Chemical Processing Plant, the Power Burst Facility, and a storage pool at the Test Area North. The Test Area North storage pool was built in the 1950s and is not considered adequate for long-term interim storage. Spent nuclear fuel may be removed and transferred to dry storage by fiscal year 2000. The CPP-603 storage pools in the Idaho Chemical Processing Plant and the pool in the Power Burst Facility also will be emptied. DOE is evaluating consolidating all INEL special nuclear fuels at the Idaho Chemical Processing Plant (DOE 1995k). The quantity of spent nuclear fuel at the INEL in 1995 was estimated as about 261,000 kg (heavy metal) (DOE 1995b).

4.4.14.2 Low-Level Radioactive Waste

Through 1991, DOE disposed of 145,000 m^3 (190,000 cu yd) of low-level waste at the Radioactive Waste Management Complex. In 1991, the total available low-level waste disposal capacity at the complex was 37,000 m^3 (48,000 cu yd) (DOE 1995b, Volume 1, Appendix B). As of 1993, INEL had approximately 147,000 m^3 (192,000 yd^3) of low-level waste with a 1993 annual produced volume of 900 m^3 (1200 yd^3) (DOE 1994b).

4.4.14.3 Low-Level Mixed Waste

At present, DOE accepts only low-level mixed waste generated at the INEL for treatment and disposal at the INEL. DOE stores low-level mixed waste generated at the INEL at interim storage facilities until treatment systems become available or operational. A total of 1800 m^3 (2400 yd^3) of low-level mixed waste interim storage capacity is available at the INEL. Current low-level mixed waste interim storage is approximately 1100 m^3 (1400 yd^3). Treatment technologies exist for much of the low-level mixed waste generated at the INEL, and waste minimization eliminates potential sources of low-level mixed waste before generation. The projected 1995 baseline for low-level mixed waste is 525 m^3 (687 yd^3) annually.

5.0 Environmental Consequences

5.1 Overview

The consequences of producing molybdenum-99 (Mo-99) and associated medical isotopes at U.S. Department of Energy (DOE) facilities are evaluated in this section. Activities considered include fabrication of targets containing highly enriched uranium, irradiation of the targets in a DOE reactor facility, processing of the targets to recover Mo-99 and other medically useful isotopes (such as iodine-131 and xenon-133), transport of waste for disposal, and transport of the isotopes to radiopharmaceutical manufacturers where the materials are prepared for medical use. Iodine-125 production, using a separate target system, is considered as well. Iodine-125 is produced by activation of nonradioactive xenon-124, as opposed to the fission targets used for producing Mo-99. The impacts of producing iodine-125, wherever such impacts differ from those of Mo-99, are included in the analysis contained in this section. The assessment includes activities necessary to prepare or modify existing facilities at the DOE sites under consideration to undertake the medical isotope production mission.

The no action alternative would not result in any additional environmental impact at any DOE site. The activities and missions at the candidate DOE facilities would, therefore, remain as described in Section 4.0. The only potential consequences of the no action alternative would be to the U.S. health care community and its consumers. These impacts would take the form of increased cost and risk to patients from lack of diagnostic procedures, or from use of alternative procedures, in the event that the Canadian source of Mo-99 for metastable technetium-99 (Tc-99m) generators became unavailable for an extended ıe and another supply was not available to meet current needs.

The impacts of producing medical isotopes at DOE facilities would vary, depending on the location and the status of existing facilities that would be converted for use in the production mission. However, the processes for target production and recovery of the isotopes would be similar wherever they might be conducted because of the need to conform to previously approved U.S. Food and Drug Administration (FDA) procedures for manufacture of medical radioisotopes. The reactor facilities for irradiation of the targets are generally of similar design, but each has unique features and operating characteristics because of the different purposes for which they were constructed. The extent of activity necessary to modify operating reactors, to restart shutdown reactors, or to prepare hot cell facilities for target fabrication and processing would also vary from site to site.

Impacts on the environment due to facility modifications would be minimal because existing facilities at all sites would be converted to the isotope production mission. Therefore, substantial effects on land use, cultural resources, aesthetic and scenic resources, geological resources, ecological resources, and community noise levels would not be expected at any site. The effect on economic climate and community resources would also be minimal because of the relatively small number of workers that would be employed in the isotope production project.

The environmental impacts of the proposed action would result from effluents released to air from facilities during routine operation, and from transportation of isotopes to radiopharmaceutical manufacturers. The consequences of these activities for workers and the public would be well within regulatory guidelines. Relatively small quantities of materials and other resources would be consumed by modifications to the facilities, and from operation of the isotope production and recovery process. The process would also generate low-level radioactive waste, which would be temporarily stored at the generation site to allow decay of short-lived radionuclides, followed by disposal either onsite (in the case of Los Alamos National Laboratory [LANL] or Idaho National Engineering Laboratory [INEL]) or at another DOE site (in the case of Sandia National Laboratories/New Mexico [SNL/NM] or the Oak Ridge National Laboratory [ORNL]). Under any alternative, less than 0.1 m^3/yr (3.5 ft^3) of mixed waste is expected to result from the process. Spent nuclear fuel from operation of the reactors would be kept in interim storage at the generation sites or at regional storage facilities until DOE makes a decision on its ultimate disposition (that is, whether to reclaim its energy resources for beneficial, non-defense purposes or to dispose of it permanently in a geologic repository). Accidents have the potential to result in health effects. However, the risk of such events, accounting for the estimated accident frequencies, is sufficiently low that no health impacts would be anticipated for any reasonable duration of the project.

As proposed, the medical isotope project would produce only a small fraction (10-30%) of the U.S. demand on a continuing basis to maintain staff and facility capabilities, unless the Canadian supply was interrupted. In that event, the production rate would increase to supply the entire domestic demand. The analysis in this Final Environmental Impact Statement (FEIS), therefore, considers operation at 100% of the capacity required to supply U.S. needs to provide a bounding analysis of the potential consequences.

Because the DOE intends to produce Mo-99 even while the Canadian source is supplying Mo-99, periods may occur when the DOE is unable to sell the Mo-99 that it produces. In this case, the unsold Mo-99 would have to be disposed of as low-level radioactive waste. The disposal of unsold Mo-99, with the other low-level radioactive waste generated during production, is bounded by the analyses in this FEIS.

This section of the FEIS is organized by consequence type, with the alternatives discussed sequentially under each impact category. This organization permits a more direct comparison of the alternatives for each type of potential consequence associated with the medical isotope production project.

5.2 Land Use

Medical isotope production would use existing, in some cases inactive, DOE facilities with relatively minor modification, and would not necessarily preclude concurrent use of the candidate facilities for research or other compatible missions. The planned facility modifications at SNL/NM are the most extensive required at any site, and consist of replacement of the Annular Core Research Reactor cooling tower, possible addition of a second cooling tower, installation of a backup generator for the reactor, extension of the reactor high bay to install an airlock, and expansion of the ventilation system for the hot cell facility. The total area required for these modifications to existing facilities is estimated to be 210 m^2 (2300 ft^2) (DOE 1994b) with a total disturbed area roughly twice that size. If a new hot cell facility were nstructed at INEL, land use might be greater than at SNL/NM; however, it would also be located within ,r adjacent to an existing facility in a previously developed area. Facility upgrades at LANL and ORNL would involve only replacement or modification of existing structures, and therefore would not represent new land use at these sites.

Typically, impacts on land use would not be expected other than for projects that require appropriation of large tracts of land that are suited for multiple uses, and for which there are competing interests. Therefore, commitment of existing facilities to provide a domestic backup capability for production of medical isotopes would be unlikely to create conflicts with regard to land use under any of the alternatives considered in this FEIS.

5.3 Socioeconomics

The socioeconomic impacts are classified in terms of primary and secondary effects. Changes in employment and expenditures associated with the production of Mo-99 are classified as primary effects; the additional changes in the general regional economy and community, as a result of these primary changes, are classified as secondary effects. Examples of secondary impacts include such changes as those in retail and service employment or changes in demand for housing. The total socioeconomic impact in the region is the sum of the primary and secondary impacts.

Table 5-1 provides the available information on year-by-year costs and labor requirements for facility ,difications and operations for each alternative considered. Current estimates place total costs to modify and restart facilities included in the various options at $17.2 million to $21 million, with annual operating costs eventually (FY 1999+) averaging from $8.4 million to $12.8 million per year (See Section 5.22). Peak startup employment is between 50 and 60 full-time equivalent employees (FTEs), with operations employment between 45 and 65 FTEs. These ranges represent net differences in employment from what otherwise would have occurred. Some jobs may represent transfers of existing residents rather than new migrants. At this point, the alternative of having target production at SNL/NM is considered not to have significantly different cost and employment from the alternative shown. Thus, the difference in its potential socioeconomic impact is expected to be negligible as well. The location of impacts would be slightly different if target production occurs at SNL/NM rather than LANL, but only $1 million in costs and about five employees would be shifted to SNL/NM.

Estimates of total employment and income impacts were calculated using the Regional Input-Output Modeling System (RIMS II) multipliers produced by the U.S. Bureau of Economic Analysis (U.S. Department of Commerce 1986) for the local area whose economy and population are affected by Mo-99 production. This area, called the region of influence, is a multi-county area that is linked economically and socially. The region of influence varies in geographical size and shape from site to site, and even by type

Table 5-1. Cost and Labor Estimates for Facility Modification and Operation of the Various Alternatives[(a)]

Costs by Alternative			FY 1996	FY 1997	FY 1998	FY 1999+
SNL/NM Alternative						
Facility Costs[(b)]	Startup Labor		$2.6	$5.7	$1.3	$0.0
	Startup Goods Services		2.7	5.9	1.4	0.0
	Operations Labor		0	0	8.6	8.6
	Operations Goods Services		0	0	4.2	4.2
		Total	$5.3	$11.6	$15.5	$12.8
Labor Requirement[(c)]	Startup Labor		25	55	12	0
	Operations Labor		0	0	59	59
		Total	25	55	71	59
LANL Alternative						
Facility Costs[(b)]	Startup Labor		$5.3	$6.4	$0	$0
	Startup Goods Services		3.6	4.4	0	0
	Operations Labor		0	0	8.0	8.0
	Operations Goods Services		0	0	3.0	3.0
		Total	$8.9	$10.8	$11.0	$11.0
Labor Requirement[(c)]	Startup Labor		41	51	0	0
	Operations Labor		0	0	45	45
		Total	34	40	45	45
ORNL Alternative						
Facility Costs[(b)]	Startup Labor		$6.4	$8.0	$1.5	$0
	Startup Goods Services		3.2	1.4	0.5	0
	Operations Labor		0	0	5.2	6.4
	Operations Goods Services		0	0	3.2	3.2
		Total	$9.6	$9.4	$10.4	$9.6
Labor Requirement[(c)]	Startup Labor		47	59	7	0
	Operations Labor		0	0	60	62
		Total	47	59	67	62
INEL Alternative						
Facility Costs[(b)]	Startup Labor		$6.7	$7.9	$0	$0
	Startup Goods Services		1.2	1.5	0	0
	Operations Labor		0	0	6.7	6.7
	Operations Goods Services		0	0	1.7	1.7
		Total	$7.9	$9.4	$8.4	$8.4
Labor Requirement[(c)]	Startup Labor		43	54	0	0
	Operations Labor		0	0	59	59
		Total	43	54	59	59

(a) Totals may differ from figures in Section 5.22 because of rounding.
(b) Costs are expressed in millions of 1995 dollars.
(c) Labor figures are presented in terms of full time equivalent employees required.

of project. For the purposes of this analysis, the construction activity for the proposed alternative was represented by the New Construction industry, and the operations phase activities are represented by the 'usiness Services industry. The primary and secondary impacts together varied from 100 to 300 total ,egional jobs and from $3 million to $6 million in annual regional income, generally less than 0.1% of the corresponding regional totals.

Impacts other than employment and income were based on changes in population, in view of current capacities of the local roads, schools, waste and water treatment, and other elements of local infrastructure. Historical geographic patterns of settlement are assumed to persist. When compared to the baseline regional employment, population, and personal income in each region of influence, the percentage changes expected as a result of applying the RIMS II multipliers are less than 0.12% in every case. Based on experiences in boomtowns, a useful rule of thumb is that 5% growth is as much growth as a small community can comfortably manage (Gilmore and Duff 1975). While conditions can vary from community to community, population increases significantly less than this are usually within the capacities of communities to absorb. The larger and less-isolated a community (as when it is next to a large metropolitan area), the greater this capacity to manage growth. Because the estimated change in population for any given year is two orders of magnitude smaller and spread over several communities, sufficient capacity for community services would be expected. The potential impacts on the adequacy of community resources and services, such as housing, schools, police, health care, and fire protection, also would be negligible under any alternative.

5.4 Cultural Resources

None of the alternatives considered in this FEIS would involve excavation or land disturbance in previously undeveloped areas of the candidate sites; therefore, the opportunity for discovery of sites or artifacts that may be of cultural significance to Native American peoples or other ethnic groups is very low. If items of potential cultural or historical importance were discovered during facility modification or expansion, work would be suspended and the disposition of the find would be determined in consultation with representatives of appropriate cultural or ethnic groups and regulatory agencies.

None of the facilities under consideration for use in the isotope production mission are currently listed on the National Register of Historic Places, although the Omega West Reactor was previously under consideration and some of the other facilities might eventually be eligible for nomination in the future. If major modification of these facilities were expected, such activities would be carried out in accordance with the National Historic Preservation Act and guidance from state historic preservation officers to preserve any information that might have historic value.

5.5 Aesthetic and Scenic Resources

Impacts on aesthetic or scenic resources generally result from major construction activities in regions where such resources exist. The consequences of such activities could result from the presence or appearance of the completed facility that detracts from the scenic value of the region, or from air emissions that might obscure the resource during construction or operations. Because of the limited extent of the construction associated with any of the alternatives evaluated in this EIS, as well as the location of candidate facilities in established complexes within DOE sites, no impacts on aesthetic or scenic resources would be expected. Construction of cooling towers to augment or replace existing structures would likewise be unlikely to represent a substantial degradation of the scenic value of the sites involved because of their location in previously developed or remote areas of the candidate sites, adjacent to similar structures. The limited facility modifications would be unlikely to require extensive additions to services, such as lighting or electrical transmission towers.

5.6 Geologic Resources

Impacts on geologic resources would not be expected because the project's requirements would not result in depletion of scarce minerals with multiple uses, nor would it involve other activities that might make those resources unavailable. The geologic resource requirements for any of the proposed alternatives consist of modest quantities of construction materials, such as gravel, cement, metals, and other minerals. These materials are not scarce resources for which there are competing uses; therefore, no detrimental effects on geologic resources would be anticipated.

5.7 Air Quality

Effects of the alternatives on air quality are considered in this section. Emissions to air under any of the alternatives would consist primarily of radionuclides from the reactors, and isotope recovery and purification facilities. Emissions of nonradioactive or hazardous materials would not be expected under normal operating conditions for any of the alternatives, and construction activities are limited in scope such that emissions of fugitive dust or exhaust from equipment would not be expected to have widespread impacts over the long term. Vehicle emissions from target, isotope, or waste shipments would be very small compared to those from normal traffic at any of the candidate sites. Therefore, no changes in nonradiological air quality would be expected under any alternative. Health effects of vehicle emissions are considered in Section 5.11.

The radiological consequences of air emissions during normal operation have been estimated for the alternatives considered in this document. The radiological doses were evaluated using the GENII computer code package (Napier et al. 1988) (see Appendix C). Three separate analyses were performed for each facility included in a particular alternative. The receptors evaluated in these cases were 1) at the location of maximum air concentration representing a potential onsite worker outside of the facility, 2) the maximally exposed offsite resident, and 3) the collective population within 80 km (50 mi).

In general, the maximally exposed individual (MEI) was hypothesized to have a lifestyle that maximized exposure to radioactive air effluents from nearby facilities. The MEI's location was identified from annual environmental monitoring reports and used as input into the model results reported in this analysis. The MEI is assumed to be exposed to and to breathe the contaminated plume all year (8766 h), to spend 50% of the year on contaminated soil, and to consume locally grown food.

Individual worker doses were calculated based on a 2000-h exposure to the contaminated plume, 2000 h of inhalation, and 200-h exposure to contaminated soil. These parameters were chosen because on average a worker spends approximately 2000 h per year at work where exposure to and inhalation of the plume is probable. The 200-h exposure to contaminated soil is a conservative estimate of the worker's time spent outdoors on contaminated soil. In the worker scenario, consumption of contaminated food and water was not considered because these commodities are generally produced at locations remote from the workplace.

The health consequences in terms of cancer fatalities were calculated based on collective population dose using recommendations of the International Commission on Radiological Protection in its Publication 60 (ICRP 1991). The health effects from low-dose radiological exposures are taken to be 5 x 10^{-4} fatal cancers/person-rem for the general population and 4 x 10^{-4} fatal cancers/person-rem for workers. In the tables that follow in this section, latent cancer fatalities less than one in the affected population are shown as the actual calculated value, although it is recognized that health effects in this range would not be observed. Other types of health effects would occur at lower rates (for example, non-fatal cancers or genetic effects), or would only be expected at much higher doses than those estimated for the types of activities discussed in this FEIS (for example, cataracts or reproductive effects).

Estimates of latent fatal cancers resulting from facility operations are presented only for collective populations in this analysis. The dose-to-cancer risk factors were not applied to individual radiation dose estimates because the exposure levels and the response of individuals to those exposures are sufficiently uncertain that such estimates would be meaningless. The cancer risk estimates for radiation exposures are based on modes and levels of exposure (primarily to Japanese atomic bomb survivors and individuals undergoing specific types of medical treatments) that are very different from those expected for the types of environmental exposures considered in this analysis. These estimates are used in this evaluation to provide an approximation of the type and extent of health effects that might occur as a result of the proposed activities; however, they are presented with the provision that the estimates are subject to substantial uncertainty and are likely to be conservative (that is, to overestimate the health effects associated with environmental radiation exposures).

The estimated radionuclide air emissions from facilities during medical isotope production, and their consequences for onsite workers and the public, are described in the following sections for the sites evaluated in this FEIS. Target fabrication was assumed to result in negligible air emissions at all sites because the process is entirely contained in a glove box for which the effluent air is filtered. Emissions of radionuclides during irradiation of targets in reactors was modeled using facility-specific release rates and building parameters where available. Emissions from the target processing facilities were assumed to be similar at most sites because each would use the same process, except where specific process modifications would be applied as noted in the alternative discussions. However, site- and facility-specific data were used to model atmospheric dispersion of the effluents under each alternative. Offsite consequences to the public were estimated using wind data and population distributions appropriate to each site and facility under consideration. Annual average atmospheric dispersion conditions were assumed for all routine air emissions because they would occur continuously throughout the duration of operations to produce medical isotopes.

5.7.1 Annular Core Research Reactor: Sandia National Laboratories/New Mexico and the Chemistry and Metallurgy Research Facility: Los Alamos National Laboratory Alternative

This section evaluates the impacts to human health resulting from radionuclide emissions associated with the proposed Mo-99 production under the SNL/NM alternative. The emissions to the atmosphere from the Annular Core Research Reactor are listed in Table 5-2. Estimated air emissions from the Annular Core Research Reactor are based on historical data, accounting for the proposed changes to the reactor

Table 5-2. Estimated Annual Air Emissions from the Annular Core Research Reactor During Target Irradiation (Massey et al. 1995)

Radionuclide	Quantity (Ci)
Tritium	2.2
Argon-41	2.2

operations associated with production of medical isotopes (Massey et al. 1995). Tritium emissions would increase from the levels experienced in past operations because of the higher operating power and increased time in operation. Argon-41 emissions would decrease compared to historical experience because removal of the air-filled test cavity from the core would reduce the opportunity for neutron activation of stable argon in air. Convection cooling of the reactor also reduces the quantity of air in the cooling water compared to systems that actively pump water through the core.

The radiological dose to the MEI living 5.4 km (3.4 mi) north of the stack release is 0.00017 mrem (see Table 5-3). The controlling dose pathway was external exposure from the gas argon-41.

Emissions from the Annular Core Research Reactor stack were modeled using a 17 m (56 ft) release height, an inner radius of 0.1 m (0.3 ft), and a flow rate of 0.35 m^3/s (740 cfm). The hot cell stack was modeled as 38 m (125 ft) high with an inner radius of 0.9 m (2.9 ft), and a flow rate of 22.1 m^3/s (1740 cfm).

Table 5-3. Annual Radiological Dose and Consequences from Routine Air Emissions from the Annular Core Research Reactor During Target Irradiation and Post-Irradiation Processing in the Hot Cell Facility

Receptor	Annular Core Research Reactor	Hot Cells
Offsite Resident (maximally exposed individual) Dose	1.7×10^{-4} mrem	0.17 mrem
Onsite Worker Dose	1.1×10^{-4} mrem	0.037 mrem
Offsite Population Dose	0.023 person-rem	13 person-rem
Latent Fatal Cancers in Offsite Population	1×10^{-5}	0.007

Target fabrication was estimated to result in negligible air emissions because the process occurs entirely in a filtered glove box. The operation involves plating uranium from solution onto the inner surface of a stainless steel tube to produce the target. No mechanism was identified by which measurable release of the uranium solids or solution from the glove box could occur during normal operations.

Estimated air emissions from target processing at the hot cell facility consist of volatile iodine and noble gases, as listed in Table 5-4. The estimated emissions from the hot cell are based on the most recent historical emissions from the Cintichem process (NRC 1984) adjusted for the relative quantities of Mo-99 production at the facilities. These estimates assume emission controls comparable to those used by the Cintichem facility, consisting of high efficiency particulate air (HEPA) filters and a charcoal bed to trap iodine. They are, therefore, relatively conservative because the emission controls at DOE hot cells would meet or exceed the level of those used at the Cintichem facility. The estimated doses from target processing are shown in Table 5-3 and amount to 0.17 mrem to an offsite resident 5.4 km (3.3 mi) north of the facility.

5.7.2 Omega West Reactor/Chemistry and Metallurgy Research Facility: Los Alamos National Laboratory Alternative

This section evaluates the impacts to human health resulting from radionuclide emissions associated with the proposed Mo-99 production under the LANL alternative. The emissions to the atmosphere from the Omega West Reactor were estimated to be 953 Ci/yr of argon-41 (LANL 1993e). The MEI was located approximately 580 m (634 yd) north-northwest of the Omega West Reactor stack. The radiological dose to this MEI was calculated to be 0.15 mrem (see Table 5-5). The controlling dose pathway was external exposure from the argon-41. Emissions from the Omega West Reactor stack were modeled using a stack height of 46 m (151 ft), an inner radius of 0.1 m (0.3 ft), and a flow rate of 0.38 m^3/s (800 cfm).

Table 5-4. Estimated Annual Radionuclide Emissions from Hot Cell Facilities During Processing of Irradiated Targets for Molybdenum-99 Extraction

Radionuclide	Quantity Released (Ci)
Krypton-83m	660
Krypton-85m	970
Krypton-85	6.3
Krypton-87	190
Krypton-88	1600
Iodine-131	3.9
Iodine-132	10
Iodine-133	18
Iodine-134	0.72
Iodine-135	11
Xenon-131m	5.9
Xenon-133m	340
Xenon-135m	16,000
Xenon-133	7200
Xenon-135	6900

Table 5-5. Annual Radiological Dose and Consequences from Routine Air Emissions from the Omega West Reactor During Target Irradiation and Post-Irradiation Processing at the Chemistry and Metallurgy Research Facility

Receptor	Dose From Omega West Reactor	Hot Cell Facility
Offsite Resident (MEI) Dose	0.15 mrem	0.0042 mrem
Onsite Worker Dose	0.012 mrem	0.00015 mrem
Offsite Population Dose	0.63 person-rem	0.032 person-rem
Latent Fatal Cancers in Offsite Population	3×10^{-4}	2×10^{-5}

Target processing at LANL would employ emission controls in addition to those assumed for the releases listed in Table 5-4. At LANL, the hot cell would be designed to process Mo-99 targets entirely within a sealed system, and volatile gases released during the process would be trapped and stored to allow decay of short-lived fission products. Although the process has not been demonstrated on a production scale, it is assumed that radioactive iodine, particulates, and short-lived noble gases could be completely contained within sealed containers during the designated decay period, after which the storage containers would be reused. Allowing for a minimum 50-day decay time, the longer-lived noble gases released to the atmosphere via the hot cell facility stack would amount to 85 Ci/yr of krypton-85, 36 Ci/yr of xenon-131m, and 1200 Ci/yr of xenon-133 for a Mo-99 production rate sufficient to supply 100% of the U.S. demand. Based on these release rates, the dose to the offsite MEI from target processing would be 0.0042 mrem/yr a location 1 km (0.6 mi) north of the Chemistry and Metallurgy Research facility (see Table 5-5). Emissions from the Chemistry and Metallurgy Research facility during target processing were modeled using a stack height of 16.6 m (54 ft), a flow rate of 52.9 m^3/s (114,000 cfm), and an inner radius of 2.6 m (8.7 ft) (DOE 1994f).

5.7.3 Oak Ridge Research Reactor/Radioisotope Development Laboratory: Oak Ridge National Laboratory Alternative

This section evaluates the impacts to human health resulting from radionuclide emissions associated with the proposed Mo-99 production under the Oak Ridge Research Reactor alternative. The Oak Ridge Research Reactor was estimated to release 950 Ci/yr of argon-41 to the atmosphere under normal operating conditions during target irradiation. The radiological dose to the MEI living 5.4 km (3.35 mi) east of the stack release, is 0.004 mrem/yr (see Table 5-6). The controlling dose pathway was external exposure from the argon-41.

Table 5-6. Annual Radiological Dose and Consequences from Routine Air Emissions from the Oak Ridge Research Reactor During Target Irradiation and Post-Irradiation Processing in ORNL's Hot Cell Facility

Receptor	Dose from Oak Ridge Research Reactor	Hot Cell Facility
Offsite Resident (MEI) Dose	0.004 mrem	0.31 mrem
Onsite Worker Dose	0.00036 mrem	0.022 mrem
Offsite Population Dose	0.41 person-rem	15 person-rem
Latent Fatal Cancers in Offsite Population	2×10^{-4}	0.008

The Oak Ridge Research Reactor stack and the Hot Cell facility were modeled using a stack height of 76 m (249 ft), an inner radius of 2.8 m (9.2 ft), and a flow rate of 66 m^3/s (140,000 cfm) (DOE 1995o). The emissions during target processing at the hot cells are listed in Table 5-4, resulting in a dose of 0.31 mrem/yr to the offsite MEI (Table 5.6).

5.7.4 Power Burst Facility/Test Area North: Idaho National Engineering Laboratory Alternative

This section evaluates the impacts to human health resulting from radionuclide emissions associated with the proposed Mo-99 production under the INEL alternative. Emissions to the atmosphere from the

Power Burst Facility were estimated from historic stack monitoring data scaled up to the integrated power requirements for production of medical isotopes (see Table 5-7).

Table 5-7. Estimated Annual Air Emissions from the Power Burst Facility During Target Irradiation

Radionuclide	Quantity (Ci)
Argon-41	620
Strontium-90	7×10^{-6}
Cobalt-60	7×10^{-6}
Cesium-134	1×10^{-5}
Cesium-137	9×10^{-5}
Iodine-131	1×10^{-6}

The radiological dose to the MEI living 12 km (7.5 mi) to the southeast is 0.0013 mrem. The controlling dose pathway was external exposure from the noble gas argon-41. Doses to the maximum worker and the general public from both the Power Burst Facility and the Hot Cell Facility (assumed to be located near the Power Burst Facility) are shown in Table 5-8.

Table 5-8. Annual Radiological Dose and Consequences from Routine Air Emissions from the Power Burst Facility During Target Irradiation and Post-Irradiation Processing in the Hot Cell Facility

Receptor	Power Burst Facility	Hot Cells Facility (Power Burst Facility Location)
Offsite Resident (MEI) Dose	0.0013 mrem	0.13 mrem
Onsite Worker Dose	0.0013 mrem	0.29 mrem
Offsite Population Dose	0.011 person-rem	1.2 person-rem
Latent Fatal Cancers in Offsite Population	7×10^{-6}	6×10^{-4}

Emissions from the Power Burst Facility stack were modeled using a stack height 24 m (79 ft), an inner diameter of 0.45 m (1.5 ft), and a flow rate of 2.8 m^3/s (5900 cfm) (DOE 1995b). For the purpose of this portion of the evaluation, the hot cell facility is assumed to be located adjacent to the Power Burst Facility because it would bound the offsite consequences, compared to those that would result if the release occurred at other potential hot cell locations (for example, Test Area North). Estimated emissions from target processing are listed in Table 5-4, resulting in a dose of 0.13 mrem/yr to the offsite MEI.

5.8 Water Quality

No routine releases of liquid effluents to either surface or ground water would occur under any of the alternatives proposed. Therefore, no consequences to water quality would occur from emissions to water supplies at any of the DOE sites considered as a result of normal operations during medical isotope production; water resources would remain as described in Section 4.0.

5.9 Ecological Resources

No ecological impacts are anticipated under any alternative, because activities associated with medical isotope production would occur in previously developed areas of the sites. Therefore, neither plants, animals, nor their habitats (including wetlands) would be adversely affected.

DOE has determined that no adverse effects would occur in aquatic systems or recreational fisheries, as a result of implementing any of the alternatives.

5.10 Noise

No noticeable increase in noise levels would occur under any of the alternatives.

,.11 Transportation

This section summarizes the transportation impacts associated with the production of medical isotopes. Further details of this analysis are in Appendix B. The alternatives evaluated have been described in Section 3.0. Potential transportation impacts could include external radiation exposures during routine transport and internal and external exposures due to vehicular accidents that result in a release of radioactive materials. Nonradiological impacts, due to pollutants emitted by the transport vehicles and vehicular accidents that result in injuries and fatalities, are also addressed.

For each alternative, the routine and accidental radiological and nonradiological impacts associated with transporting unirradiated targets from the target fabrication site to the reactor, transporting irradiated targets from the reactor to a processing facility for separations, and transporting the separated medical isotope from the processing facility to the pharmaceutical distributor were evaluated. Impacts associated with transporting the wastes generated during processing were also addressed. The impacts of transporting spent nuclear fuel are not addressed, because each of the reactor facilities has available spent fuel storage capacity (see Section 5.14). Therefore, no near term impacts would be associated with the transport of spent nuclear fuel from the reactor facilities to an interim or permanent offsite storage facility. The environmental impacts of managing DOE's spent nuclear fuel inventory are addressed in DOE (1995b).

5.11.1 Methods and Assumptions

The following sections describe the assumptions used to evaluate potential of transportation in each of the alternatives. The analysis focuses on the activities associated with transportation of the unirradiated and irradiated targets, medical isotopes, and processing waste. A detailed description of the analyses is provided in Appendix B.

5.11.1.1 Shipping Scenarios

Four transportation scenario alternatives, one for each medical isotopes production alternative, are presented in this evaluation, however, Appendix B provides a detailed analysis of five alternatives, (that is, a separate analysis was performed for each of the SNL/NM target fabrication options). The information presented is based on the shipment of 100% of the U.S. demand for Mo-99 and the associated amounts of related medical isotopes in equal amounts to each of the three U.S. radiopharmaceutical companies. Appendix B also provides transportation information for the shipment of 100% of the product to each of the three U.S. radiopharmaceutical companies. Also evaluated in this section and Appendix B is the shipment of 100% of the product to Nordion International in Canada. It was assumed that all overland transportation would be performed by truck. For example, unirradiated targets would be transported from the fabrication facility to the irradiation facility by truck and final product would be transported to and from the airport by truck. For all alternatives, it was assumed that a maximum of 52 target shipments/yr and a maximum 1140 purified medical isotope shipments/yr or would be required to meet the demand; that is, 100% of the U.S. market. Of the 1140 shipments, 1035 shipments would contain 3 packages each of Mo-99, xenon-133, and iodine-131, and 105 shipments would contain 3 packages of iodine-125. It was also assumed, based on the total number of targets shipped and the assumption that a representative waste cask would contain processing waste from 14 irradiated targets, a maximum of 90 waste shipments/yr would be expected.

Each of the alternatives evaluated is presented in the following list. In addition, for each of the alternatives listed, shipments of the isotopes from the destination airport to the pharmaceutical suppliers (for example, O'Hare to Amersham Mediphysics) have been evaluated. A detailed description of each of the shipping scenarios is provided in Appendix B.

- Los Alamos National Laboratory Target Fabrication, Irradiation, Separations, and Shipments from Albuquerque International Airport

- Los Alamos National Laboratory or Sandia National Laboratories Target Fabrication, Sandia National Laboratories Irradiation, Separations, and Shipments from Albuquerque International Airport

- Oak Ridge National Laboratory Target Fabrication, Irradiation, Separations, and Shipments from McGhee Tyson Airport

- Idaho National Engineering Laboratory Target Fabrication, Irradiation, Separations, and Shipments from Idaho Falls Airport.

5.11.1.2 Shipping System Descriptions

The following sections provide descriptions of the representative shipping cask for unirradiated target shipments, irradiated target shipments, and both overland and air medical isotopes shipments. For all but one of the options (target fabrication at LANL and irradiation and separations at SNL/NM) target transportation would be onsite. However, all shipments would made by truck and would comply with the appropriate requirements contained in 10 CFR 71 (Type B container) and 49 CFR 173 (Type A container). All air shipments would comply with the requirements contained in 49 CFR 175.

Representative Target Truck Shipping Container and Cask. It was assumed that a target transfer container and shipping cask would be used. A target transfer container can hold up to four irradiated targets. The number of unirradiated or irradiated targets to be shipped at one time would be a maximum of 24 (6 target transfer containers packaged in a cask or 6 casks containing 4 targets each or 2 casks containing 12 targets). Based on a common target design (up to 20 g of 93% enriched uranium-235 [highly enriched uranium] per target) and cask capacity (24 targets per cask) the limits contained in Part 71.22 of 10 Code of Federal Regulations General License: Type A package, Fissile Class III shipment (500 grams per shipment) would not be exceeded.

Representative Separated Medical Isotopes Truck and Air Shipping Cask. The separated medical isotopes would be transported in a Type B shipping cask by truck to the departure airport and from the 'estination airport to the medical isotope distributors, DuPont-Merck, Amersham Mediphysics and ιallinckrodt Medical. It was assumed that a Type B cask similar to a CI-20WC-2 would be used. The cask would be certified for air transport, using commercial passenger or cargo flights. Based on the analysis assumptions (Appendix B), additional shielding could be required for some passenger flights to meet regulatory requirements. This cask may contain up to 1000 Ci of Mo-99/Tc-99m in normal form as solids or liquid, or up to 200 Ci of iodine-131.

The CI-20WC-2 cask is not currently certified for international shipments which would be required for shipments to Nordion. However, often cask designs suitable for transport of Mo-99 product, such as those owned by Nordion, are certified for international transport. The capacities and shielding of the internationally certified casks are similar to those of the CI-20WC-2 cask and would not have a significant effect on the number of shipments and their dose rates. Certification of the CI-20WC-2 cask for international transport is an option, if for some reason the internationally certified casks are unavailable.

Representative Low-Level Waste Truck Shipping Cask. It was assumed that a B-3 Type B package would be used to transport waste packages on onsite and public roadways. This package is suitable for transporting low-level solid radioactive wastes.

5.11.1.3 Transportation Route Information

The transportation routes assumed for this analysis are shown in Table 5-9. The information shown in Table 5-9 includes the number of shipments required, origin, and destination facilities and shipping distances. These data were developed using the HIGHWAY (Joy and Johnson 1992) computer code for truck shipments, or estimated using site maps, and are used to calculate transportation impacts. These data are summarized in Table 5-9 for each transport segment described in Section 5.11.1.1.

5.11.2 Routine or Incident-Free Transportation Impacts

The following sections describe projected radiological and nonradiological impacts during routine or incident-free transportation of unirradiated and irradiated targets, separated isotopes, and secondary waste products for each of the alternatives. A detailed description of the analysis methodology, assumptions, and data is provided in Appendix B.

5.11.2.1 Radiological Impacts from Transportation Activities

This section summarizes the analysis of the radiological impacts to the public and onsite individuals due to routine transportation. Members of the public or onsite individuals exposed to radiation include persons on onsite roads or offsite highways with the shipment, persons residing near these transport links, and persons at intermediate stops along the route (such as refueling stops). For air transport, it was assumed that all shipments would be made using commercial passenger flights with one intermediate stop at a hub. Therefore, impacts to the public include airplane passengers and people in the airport terminals. This additional population will result in conservative estimates relative to cargo air transport, and will bound the impacts of the air transport scenarios. The RADTRAN 4 computer code was used to perform these calculations. A description of RADTRAN 4 is provided in Appendix B.

The results of the public and onsite individual dose calculations, developed using the RADTRAN 4 computer code and the input parameters shown in Table 5-9 and provided in Appendix B are presented in Table 5-10. This table shows the radiological impacts to the combined truck and air transport crew (including handlers at the hubs) and range from 23 to 24 person-rem annually (or 0.01 latent cancer fatalities [LCFs]). The onsite and public radiological impacts range from 26 person-rem annually (or 0.01 LCFs) (ORNL) to 53 person-rem annually (or 0.03 LCFs) (INEL). For shipments to Nordion (see Appendix B), (100% demand), the calculated radiological impacts range from 21 person-rem (ORNL) to 23 person-rem (LANL and SNL/NM) to the combined crew; and from 33 person-rem (ORNL) to 69 person-rem (LANL and SNL/NM) to onsite individuals and the public. The calculated onsite and public health effects, range from 0.02 to 0.04 LCFs and to the combined crew are less than 0.01 LCFs.

This action may require the transport of highly enriched uranium to the target fabrication facilities. Currently, all of the sites (except for SNL/NM) have a sufficient supply of highly enriched uranium in

Table 5-9. Summary of Transportation Routing Information

Option/Material Transported Transportation Route Origin	Destination	Shipments/yr	Shipment Description (km one-way)[a] Onsite	Offsite
Target Fabrication, Irradiation, Separations, and Waste Handling at LANL				
Unirradiated Targets				
CMR Facility	Omega West Reactor	52	6.5	0
Irradiated Targets				
Omega West Reactor	CMR Facility	52	6.5	0
Low-Level Waste				
CMR Facility	Technical Area 54[b]	90	8	0
Separated Medical Isotope				
CMR Facility	Albuquerque Int Airport	1520	18	135
Albuquerque Int Airport	Boston, MA[c]	380	Not applicable	3200
Boston, MA	Dupont-Merck	380	Not applicable	56
Albuquerque Int Airport	Chicago, IL	380	Not applicable	1800
Chicago, IL	Amersham Mediphysics	380	Not applicable	13
Albuquerque Int Airport	St. Louis, MO	380	Not applicable	2200
St. Louis, MO	Mallinckrodt Medical	380	Not applicable	8
Target Fabrication at LANL or SNL/NM; Irradiation and Separations at SNL/NM; and Waste Handling at Nevada Test Site				
Unirradiated Targets				
LANL-CMR Facility	ACRR	52	28	148
SNL/NM-Hot Cell Facility	ACRR	52	0	0
Irradiated Targets				
ACRR	Hot Cell Facility	52	0	0
Low-Level Waste				
Hot Cell Facility	NTS	90	9	1099
Separated Medical Isotope (Shipments from Albuquerque Int Airport to distributors as above)				
Hot Cell Facility	Albuquerque Int Airport	3225	9	8.5
Target Fabrication, Irradiation, and Separations at ORNL, and Waste Handling at NTS				
Unirradiated Targets				
Radioisotope Development Laboratory	ORRR	52	0	0
Irradiated Targets				
ORRR	Radioisotope Development Laboratory	52	0	0

Table 5.9. (contd)

Option/Material Transported Transportation Route Origin	 Destination	Shipments/yr	Shipment Description (km one-way)[a] Onsite	 Offsite
Low-Level Waste				
Radioisotope Development Laboratory	NTS[b]	90	11	3300
Separated Medical Isotope (Shipments from Destination Airports to distributors as above)				
Radioisotope Development Laboratory	McGhee Tyson Airport	1520	11	29
McGhee Tyson Airport	Boston, MA[c]	380	Not Applicable	1340
McGhee Tyson Airport	Chicago, IL	380	Not Applicable	750
McGhee Tyson Airport	St. Louis, MO	380	Not Applicable	650
Target Fabrication, Irradiation, Separations, and Waste Handling at INEL				
Unirradiated Targets				
Test Area North Facility	Power Burst Facility Reactor	52	53	0
Irradiated Targets				
Power Burst Facility Reactor	Test Area North Facility	52	53	0
Low-Level Waste				
Test Area North Facility	ICPP[b]	90	44	0
Separated Medical Isotope (Shipments from Destination Airports to distributors as above)				
Test Area North Facility	Idaho Falls Airport	1520	80	40
Idaho Falls Airport	Boston, MA	380	Not Applicable	3320
Idaho Falls Airport	Chicago, Il	380	Not Applicable	1990
Idaho Falls Airport	St. Louis, Mo	380	Not Applicable	1890

(a) Zero onsite distance implies facilities are adjacent.
(b) Assuming 52 target shipments/yr, 24 targets/shipment, and waste from 14 targets/waste cask.
(c) Transportation impacts for shipments and number of shipments (380/yr) to Nordion are similar or bounded by the analyses.

ACRR - Annular Core Research Reactor; CMR - Chemistry and Metallurgy Research Facility;
ICPP-Idaho Chemical Processing Plant; ORRR - Oak Ridge Research Center; NTS - Nevada Test Site.

storage to fabricate targets for five years or more. Consequently, no environmental impacts would be associated with transporting highly enriched uranium to these sites. For SNL/NM, approximately 25 kg of highly enriched uranium per year are estimated to be needed. The impacts of this were estimated, based on information presented in DOE 1995r. Preliminary unit risk values (person-rem/km per kg of highly enriched uranium shipped) were also derived from this data. Based on the results for the option in DOE (1995r) in which would be shipped from the Y-12 Area to Erwin, Tennessee for blending, the unit risk values were calculated to be 5×10^{-8} person-rem/km-kg for the public and 1.3×10^{-7} person-rem/km-kg for truck crews. These values were then multiplied by the approximate distance from Y-12 to SNL/NM (2200 km) and the annual highly enriched uranium requirements (25 kg/yr) to calculate the annual radiological exposures for the highly enriched uranium shipments needed by SNL/NM to fabricate the required targets. The resulting radiological exposures for incident-free transport were 3×10^{-3} person-rem/yr to the public and 7×10^{-3} person-rem/yr to the truck crews. These exposures are insignificant, relative to the annual exposures presented in Table 5-10.

Although not shown in Table 5-10, the radiological impacts for air transport activities account for greater than 90% of the totals. This percentage is primarily due to the number of air shipments required annually, the number of passengers and crew exposed during the entire flight, and the number of individuals exposed in the airport terminal. However, the calculated dose to an individual passenger is approximately 0.7 mrem/shipment, which is less than the average dose received by a passenger from

Table 5-10. Radiological Impacts Due to Routine or Incident-Free Transportation

Alternative	Radiological impacts (person-rem/yr)[a]		Health Effects (LCFs/yr)[d]	
	Crew[b]	Public[c]	Crew[b]	Public[c]
Los Alamos National Laboratory Target Fabrication, Irradiation, Separations, Onsite Waste Storage, and Shipments from Albuquerque International Airport	23 (1)	52 (0.08)	0.01	0.03
Los Alamos National Laboratory or Sandia National Laboratories Target Fabrication and Irradiation and Separations at Sandia National Laboratories, Waste to Nevada Test Site, and Shipments from Albuquerque International Airport	24 (2)	52 (0.2)	0.01	0.03
Oak Ridge National Laboratory, Target Fabrication, Irradiation and Separations, Waste to Nevada Test Site, and Shipments from McGhee Tyson Airport	23 (2)	26 (0.2)	0.01	0.01
Idaho National Engineering Laboratory Target Fabrication, Irradiation, Separations, Onsite Waste Storage, and Shipments from Idaho Falls Airport	23 (1)	53 (0.05)	0.01	0.03

(a) Radiological impacts for truck transport are shown in parentheses.
(b) Truck crew and air transport crew, including handlers at hubs.
(c) Includes public and onsite individuals where appropriate.
(d) Latent cancer fatalities calculated in accordance with ICRP Publication 60 (ICRP 1991).

natural cosmic radiation during a 4-hour flight (2 mrem) (NCRP 1987). This dose is also negligible relative to the annual dose received by the average U.S. citizen from natural and man-made radiation sources (approximately 360 mrem/yr) (NCRP 1987).

Assuming the medical isotopes are shipped air cargo, the crew impacts would remain approximately the same; however, impacts to the public (passengers and people in the airport terminal) would be significantly lower (less than 1 person-rem/yr).

5.11.2.2 Nonradiological Impacts from Transportation Activities

Impacts to the public from nonradiological causes were also evaluated. These impacts include fatalities resulting from pollutants emitted from the vehicles during normal transportation. Based on the information contained in Rao et al. (1982), the types of pollutants that are present and can impact the public are sulfur oxides (SO_x), particulates, nitrogen oxides (NO_x), carbon monoxide (CO), hydrocarbons (HC), and photochemical oxidants (O_x). Of these pollutants, Rao et al. (1982) determined that the majority of the health effects are due to SO_x and the particulates. Unit risk factors (fatalities per kilometer) for truck shipments were developed by Rao et al. (1982) for travel in urban population zones (1×10^{-7}/km for truck).

Table 5-11 presents the results of the incident-free or routine nonradiological impacts. As shown in this table, the impacts to the public (not including onsite individuals) are essentially the same as the radiological impacts (0.008 to 0.009 fatalities).

Table 5-11. Nonradiological Impacts to the Public Due to Routine or Incident-Free Transportation

Alternative	Fatalities/yr
Los Alamos National Laboratory Target Fabrication, Irradiation, Separations, Onsite Waste Storage, and Shipments from Albuquerque International Airport	0.008
Los Alamos National Laboratory or Sandia National Laboratories Target Fabrication and Irradiation and Separations at Sandia National Laboratories, Waste to Nevada Test Site, and Shipments from Albuquerque International Airport	0.009
Oak Ridge National Laboratory, Target Fabrication, Irradiation and Separations, Waste to Nevada Test Site, and Shipments from McGhee Tyson Airport	0.009
Idaho National Engineering Laboratory Target Fabrication, Irradiation, Separations, Onsite Waste Storage, and Shipments from Idaho Falls Airport	0.008

5.11.3 Transportation Accident Impacts

Radiological and nonradiological transportation accident impacts during transportation of unirradiated and irradiated targets, separated isotopes, and secondary waste products for each of the alternatives are discussed in the following subsections. A detailed description of the analysis methodology and accident characteristics is provided in Appendix B.

5.11.3.1 Radiological Impacts Due to Transportation Accidents

Radiological impacts are calculated for the public, as well as the MEI (located 100 m or 328 μ from the accident). The impacts to the public are presented in this section as integrated population risks (that is, accident frequencies multiplied by consequences integrated over route-specific population data, for a 1-year shipping campaign).

Population risk calculations were performed using the RADTRAN 4 computer code (Neuhauser and Kanipe 1992) (see Appendix B). The radiological doses to the MEI have been calculated using GENII (Napier et al. 1988). The results of the integrated population risk assessment presented in Appendix B are summarized in Table 5-12.

Table 5-12. Radiological Impacts Due to Transportation Accidents, Including Truck and Air Transport

Alternative	Public[a]	
	Radiological Risk (person-rem/yr)[b]	**Health Effects Risk (LCFs)[c]**
Los Alamos National Laboratory Target Fabrication, Irradiation, Separations, Onsite Waste Storage, and Shipments from Albuquerque International Airport	0.04 (5×10^{-4})	2×10^{-5}
Los Alamos National Laboratory or Sandia National Laboratories Target Fabrication and Irradiation and Separations at Sandia National Laboratories, Waste to Nevada Test Site, and Shipments from Albuquerque International Airport	0.04 (2×10^{-3})	2×10^{-5}
Oak Ridge National Laboratory, Target Fabrication, Irradiation and Separations, Waste to Nevada Test Site, and Shipments from McGhee Tyson Airport	0.02 (8×10^{-4})	1×10^{-5}
Idaho National Engineering Laboratory Target Fabrication, Irradiation, Separations, Onsite Waste Storage, and Shipments from Idaho Falls Airport	0.04 (5×10^{-4})	2×10^{-5}

(a) Includes public and onsite individuals where appropriate.
(b) Radiological impacts for truck transport are shown in parentheses.
(c) Latent cancer fatalities calculated in accordance with ICRP Publication 60 (ICRP 1991).

The radiological impacts to the public (including onsite individuals) associated with truck transportation accidents range from 0.02 person-rem (ORNL alternative) to 0.04 person-rem (LANL and SNL/NM alternatives 100% demand). The projected health effects are less than 2×10^{-5} LCFs. For shipments to Nordion (see Appendix B), the calculated radiological impacts are 0.05 person-rem and the calculated health effects are 2×10^{-5} LCFs.

Results of Transportation Accident Impacts to a Maximally Exposed Individual. In addition to the radiological dose to the public, the doses to an MEI were calculated. It was assumed that a vehicle accident that would result in a release (catastrophic cask failure) would result in crew fatalities; therefore, radiological impacts to the crew were not calculated. The MEI was assumed to be located 100 m (328 ft) from the accident.

Radiological accident impacts to the MEI are calculated using GENII (Napier et al. 1988) (see Appendix B). To calculate the impacts to the receptor, it was assumed the release occurred at ground level due to catastrophic failure of a shipping cask.

The dose by material to the MEI located 100 m (328 ft) from a truck transportation accident is shown in Table 5-13. As can be seen, the dose received due to an accident involving a shipment of iodine-131 is greater than all other calculated doses

Table 5-13. Accidental Releases and Dose to the Maximally Exposed Individual Located 100 m (328 ft) from Transport Accident

Isotope/Material	Unirradiated Target	Irradiated Target	Mo-99	I-125	I-131	Xe-133	Waste
Qty. of Material[a]	1.1×10^{-3} Ci	one shipment	41.0 Ci	0.35 Ci	11.0 Ci	31.0 Ci	one shipment
Dose (rem)	0.91	1.3	0.62	0.054	2.6	0.063	1.4×10^{-6}

(a) With the exception of the irradiated target and waste, quantities shown are the quantities respirable.

5.11.3.2 Nonradiological Impacts from Transportation Accidents

This section summarizes the analyses presented in Appendix B to assess nonradiological impacts. Nonradiological accident impacts are the fatalities resulting from potential vehicular accidents involving the shipments. It is assumed that a vehicle accident that would result in a release from a shipping cask could also result in crew fatalities; therefore, nonradiological vehicular accident impacts are calculated for the public and transport crew.

The results of the nonradiological accident impact calculations for the four potential shipping scenarios are presented in Table 5-14. The values reported in the table represent the sum of the impacts from all of the shipments and include the impacts from shipments carrying cargo, as well as those from empty return shipments.

Table 5-14. Nonradiological Impacts Due to Truck Transportation Accidents

Alternative	Fatalities/ Year[(a)]
Los Alamos National Laboratory Target Fabrication, Irradiation, Separations, Onsite Waste Storage, and Shipments from Albuquerque International Airport	0.01
Los Alamos National Laboratory or Sandia National Laboratories Target Fabrication and Irradiation and Separations at Sandia National Laboratories, Waste to Nevada Test Site, and Shipments from Albuquerque International Airport	0.01
Oak Ridge National Laboratory, Target Fabrication, Irradiation and Separations, Waste to Savannah River Laboratory, and Shipments from McGhee Tyson Airport	0.02
Idaho National Engineering Laboratory Target Fabrication, Irradiation, Separations, Onsite Waste Storage, and Shipments from Idaho Falls Airport	0.01
(a) Includes public and transport crew.	

5.12 Occupational and Public Health and Safety

Implications of implementing the alternatives for production of medical isotopes on worker and public health and safety at the candidate sites are discussed in the following subsections. In general, this section summarizes material presented in Sections 5.7, 5.8, 5.11, and 5.15.

5.12.1 Radiological Consequences to Members of the Public

Emissions of radionuclides to surface- or groundwater would not be expected from normal operations ı any alternative associated with production of medical isotopes. The majority of radiological consequences to the public result from air emissions associated with medical isotope production facilities (see Section 5.7) or from transportation of separated isotopes to distributors (see Section 5.11). Collective doses to the offsite populations within 80 km (50 mi) from facility air emissions could range from 0.6 to 15 person-rem/yr at the alternative sites (Section 5.7). Transportation was estimated to result in 49 to 76 person-rem/yr, primarily through direct exposure to workers and the public during air shipments (Section 5.11). The affected populations for transportation would be different from those surrounding the production sites. Neither facility operations nor transportation would be expected to result in latent cancer fatalities for a year of isotope production operations, or for any reasonable duration of the project.

Radionuclide emissions to air from processing irradiated targets might result in doses to the maximally exposed offsite individual of 0.004 to 0.3 mrem/yr, depending on the site selected. Estimated doses from operation of the reactors during target irradiation were generally lower than those for target processing, amounting to 0.0002 to 0.2 mrem/yr. Target fabrication would not be expected to add measurably to radionuclide air emissions.

The U.S. Environmental Protection Agency (EPA) radionuclide air emission standards for DOE facilities limit the dose to a member of the public to 10 mrem/yr for the air pathway (as calculated using the EPA Clean Air Act Assessment Package 1988 [CAP88] model, which generally results in doses similar to those from the GENII code used in this analysis). Doses to individual members of the public from all pathways (including air, water, and direct exposure) are limited by DOE regulations to 100 mrem/yr. This limit would apply to individual transportation workers who are involved in commercial air shipments, and who are assumed, for the purpose of this analysis, to be members of the public. The activities evaluated in this EIS would comply with EPA and DOE regulations for radiation exposure to the public.

For perspective, an average person in the U.S. receives about 300 mrem (0.3 rem) per year from natural background sources of radiation and an additional 60 mrem/yr from artificial sources, such as medical exposure (NCRP 1987). The collective annual dose from natural background radiation to populations within 80 km (50 mi) of the DOE sites considered in the FEIS alternatives would therefore amount to approximately 180,000 person-rem at SNL/NM (610,000 people), 75,000 person-rem at LANL (250,000 people), 270,000 person-rem at the Oak Ridge Reservation (910,000 people), and 36,000 person-rem at INEL (120,000 people).

Accidental releases of radionuclides during transportation or facility operation have the potential to result in health effects if the accidents occur (see Sections 5.11 and 5.15). However, the risk from such accidents, accounting for accident frequency as well as consequences, is sufficiently low that no health effects would be expected for any of the alternatives considered in this FEIS.

5.12.2 Radiological Consequences to Workers

Direct radiological exposures to workers during routine facility operations are summarized in Table 5-15. Collective worker doses might vary somewhat from site to site because of facility-specific considerations; however, because the processes are similar at all sites, the doses to involved workers would likely be within the range of doses estimated for the SNL/NM and LANL operations (Massey et al. 1995). Annual worker doses during facility modifications would likely be bounded by the annual operational dose estimates because the quantities of radioactive materials that might be encountered during the minor construction projects would be substantially lower than during operations for these facilities, which are not highly contaminated. For example, estimates of the worker dose for refueling and replacing instrumentation at the Power Burst Facility were about 8 person-rem, and LANL estimates for hot cell decontamination were about 2.5 person-rem. Doses from air emissions to onsite workers outside the facility are likewise expected to be lower than those to workers directly involved in the isotope production operations.

Table 5-15. Routine Radiological Exposures to Workers During Facility Operations (Massey et al. 1995)

Operation	Collective Worker Dose (person-rem/yr)			
	SNL/NM	LANL	ORNL	INEL
Target Fabrication	0.5	0.5	(a)	(a)
Reactor Operation	10.0	5.0	(a)	(a)
Target Processing	9.0	1.5	(a)	(a)
Onsite Loading of Isotope Shipments	2-5	2-5	(a)	(a)
Total	22-25	9-12	(a)	(a)
Latent Cancer Fatalities	0.009-0.01/yr	0.004-0.005/yr	(a)	(a)

(a) Dose estimates for these sites are expected to fall within the range of those for SNL/NM and LANL.

Collective worker doses of the magnitude estimated for isotope production would not be expected to result in latent fatal cancers for any reasonable duration of the project (0.004 to 0.01 per year of operation).

Individual doses for workers at DOE facilities are limited to 5 rem/yr by regulation, and at many DOE facilities, they are controlled administratively to a maximum of 0.5 rem/yr, unless special approval is obtained. DOE facilities are required to implement programs that will maintain worker doses as low as reasonably achievable by evaluating processes where radioactive materials are handled and using procedures to minimize worker exposure wherever possible. For most types of operations, individual worker doses would be well below the applicable administrative control levels.

Impacts to individual involved workers from radiological accidents at facilities associated with medical isotope production were estimated to result in doses of 1 to 80 rem (Massey et al. 1995). Doses of that magnitude have the potential to produce short-term effects on the individuals involved but would not be considered life-threatening with appropriate medical management.

5.12.3 Nonradiological Consequences

The consequences of routine emissions to air and water of nonradiological compounds that could result in potential health effects are discussed in Sections 5.7, 5.8, and 5.11. Emissions of criteria pollutants (particulates, nitrogen oxides, and sulfur oxides) from facilities or vehicles during modification or transportation would not be expected to result in adverse health effects at these levels (Section 5.11). Routine emissions of other potentially hazardous materials to air or water are not expected as a result of any alternatives in this EIS.

Accidents involving releases of hazardous or toxic material from facilities are evaluated in Section 5.15, and potentially could result in adverse health effects to a limited number of nearby individuals if such accidents were to occur. Because the accident assessment uses hypothetical, nonspecific release scenarios based on facility inventory, the estimated frequency and the resulting risk from these accidents cannot be assessed directly. However, the frequencies of the types of accidents that could result in substantial releases to the environment are typically low enough that they would not be expected to occur during the operations considered in this EIS.

Health effects and fatalities due to traffic or industrial accidents are discussed in Sections 5.11 and 5.15, respectively. Facility modification would be expected to contribute to, at the most, seven illnesses or injuries over the time required to modify facilities for medical isotope production, and two or less per year during normal operations, based on historical operating statistics for DOE facilities (see Section 5.15). Traffic accidents, and accidents during facility modification and operation, would not be expected to result in any fatalities during a year of normal operations.

5.13 Site Services and Resources

5.13.1 Annular Core Research Reactor: Sandia National Laboratories/New Mexico and the Chemistry and Metallurgy Research Facility: Los Alamos National Laboratory Alternative

This section provides a discussion on the use of materials, energy, and chemicals associated with upgrading or operation of the facilities necessary to produce Mo-99 at SNL/NM and SNL/LANL. Plans remain in the conceptual stage, and detailed designs have not yet been prepared.

5.13.1.1 Modifications at LANL for Target Fabrication

Several upgrades would be required at the LANL target fabrication facility, all of which would require energy and materials:

- Nine glove boxes would be custom fabricated to contain the apparatus for target fabrication in two duplicate production lines. Each glove box exhaust would be fitted with a HEPA filter. Apparatus in glove boxes would include dissolution tanks, introduction boxes, and target coating equipment. Exhaust ducting and fans would connect the glove box ventilation systems to the existing Chemistry and Metallurgy Research Facility, Wing 9 ventilation system.

- Some interior walls would be removed and doors would be relocated.

5.13.1.2 Modifications at SNL/NM Hot Cell Facilities

If target fabrication is to be performed at SNL/NM, certain modifications would be required. Upgrades and improvements required for SNL/NM target fabrication facilities would be essentially the same as those required for the LANL facilities, as described in Section 5.13.1.1.

5.13.1.3 Annular Core Research Reactor Facility Modifications at SNL/NM

Several upgrades would be required at the Annular Core Research Reactor, all of which would require energy and materials. In addition, the reactor would need to operate on a sustained basis. Materials and energy expended to accomplish the proposed upgrades, as described in Section 3.0, are estimated in Table 5-16.

5.13.1.4 Hot Cell Facility Modifications

Several upgrades would be required at the hot cell facility, as described in Section 3.0, all of which would require energy and materials. Table 5-16 provides estimated resource use.

Table 5-16. Estimated Annual Quantities of Selected Resources Required for 100% Operation and Upgrade of Facilities at Each Site.

	Resources Required for Construction				Annual Resources Required for Operations				
Site	Concrete m^3 (yd^3)	Steel tonnes (tons)[a]	Electricity (kWh)[b]	Stainless Steel tonnes (tons)	Water (evap cooling) m^3/yr (gal/yr)	Electricity (Mwh)	LEU (fuel bundle total) kg (lb)	HEU (U^{235} targets) kg (lb)	Targets Stainless Steel tonnes (tons)
SNL	1200 (1500)	0.21 (0.24)	230	1.0 (1.1)	40,000 (11 x 10^6)[c]	400	16 (35)	4-36 (8-79)[d]	0.50 (1.1)
LANL	0	0	negligible	0.2 (0.22)	120,000 (31 x 10^6)	500	32 (70)	3 (7)[d]	0.36 (0.8)
ORNL	20 (26)	negligible	4	3.5 (3.9)	120,000 (31 x 10^6)	500	32 (70)	3-26 (7-57)[d]	0.36 (0.8)
INEL	2400 (3100)	0.39 (0.44)	450	1.5 (1.7)	120,000 (31 x 10^6)	500	32 (70)	3-26 (7-57)[d]	0.36 (0.8)

Notes:

(a) Numbers were derived by proportion from data acquired from other DOE construction projects. An assumption was made that the amount of steel required per cubic yard of concrete poured would be similar for hot cell walls and spent nuclear fuel storage facilities.

(b) Numbers were derived by proportion from data acquired from other DOE construction projects. An assumption was made that the amount of electricity consumed per cubic yard of concrete poured would be similar for constructing spent nuclear fueled storage facilities and for constructing hot cell facilities.

(c) From: DOE 1994e.

(d) Minimum values assume approximately 90% U-235 recovery. Recovery would occur at LANL, and could be implemented at other sites. However, the analyses presented in other sections do not assume uranium recovery at sites other than LANL.

5.13.1.5 Operational Resources Required

Target fabrication would require resources, the most important of which would be highly enriched (93%) uranium-235 and stainless steel. Table 5-16 provides an estimate of these resource needs.

- Stainless steel for target fabrication. A typical target would be constructed of stainless steel tubing approximately 0.89 mm (0.035 in.) thick, 46 cm (18 in.) long, and 3.2 cm (1.25 in.) in diameter.

- Highly enriched uranium is coated onto the stainless steel targets for irradiation in the reactors.

Electrical use for operation of the reactor is anticipated to be approximately 400 MWh/yr. Yearly water consumption is estimated to be 40,000 m^3 (11 x 10^6 gal).

In addition, the chemical use anticipated for target processing to produce Mo-99 is shown in Table 5-17.

Table 5-17. Approximate Yearly Chemical Usage for Production of Molybdenum-99 at Any of the Proposed Project Sites

Chemical Identification	Annual Consumption[a]
sulfuric acid, 2N	120 L
sulfuric acid, 0.1N	36 L
hydrochloric acid, reagent grade	1.2 L
nitric acid, reagent grade	6 L
sodium hydroxide, 0.2N	24 L
sodium iodide	120 g
silver nitrate	600 g
benzoin-a-oxime	2.4 Kg
molybdenum trioxide	24 g
potassium permanganate	100 g
rhodium trichloride	24 g
potassium hexachlororuthenate	24 g
hydrogen peroxide	2.4 L
calcium oxide	12 L
calcium sulfate (drierite)	36 L
calcium sieve type 13X	36 L

(a) From (DOE 1994b). Values are based on 100% replacement of U.S. requirements using 20 kW targets. At SNL/NM, the requirements would increase by about 40% because a greater number of targets would be required to achieve 100% replacement of U.S. demand.

5.13.2 Omega West Reactor/Chemistry and Metallurgy Research Facility: Los Alamos National Laboratory Alternative

This section provides a discussion on the use of materials, energy, and chemicals associated with upgrading or operation of the facilities necessary to produce Mo-99 at the Omega West Reactor at LANL.

5.13.2.1 Materials Required for Omega West Reactor Upgrades

Resource consumption data on materials, energy, and chemicals required to upgrade the Omega West Reactor to produce Mo-99 have been estimated (Table 5-16). Plans are in the conceptual stage, and detailed designs have not yet been prepared.

5.13.2.2 Operational Resources Required

Electrical consumption for operation is estimated to be 500 MWh/yr. Yearly water consumption for evaporative cooling is estimated to be 120,000 m^3 (31 x 10^6 gal) per year. Requirements for target fabrication and processing would be as described in Section 5.13.1.5.

5.13.3 Oak Ridge Research Reactor/Radioisotope Development Laboratory: Oak Ridge National Laboratory Alternative

This section discusses the use of materials, energy, and chemicals associated with retrofitting or operating the facilities necessary to produce Mo-99. Anticipated upgrades include activities needed to start the reactor, relocate cooling towers, and install process equipment in the hot cells. Plans are in the conceptual stage, and detailed designs have not yet been prepared. Table 5-16 provides estimated resource use for facility upgrades and operations.

5.13.3.1 Oak Ridge Research Reactor Facility Modifications

Several upgrades would be required at the Oak Ridge Research Reactor facility, as described in Section 3.0, all of which would require energy and materials. The major material requirement is an estimated 20 m^3 (26 yd^3) of concrete for relocating the cooling towers (Table 5-16).

5.13.3.2 Mo-99 Processing Facility Modifications

Several upgrades would also be required at the target fabrication and Mo-99 processing facility, as described in Section 3.0, all of which would require in energy and materials. Estimated quantities of materials and energy necessary to accomplish these upgrades are listed in Table 5-16.

5.13.3.3 Operational Resources Required

It is estimated that the Oak Ridge Research Reactor would consume 500 MWh/yr of electrical power and 120,000 m^3 (3.1×10^7 gal) per year of water for evaporative cooling (Table 5-16). Requirements for target fabrication and processing would be as described in Section 5.13.1.5.

5.13.4 Power Burst Facility/Test Area North: Idaho National Engineering Laboratory Alternative

This section provides a discussion on the use of materials, energy, and chemicals associated with retrofitting or operating the facilities necessary to produce Mo-99. Plans are in the conceptual stage, and detailed designs have not yet been prepared.

5.13.4.1 Power Burst Facility Modifications

The Power Burst Facility would require a few modifications to be able to restart. A significant portion of the reactor instrumentation would need to be replaced and all of the systems would need to be tested to determine operability. Data on exact quantities of materials and energy necessary to accomplish these upgrades are not available.

5.13.4.2 Hot Cell Facility Modifications

The existing Test Area North hot cell annex would require slight modifications to be able to receive and process the target elements, as described in Section 3.0. Data are not available on exact quantities of materials and energy expended to accomplish the proposed upgrades and for processing of irradiated targets.

If new hot cells are constructed adjacent to the Power Burst Facility, instead of using existing facilities, it is estimated that 2400 m^3 (3100 yd^3) of concrete and one half ton of steel would be needed.

5.13.4.3 Operational Resources Required

It is estimated that the Power Burst Facility would consume 500 MWh/yr of electrical power and 120,000 m^3/yr (31×10^6 gal/yr) of water use for evaporative cooling (Table 5-16), based on anticipated operating power levels. Requirements for target fabrication and processing would be as described in Section 5.13.1.5.

5.14 Waste and Spent Nuclear Fuel Management

The Cintichem process would be used under each of the alternatives. A detailed description of the Cintichem process can be found in Appendix A. The purpose of this section is to identify wastes generated by that process, how these wastes could be handled, and what impact they may have on current site waste management capabilities. An evaluation of that information is included under the discussion of the preferred alternative of SNL/LANL. Significant variations in waste volume production and management issues are addressed in the subsequent alternative sections (5.14.2 through 5.14.4). For each alternative, the wastes generated would be required to meet applicable waste acceptance criteria to ensure that wastes are safely treated and disposed.

Management of spent nuclear fuel is also considered for each of the alternatives. Near-term management of spent fuel would occur at the site where the fuel was initially generated. All of the sites have the capacity to store the limited quantities of spent nuclear fuel resulting from Mo-99 production for at least 5 years, assuming 100% production. The facilities identified for spent nuclear fuel storage in this FEIS were evaluated in a 1993 DOE report (DOE 1993d). Although some of the spent nuclear fuel storage facilities identified in this FEIS were listed as having vulnerabilities, none of those vulnerabilities were identified as priority issues needing immediate corrective action. All corrective actions necessary to allow the safe storage of spent nuclear fuel generated during Mo-99 production would be completed prior to storage of fuel in the affected facilities.

The DOE intends to produce a baseline quantity of Mo-99 (about 10% to 30% of U.S. demand) in order to maintain the capability to respond to shortages in domestic Mo-99 supply. Because the DOE intends to produce Mo-99 even when the Canadian source is supplying Mo-99, periods may occur when the DOE is unable to sell the Mo-99 that it produces. In this case, the unsold Mo-99 would be disposed of as low-level radioactive waste at the same disposal site as other low-level wastes generated during Mo-99 production. The disposal of unsold Mo-99 with the other low-level radioactive waste generated during production is bounded by the analyses in this section.

5.14.1 Annular Core Research Reactor: Sandia National Laboratories/New Mexico and Chemistry and Metallurgy Research Facility: Los Alamos National Laboratory Alternative

5.14.1.1 Waste Generation from Medical Isotope Production

The Mo-99 process and the waste produced can be divided into three major stages: target fabrication, reactor irradiation of the uranium-loaded targets, and processing (recovery) where molybdenum is chemically extracted from the other fission products in a hot cell facility. Waste quantities in this analysis are based on production rates required to supply 100% of U.S. needs.

Target Fabrication. Target fabrication would be done at the Chemistry and Metallurgy Research Facility at LANL. Target fabrication would be performed inside glove boxes where 93%-enriched uranium would be coated on the inner walls of stainless steel tubes. Spent plating solution would be recycled in the ion exchange glove boxes to recover unused uranium. LANL is the only alternative (of the four sites under consideration) with the pre-existing capability to perform this recycle step. Residues consisting of low activity, low-level waste, would be collected in holding tanks, sampled, and analyzed before being transported through a process line to the TA-50 Radioactive Liquid Waste Treatment Facility onsite at LANL. Approximately 7.3 m^3/yr (140 L/wk) of low-level solidified liquid waste would result from the target fabrication process. Alternatively, the residue solution could be placed in interim liquid waste storage tanks, then routed later to the TA-50 Low-Level Liquid Waste facility. Some solid low-level waste, (gloves, lab equipment), approximately 7.0 m^3 (247.0 ft^3), would be produced annually. This low-level solid waste would be routed to the Area G, TA-54 facility. No hazardous or mixed waste would be produced (Massey et al. 1995).

Target Irradiation. Target irradiation would occur at the Annular Core Research Reactor at SNL/NM and continue for about 7 days. The irradiation process is expected to produce 57 spent fuel elements (16 kg [35.2 lb] of uranium) a year under full production power of approximately 3 MW. Each element would be approximately 1.5 kg (3.3 lb) total mass. The spent fuel elements would consist only of solids; no liquids would be present.

SNL/NM would have sufficient storage space for the spent nuclear fuel in the adjacent Gamma Irradiation Facility (GIF) pool. The GIF pool is capable of storing 300 fuel elements. At the anticipated rate of discharge, the GIF pool would be adequate for up to 5 years of near-term storage. Additional racks could be added to extend the storage capacity to 1000 elements, or up to 17 years, if required. The fuel elements could also be moved, after an initial cooling period of approximately 1 year, into dry spent nuclear fuel storage located in the same area. If dry storage is desired, the spent nuclear fuel would be removed from the pool and placed in storage casks. These casks would be monitored to verify the integrity of the spent nuclear fuel and the casks.

Permanent storage of spent nuclear fuel from all sites would be in accord with a future DOE decision on its ultimate disposition. DOE has completed a programmatic FEIS that addresses the potential environmental consequences over the next 40 years of the alternatives related to the transportation, receipt, processing, and storage of DOE spent nuclear fuel.

The Record of Decision for the SNF PEIS (DOE 1995b) provides for interim storage of all DOE-managed spent nuclear fuel at one of three designated DOE regional SNF management sites (INEL, Savannah River, or Hanford) for up to 40 years or until a decision has been made on its ultimate disposition. Under this decision, research reactor fuel from the Annular Core Research Reactor would be shipped offsite for management at INEL, the regional site designated by DOE for interim management of its stainless steel clad spent fuel.

Processing. Mo-99 is generated as a fission product in the targets. After irradiation of the target, processing (recovery/extraction) occurs in dedicated, shielded confinement boxes where the molybdenum is extracted from the remainder of the fission products by chemical dissolution and precipitation. Processing consists of several substeps including the removal of fission gases by condensation into a trap; addition of an acid solution to dissolve the plated uranium oxide coating; the separation and purification of Mo-99; and the collection and packaging of wastes.

Two types of waste products would be generated during processing: high-activity, low-level liquid waste; and hardware, such as glassware and tubing. Prior to packaging in drums, liquid waste would be solidified in metal containers. The estimated activity levels for the solidified liquid waste, from a single 10-kW target, are 4000 Ci after 1 day and 40 Ci after 6 months. The solidified liquid waste would be packaged in drums and stored separately from the remaining solid waste (glass, plastic, metals). Hardware would be compacted prior to packaging in drums. Solid waste has an estimated activity level of 5.3 Ci after 1 day and 2.5 Ci after 6 months (Massey et al. 1995).

Hot cell operations are expected to generate approximately 28 m^3 (134 drums) of uncompactable waste, consisting mostly of targets and solidified liquid waste; and 56 m^3 of compactable waste (14 m^3, 67 drums, after compaction) consisting mostly of hardware. The total volume of low-level waste generated during processing would be approximately 42 m^3 per year at 100% production (based on 27 targets per week). Hot cell operations are expected to generate approximately three to four 55-gal drums of low-level waste per week, or about 200 drums per year if SNL/NM supplied 100% of the U.S. need for Mo-99.

Waste drums would be stored temporarily in the hot cell itself for about 6 months to a year to reduce the activity level and allow for easier handling. At that time, the waste material would be shipped to the Nevada Test Site for final disposal. Drums could remain in the Hot Cell Facility for longer periods before disposal if necessary. One to two years of temporary storage is available at the Hot Cell Facility for projected operating wastes.

No mixed waste is expected to be generated in the recovery/extraction process; however, some incidental mixed waste, estimated to be less than 0.1 m^3/yr under any of the alternatives, would be produced by facility operations incidental to the process. Examples of incidental mixed waste include absorbent wipes, batteries, spent solvents, lubricants, vacuum pumps, and other items that become contaminated with radioactive materials. These mixed waste streams would be managed in accordance with applicable requirements (Massey et al. 1995).

A summary of the types and masses of wastes produced from 12 targets (one drum) is given in Table 5-18. A generic flow chart illustrating the three primary processing steps in Mo-99 medical isotope production, the waste generated from each step, and the management of these wastes is provided in Figure 5-1. Although the quantity and type of waste produced from the processing step would be very similar for each alternative site, the final volumes would differ due to how and if the waste is treated, solidified, compacted, or crushed.

Table 5-18. Waste Characterization Data Summary[a]

Waste Component	Mass/Target in grams	Mass/Drum in grams
Copper	1440	17,150
Stainless Steel	1380	16,550
Brass	18	220
Tin	290	3480
Aluminum	1	12
Glass	2770	33,260
Plastic	390	4630
Dry Chemicals	430	5170
Liquid Chemicals	670	8060
Cement	2430	29,120
Fission Products[b]	0.1	1.2
Total Mass	9800	117,640
Total Curies	53.9	646

(a) Data taken from LANL 1993e.
(b) Includes Ba-137m, Ba-140, Ce-141, Ce-144, Cs-137, I-129, I-132, La-140, Nb-95, Nb-9Sm, Nd-147, Pm-147, Pr-143, Pr-144, Pr-144m, Rh-103m, Rh-106, Ru-103, Ru-106, Sm-147, Sr-89, Sr-90, Te-127, Te-127m, Te-129, Te-129m, Te-132, Y-90, Y-91, Zr-95.

5.14.1.2 Waste Disposal

Low-level radioactive wastes would be shipped from SNL/NM to the Nevada Test Site for disposal. A site-wide EIS, currently being prepared by DOE for the Nevada Test Site, will address the consequences of the Mo-99 waste stream. Individual waste streams from SNL/NM must meet the waste acceptance criteria for the Nevada Test Site. Throughout the process, waste minimization would be implemented to the extent possible in keeping with good and safe laboratory practices.

5.14.1.3 Target Fabrication/Annular Core Research Reactor Irradiation: Sandia National Laboratories/New Mexico Alternative

As an alternative, the target fabrication process could be implemented at SNL/NM as opposed to LANL. Such a configuration would allow for all three Mo-99 processing stages to occur at the same site. The target fabrication process and low-level waste volumes would be the same as those developed by LANL and described previously in this section. Targets would be fabricated and stored onsite until needed

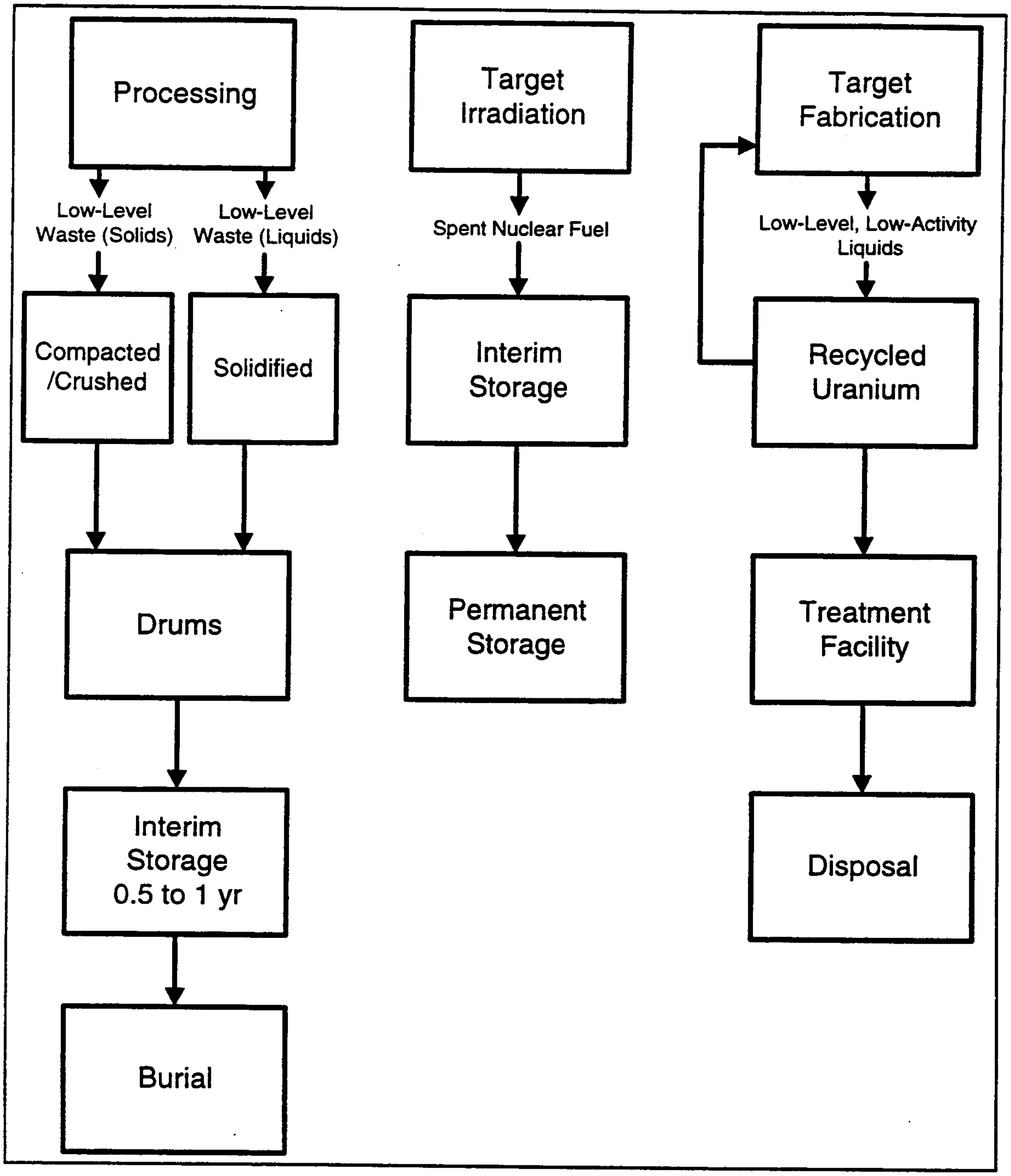

Figure 5-1. Waste Generation and Management. This figure is a generic representation of the Mo-99 production process. Specific variations on such steps as recycling, solidification compaction, and crushing are discussed in Subsection 5.14.1.1.

for irradiation in the Annular Core Research Reactor. The wastes (solid and liquid) from the fabrication process would be low-activity, low-level waste and would be transported to the Nevada Test Site for disposal along with the other low-level waste produced at SNL/NM. Unlike residue at LANL, the SNL/NM residue from the fabrication process would contain a greater concentration of uranium, because no uranium recycling step is in place.

5.14.2 Omega West Reactor/Chemistry and Metallurgy Research Facility: Los Alamos National Laboratory Alternative

In this alternative, all three steps would be carried out onsite at LANL. The Chemistry and Metallurgy Research building would be used for manufacturing the targets (see Section 5.14.1.1) and recovering Mo-99 in the hot cells. Approximately 5.2 m^3 (183.7 ft^3) per year of low-level liquid waste and 5.0 m^3 (176.6 ft^3) per year of low-level solid waste would result from target fabrication. Target irradiation would take place at the Omega West Reactor, which would be repaired and restarted. At present, enough fuel elements are stockpiled to operate the reactor for several years. Approximately 16 targets per week would be irradiated at Omega West Reactor under current core configurations. After irradiation, the targets would be transferred to the Chemistry and Metallurgy Research Facility, Wing 9 Hot Cells for processing.

Spent fuel from the reactor, after a cooling-off period of about 6 months in the Omega West Reactor, would be transported in an existing container to the onsite storage area. Interim wet storage capabilities exist at the Omega West Reactor. Dry storage is also available at other facilities, including TA-54. At the anticipated discharge rate, LANL has adequate near-term spent nuclear fuel storage for up to 37 years. At full power, approximately 29 spent fuel elements (32 kg [70.5 lb] of uranium) per year would be discharged. In accordance with the Record of Decision for the SNF PEIS (DOE 1995b), spent fuel from the Omega West Reactor would be shipped offsite for management at the Savannah River Site, the regional site designated by DOE for interim management of its aluminum clad spent fuel. Under normal operating conditions, radioactive liquid wastes from Omega West Reactor are minimal. Wastes produced during irradiation are placed in drums for disposal under standard LANL low-level liquid waste disposal practices. Less than 2 L (0.53 gal) per year of liquid waste would be sent to the TA-50 radioactive liquid waste treatment facility for disposal.

Adequate facilities and space exist at LANL to handle, manage, and store all types of wastes, including spent fuel, generated during the Mo-99 production. Chemistry and Metallurgy Research Facility waste from processing would be collected or transferred via a radioactive liquid waste pipeline, and placed in labeled drums. Waste disposal from processing is predicted to entail weekly disposal of one or two 55-gal drums of waste or about 60 drums per year at 100% production. Liquid radioactive wastes would be stored for 3 months to allow for decay of short-lived radionuclides before being solidified and sent to TA-50; solid and incidental mixed wastes (<0.1 m^3 [<3.5 ft^3]) would be taken to TA-54, where the waste would be neutralized. LANL would crush its solid waste, thus reducing the volume presented for disposition from the processing step. All waste management activities would be performed in accordance with the site's ongoing, innovative, waste minimization program. The total volume of low-level crushed waste (solidified liquid and solid) from processing would be approximately 12.6 m^3 (16.5 yd^3) per year. Incidental mixed waste would be less than 0.1 m^3 (3.5 ft^3).

5.14.3 Oak Ridge Research Reactor/Radioisotope Development Laboratory: Oak Ridge National Laboratory Alternative

The ORNL alternative would use the Oak Ridge Research Reactor, which would be restarted as a class B reactor and redesignated as the Medical Isotope Production Center. The Radioisotope Development Laboratory would be customized and dedicated for Mo-99 processing. A separate area in the Radioisotope Development Laboratory would be set up for fabrication. The target fabrication process and low-level waste volumes are expected to be the same as for LANL. No uranium recycling would occur at this time. Liquid and solid low-level waste from the fabrication process would be transported to the Nevada Test Site for disposal. As with the LANL alternative, all steps of Mo-99 production would occur at a single site.

The Oak Ridge Research Reactor has some capacity to handle spent nuclear fuel onsite. It has a storage pool capacity of 180 fuel elements, of which 96 would be used for core loading and 84 for storing spent fuel. At the anticipated rate of discharge of 22 spent fuel elements (32 kg [70.5 lb] of uranium) per year, the pool would be adequate for 4 years of operation. Additional storage space for approximately 900 Oak Ridge Research Reactor fuel elements is available at the nearby Bulk Shielding Reactor pool. This translates into approximately 40 years of additional spent nuclear fuel storage space. Less than 0.07% of DOE's spent nuclear fuel is either in storage or being generated at ORNL facilities (DOE 1995b). In accordance with the Record of Decision for the SNF PEIS (DOE 1995b), spent fuel from the Oak Ridge Research Reactor would be shipped offsite for management at the Savannah River Site, the regional site designated by DOE for interim management for its aluminum clad spent nuclear fuel.

Radioactive waste from target processing would be stored in the hot cell facility for approximately 6 months to allow the high activity, low-level waste to decay. The low-level waste would then be solidified, packed, and transferred to an above-ground pad for storage awaiting shipment to the Nevada Test Site. The anticipated total volume of low-level waste (solidified-liquid and solid) from processing would be approximately 63 m^3 (82.4 yd^3) per year. Oak Ridge does not currently have the capability to reduce this waste volume by compaction or compression. If ORNL supplied 100% of the U.S. need for Mo-99, processing operations are expected to generate approximately five to six drums of low-level waste per week, or about 303 drums per year. Resource Conservation Recovery Act (RCRA) mixed waste (incidental) (<0.1 m^3/yr [<3.5 ft^3/yr]) would be stored in permitted mixed waste areas, using the appropriate shielded or unshielded B-25 boxes, based on activity levels as previously discussed.

A detailed estimate of waste quantities and types would be developed after a specific engineering design is completed. All wastes would be managed in accordance with applicable requirements.

5.14.4 Power Burst Facility/Test Area North: Idaho National Engineering Laboratory Alternative

In this alternative, all three steps (fabrication, irradiation, and processing) would be carried out onsite at INEL. This alternative would use the Power Burst Facility for irradiating targets. Specific information for INEL regarding waste quantity and management for this proposed alternative is not yet available. The process and associated wastes (low-level waste, spent nuclear fuel, and <0.1 m^3 [<3.5 ft^3] of incidental mixed waste) would be very similar to those of the other proposed alternatives. The target fabrication process would generate approximately 5.2 m^3 (183.7 ft^3) of liquid low-level waste that would be treated and disposed of onsite. In addition, approximately 5.0 m^3 (176.6 ft^3) of solid low-level waste would be generated during target fabrication. During target irradiation, an anticipated discharge rate of 17 spent fuel elements (32 kg [70.5 lb] of uranium) per year is also expected. Processing would generate approximately 77.0 m^3 (104 yd^3) of combined liquid and solid low-level waste. After an initial 6-month cooling period at the Power Burst Facility, the spent nuclear fuel would be transferred to another onsite facility at the Idaho Chemical Processing Plant for interim wet or dry storage. It would likely be stored at the Irradiated Fuel Storage Facility (786 bundle capacity, if dry storage is selected); however, other facilities such as the CPP-666 (wet storage) or CPP-749 (dry storage) are also available. At the anticipated discharge rate, INEL has adequate near-term spent nuclear fuel storage for up to 46 years.

INEL has substantial hot cell and processing capabilities. Adequate facilities and space exist at INEL to handle, manage, and store all the types of waste generated during Mo-99 production. INEL is a cradle-to-grave waste management operation with all Mo-99 generated waste being managed within INEL facilities.

In accordance with the Record of Decision for the SNF PEIS (DOE 1995b), spent fuel from the Power Burst Facility would be managed at INEL as the regional site designated by DOE for interim management of its stainless steel clad fuel. INEL has been safely managing spent nuclear fuel for over 40 years. Currently, the site stores about 10% of DOE's spent nuclear fuel from a variety of DOE programs and a limited number of commercial and foreign sources (DOE 1995b).

Waste volumes associated with the processing of Mo-99 would not present significant increases in either solid or liquid waste volumes, compared with other typical INEL radioactive waste streams. All waste would be managed, stored, and eventually disposed of in accordance with applicable regulations and requirements.

5.14.5 Comparison to Current Waste Generation Rates

The volumes of spent nuclear fuel, low-level, and incidental mixed waste are summarized in Table 5-19 for each proposed alternative site. Waste generation quantities from the proposed Mo-99 production process are presented in comparison with current production volumes. No alternative is expected to generate high-level or transuranic waste.

5.15 Facility Accidents

Consequences of facility accidents associated with implementing the alternatives for medical isotope production are discussed in the following subsections. The method used to select accidents for analysis is described, as are the procedures for evaluating the consequences of selected accidents, and the results of the analysis.

The alternatives for medical isotope production considered in this FEIS necessitate evaluation of accidents at three different types of facilities. The facilities necessary to carry out the project include facilities for production of targets containing highly enriched uranium, irradiation of the targets in a reactor, transfer to the hot cell, and processing of targets to extract the medically useful isotopes. Hot cell facilities are typically used for the target fabrication and processing steps, and the irradiation, as proposed, would be carried out in a DOE research reactor at one of the candidate sites. The hot cell facilities for target fabrication and processing may be in the same location at the sites under consideration, but those activities would not necessarily have to occur at the same site.

Accidents evaluated for medical isotope production consist of maximum reasonably foreseeable accidents described in such previously published analyses as National Environmental Policy Act (NEPA) documentation, safety analyses, or are adaptations of accident scenarios developed for similar types of facilities. Source documents evaluated accidents caused by natural phenomena, mechanical, and procedural errors. These evaluations were considered when choosing the appropriate scenarios for consideration in the FEIS. Those accidents that had low probability, but high consequences were compared against those with higher probability and lower consequences. Thus, scenarios representing the greatest overall risk were chosen based on the product of the probabilities and the consequences for each accident type. Where applicable, the source documents for specific accidents evaluated in this section are referenced in the detailed accident descriptions. In some cases, the source documents predate the new DOE safety analysis order, and may not conform to current requirements. However, in all cases the source documents represent the best available information. With one exception, transportation accidents are considered in Section 5.11 of this document. The transfer of irradiated targets from the reactor to the process facility is evaluated in this section, if the transfer occurs between adjacent facilities and does not require the use of onsite roads.

Table 5-19. Summary of Site Waste Management Cumulative Impacts

Alternatives	Spent Nuclear Fuel	Low-level Waste (liquids)	Low-level Waste (solids)	Incidental Mixed Waste
SNL/NM				
SNF Cumulative Total (Uranium)[a]	440 kg	n/a	n/a	n/a
Historical Annual Production[b]	n/a	15.74 m^3/yr	100.7 m^3/yr	1.80 (l)* m^3/yr 3.26 (s)* m^3/yr
Mo-99 Production[c,d,e]	57 elements 16 kg/yr	7.3 m^3/yr	49. m^3/yr	<.1 m^3/yr
Interim Storage Capacity for SNF (GIF Pool)	300-1000 elements 84-281 kg	n/a	n/a	n/a
LANL				
SNF Cumulative Total (Uranium)[a]	14.0 kg	n/a	n/a	n/a
Historical Annual Production[b]	n/a	21,906 m^3/yr	5765 m^3/yr	34.1 (l)* m^3/yr 15.1 (s)* m^3/yr
Mo-99 Production[d,e]	29 elements 32 kg/yr	5.2 m^3/yr	17.6 m^3/yr	<.1 m^3/yr
Interim Storage Capacity for SNF (Omega West & TA-54)	1091 elements 1204 kg	n/a	n/a	n/a
ORNL				
SNF Cumulative Total (Uranium)[a]	650 kg	n/a	n/a	n/a
Historical Annual Production[f]	n/a	6900 m^3/yr	2600 m^3/yr	50,000 m^3/yr
Mo-99 Production[d,e]	22 elements 32 kg/yr	5.2 m^3/yr	68 m^3/yr	<0.1 m^3/yr
Interim Storage Capacity for SNF (ORRR and BSR)	984 elements 1432 kg	n/a	n/a	n/a
INEL				
SNF Cumulative Total (Uranium)[a]	261,000 kg	n/a	n/a	n/a
Historical Annual Production[f]	n/a	n/a[g]	900 m^3/yr[g]	525 m^3/yr
Mo-99 Production[d,e]	17 elements 32 kg/yr	5.2 m^3/yr	80 m^3/yr	<0.1 m^3/yr
Interim Storage Capacity for SNF (IFSF, ICPP-749, ICPP-666)	786 elements 1480 kg	n/a	n/a	n/a

(a) Cumulative totals for spent nuclear fuel based on DOE (1995b).
(b) Based upon 1991 annual sitewide rates.
(c) These values correspond to 100% replacement of U.S. demand using 15-kW targets; irradiation of targets to 20-kW was assumed for all other alternatives in supplying 100% of the U.S. demand.
(d) Mo-99 Production values reflect total generated waste quantities from all three production steps: fabrication, irradiation, and processing.
(e) Mass of spent nuclear fuel is based on continuous operation at full power using LEU (20% U-235).
(f) Based upon 1995 annual forecasted sitewide rates.
(g) Solidified liquid waste volume incorporated in low-level waste total.
n/a = Not applicable.
SNF = Spent Nuclear Fuel; BSR = Bulk Shielding Reactor.
GIF = Gamma Irradiation Facility.
IFSF = Irradiated Fuel Storage Facility.
ORRR = Oak Ridge Research Reactor.
ICPP = Idaho Chemical Processing Plant.
* (l) indicates liquid; (s) indicates solid.

Accident frequencies, as reported in the source documents, safety analysis reports, and related analyses, typically represent the overall probability of the accident, including the probability of the ıitiating event combined with the frequency of any contributing events required for an environmental release to occur. The contributing events may include equipment or barrier failures, or failures of other mitigating systems designed to prevent accidental releases. In general, the safety documents do not evaluate the consequences of events with expected frequencies of $<10^{-6}$ per year because such accidents are not considered reasonably foreseeable. Thus, all accidents considered here have a 1 in 1,000,000 years, or greater, likelihood of happening.

Accident consequence analyses used release estimates as presented in the source document for a given existing facility or as adapted for this analysis. The downwind concentrations for materials released in accidents were then calculated at a consistent set of receptor locations, as defined for the FEIS. The receptors included a nearby worker who is onsite but outside the facility where the accident takes place, a member of the public who is temporarily at the nearest access location (such as a road that crosses the site, or at the site boundary), and the MEI - offsite resident. Collective dose to the offsite population within 80 km (50 mi) was also calculated for radionuclide releases. Consequences in terms of the involved workers for the representative accident scenarios in each type of facility are discussed as applicable.

The accident evaluation is a conservative scoping analysis intended to identify events that would potentially impact onsite or offsite receptors at levels that could result in health effects, and the exposure pathways that would contribute to those consequences. The scenarios for release of radionuclides or hazardous materials to air or water generally assume some level of mitigation by facility effluent controls; however, no credit is taken for systems designed to prevent or mitigate the emissions from specific types of ~ccidents, such as fire suppression systems.

Individual doses were based on exposure of the receptor during the entire release, except where the release time was sufficiently long that such an assumption is unrealistic. For releases that were expected to last more than a few hours, the exposure duration for onsite workers and members of the public at accessible onsite locations was limited to 2 h, corresponding to the assumed time required to evacuate the candidate site in the event of an accident. Offsite residents were assumed to be exposed during the entire release, regardless of the accident duration. Exposure via inhalation and external pathways (groundshine and submersion in the plume) were considered for workers and the nearest public access receptors; in addition to those pathways, ingestion of contaminated food grown in the downwind sector was evaluated for the offsite population. The ingestion pathway for the population dose was based on where food was grown, and not on the location of the consumers.

Site specific food production data were used for sites when available. Because EPA protective action guidelines specify mitigative actions to prevent consumption of contaminated food, the dose to offsite individuals and populations from inhalation and external pathways is reported separately from the dose including all pathways. If the dose to the maximally exposed individual exceeds specified protective action guidelines, the locally produced food would be kept from the market, and the backyard gardeners would be cautioned not to consume their produce. More realistic potential doses are presented by the inhalation and external pathways. Ingestion pathways are shown here to represent the maximum potential dose to the local population and to determine the extent to which protective action might be required. Reduced exposure to the plume or to contaminated ground surface as a result of early evacuation of offsite populations was not assumed for the purposes of this analysis, although such actions would also be mandated if the projected dose from an accident exceeded the protective action guidelines.

The expected latent cancer fatalities were calculated by multiplying the potential dose to the population by the latent cancer fatalities risk factor developed in ICRP Publication 60 (ICRP 1991). The latent cancer fatalities for the general population is 0.0005 per person rem, and the latent cancer fatalities for a worker population is 0.0004 per person rem. The total risk to the population of developing any fatal cancers is calculated for each accident scenario. The total risk is the product of the probability the accident happens, the probability of specific wind and stability conditions, and the expected latent cancer fatalities if the accident occurs. Two atmospheric conditions were considered in the accidents, the "median" (expected) conditions that are not exceeded 50% of the time, and the *bounding* conditions that would not be exceeded more than 5% of the time. The bounding conditions have a frequency one-tenth of the median conditions, thus they carry one-tenth the risk of the median conditions. The median (50%) dispersion condition is assumed to have a probability equal to 1.0.

Radiological accidents resulting in the release of radionuclides into the environment were evaluated for the target fabrication, reactor, transport, and hot cell process facilities needed for medical isotope production under each of the alternatives. In general, the accidents evaluated represent the maximum reasonably foreseeable accidents for a given type of facility and are intended to bound the potential risk and consequences of the proposed activities. For each alternative, an analysis was performed for damage to reactor fuel, a target rupture in the reactor pool, a target rupture outside of the reactor pool, and operator error during target processing for both Mo-99 and iodine-125 targets. Except for the fuel damage scenarios, the same estimated release was applied to all the facilities.

The fuel damage scenario differed at SNL/NM because the design of the Annular Core Research Reactor is significantly different from the other reactors. It is physically impossible for the annular core design of the reactor to melt a fuel element because the neutrons are moderated at high temperatures, which in turn will shut down the reactor. Therefore, a physical mechanism (such as, a plane crash or crane drop) would be necessary to rupture a fuel element in the Annular Core Research Reactor. The reactors at the other sites could experience a fuel melt under the conditions described in the analyses. In the accident scenario for SNL/NM, four fuel elements are assumed to be ruptured in a plane crash, whereas in the accident scenarios for the other reactors, one fuel element is assumed to melt. All scenarios represent the bounding design basis accidents for the respective facilities.

The GENII set of computer codes (Napier et al. 1988) was used to perform the downwind 50-yr committed total effective dose equivalent (TEDE) estimates using ICRP 26 (ICRP 1991) and 30 (ICRP 1979-1982) organ-weighted methodology (see Appendix C). Location-specific meteorology and population files were used to model each facility site.

The receptors for each scenario include the nearest uninvolved worker, the nearest point of public access, the nearest resident, and the downwind population in the one sector (out of 16) that has the highest population-weighted concentration in air (that is, the concentration is air times the population for the distance and direction). All sectors and receptor locations are evaluated based on the plume's release height and the local meteorologic data. It should be noted the location of all these receptors are not necessarily in the same direction; thus, in an accident, not all the receptors would receive the reported dose levels simultaneously.

The uninvolved worker is assumed to be working in the onsite location with the highest air concentration. The nearest public access receptor is in the offsite or publicly accessible onsite location with the highest air concentration. Both receptors are assumed to be exposed for 2 h to the plume via external exposure and inhalation. The nearest resident is assumed to be the MEI. The location of the nearest resident is based on actual residences, but the lifestyle of the MEI is hypothetical. The MEI is assumed to grow all his vegetables, meat, and dairy products in his backyard. While at some sites, this clearly is not feasible, it does provide the bounding case beyond which the dose would not be exceeded. The MEI is assumed to be at the house for the entire year, breathing 8766 h/yr, and shielded by the house for an effective exposure to soil contamination of 4383 h/yr. The MEI is assumed to eat 220 kg (485 lb) meat and drink 330 L (87 gal) milk annually. Finally, the sector with the highest population-weighted concentration in air was used to develop the population dose. Sectors with equal population-weighted air concentrations were evaluated using a site-specific food production grid, so the sector with the higher actual food production was chosen for evaluation in this analysis. Where information was available, food production parameters for meat and dairy products were evaluated as a function of distance from the release point, so that all the food produced in that sector was assumed to be consumed. Dose factors per kilogram of meat or liter of milk consumed for each distance were multiplied by the total production at that distance, and the total doses were summed for the sector. The ingestion dose was then added to the external and inhalation doses to obtain the dose for all pathways.

5.15.1 Annular Core Research Reactor: Sandia National Laboratories/New Mexico and the Chemistry and Metallurgy Research Facility: Los Alamos National Laboratory Alternative

5.15.1.1 Target Fabrication at LANL

Radiological Impacts. Target fabrication presents few opportunities for accidents that would cause radioactive material to be released. The only accidents chosen for analysis within LANL's Chemistry and Metallurgy Research facility are an operator dropping a canister of uranium oxide and a solution spill. Solution containing uranium-235 in HNO_3 could be spilled due to earthquake or to operator error (LANL 1993e).

Other accidents were considered, but were not analyzed because no reasonably foreseeable mechanism became apparent by which the accident could occur or produce a radionuclide release to the environment.

Quantities of fissile material handled in a glove box at any given time would not exceed a critical mass; therefore, criticality accidents would be below the threshold of reasonably foreseeable accidents. No flammable materials would be used and welding would be done in an inert atmosphere that would prevent fires. If a worker should drop an open-ended target, no release would be expected because the uranium-235 would be plated onto the tube's inner wall (Massey et al. 1995). The consequences of the canister drop and spill accidents are discussed in the following sections.

Canister Drop. An operator could drop a canister of particulate uranium oxide outside the glove boxes. Administrative controls require that the canister is to be opened only in a glove box. When it is out of the glove box, it is to be kept under double containment. No release would be expected outside the glove box because the uranium oxide is contained in a canister, which is in a sealed plastic bag, which in turn is in an outer canister. The canisters have slip-on tops that are taped in place. If the drop were to occur while the canister is opened in the glove box, the particulate uranium oxide would be contained by the glove box.

Spill. A spill would be unlikely to occur because solutions would be moved using vacuum lines. If a line were to rupture, the solution would tend to stay within the line because of the negative pressure created by the vacuum. However, a major line rupture or an earthquake could cause a solution of uranium-235 in HNO_3 to spill inside a HEPA-filtered glove box. The volume of the spill is assumed to be 5 L based on fabrication processes (Massey et al. 1995).

In the event of a spill, an alarm for evacuation would be sounded by personnel or continuous air monitors. Personnel would be instructed to immediately leave the area. The accident response team, equipped with protective clothing and supplied breathing air, would clean up the spill. Because uranium-235 would be contained within the glove box, no reasonably foreseeable mechanism would exist for a release to occur. No doses to involved personnel, other personnel in the Chemistry and Metallurgy Research Facility, or members of the public would be expected.

Toxicological Impacts. No accidents involving release of toxicological materials were identified. If solution were spilled, any acid fumes in the ventilation system would be neutralized by the NaOH scrubber before leaving the Chemistry and Metallurgy Research Facility stack (Massey et al. 1995).

5.15.1.2 Target Fabrication at SNL/NM

The consequences of accidents during target fabrication at SNL/NM hot cell facilities would be similar to those described in Section 5.15.1.1 for the Chemistry and Metallurgy Research Facility at LANL. As described in that section, no consequences to workers or the public would be expected.

5.15.1.3 Facility Accidents for Target Irradiation at the Annular Core Research Reactor

The analyses for the Annular Core Research Reactor irradiation option assume the reactor is configured in such a manner as to accommodate 80% of the U.S. demand for Mo-99. If the reactor were to be run with 100% of the production, the total number of targets would increase, but the power level and radionuclide inventory per target would decrease. Thus, the resulting risk would be reflected by the analyses presented here.

Analyses in Massey et al. (1995) for the Annular Core Research Reactor included several possible scenarios that could cause four fuel elements to rupture: a plane crash into the facility (but not into the reactor itself) causing the overhead crane to fall into the reactor pool, earthquake also causing the crane to fall, and a transient power pulse that ruptures four fuel elements. The releases for any of the four fuel element ruptures would be the same, but the probability of the plane crashing into the facility was estimated to be the higher than either of the other events, thus it was chosen for evaluation in this FEIS. Other accidents such as fuel handling accidents, reactivity-induced accidents or loss of coolant accidents were evaluated and were not considered to have as great a risk as those chosen for inclusion in this FEIS. In the past, an accident involving the release of radioactive liquids resulted from overfilling the reactor pool. A secondary containment has been added to the facility to prevent release of pool overflow in such an event. With the facility modification, this accident is no longer considered to be reasonably foreseeable.

In addition to potential accidents involving reactor fuel, targets were analyzed for potential releases to the atmosphere (Massey et al. 1995). Two credible bounding accidents were analyzed that might take place during the irradiation of the targets in the Annular Core Research Reactor. The first is a possible rupture of four fuel elements caused by the crash of an airplane into the Annular Core Research Reactor building, resulting in secondary damage to reactor fuel. The second analyzed accident is from a leak in the target, which causes the release of noble gases. The target rupture was assumed to occur with a frequency of 10^{-4} per year. It was further assumed the rupture occurs after a 21-kW, 7-day irradiation, and that all of the noble gases and 1% of the halogens are immediately released from the pool. All of the noble gases and 10% of the remaining halogens were assumed to be released from the stack. These assumptions are conservative; pool releases on the order of 37% of the krypton, 23% of the xenon, and 1.3×10^{-4}% of the iodine are plausible (Massey et al. 1995).

Downwind dose estimates were calculated by conservatively assuming all of the noble gases and halogens for a target or fuel rods were immediately released into the pool. From there, the radionuclides were assumed to be divided into two fractions, one that is released immediately into the atmosphere, and another that is released over time from the evaporation of the pool water. Because the largest fraction of the dose is due to the radionuclides that are immediately released to the atmosphere, only the acute portions were evaluated in these scenarios. The target leak was assumed to occur following a 21-kW, 7-day target irradiation, and the fuel rod ruptures after a 25-kW, 60-day fuel irradiation.

Calculations based on the frequency of airplane traffic, the area of the facility, and industry probabilities of crashes indicate the estimated probability of an aircraft crash into the Annular Core Research Reactor facility is about 5 x 10^{-5} per year, or one crash expected in 20,000 years. If an airplane were to crash into the Annular Core Research Reactor building, no release of materials would occur, unless targets or fuel elements were ruptured. In the interest of bounding the risks of an airplane crash, it is assumed the crash results in the bridge crane falling into the reactor pool and rupturing four fuel elements. The radionuclides expected to be released are shown in Table 5-20, and the consequences of such an accident are shown in Table 5-21. The maximum public individual dose from an airplane crash would be 200 mrem for a resident located 5400 m (3.4 mi) from Technical Area V. The limiting MEI organ dose would be 4.2 rem to the thyroid with ingestion and 53 mrem without ingestion. If the accident occurs, the airplane crash would result in at most one latent cancer fatality. This translates into an average annual accident risk of 6 x 10^{-6} or the chance of any individual in the affected population dying of a cancer from a plane crash rupturing four fuel elements is about 1 in 200,000 per year of operation. For facility workers, it is assumed that anyone in the facility during an airplane crash would be killed by the impact, building collapse, or subsequent fires; therefore, worker doses were calculated only for onsite non-involved workers.

The previous plane crash scenario analysis evaluates the secondary effects from a plane crashing into the reactor building, but not into the reactor core itself. The probability of an airplane crash resulting in a

Table 5-20. Radionuclides Released from Annular Core Research Reactor During a Postulated Four Fuel Element Rupture Scenario (Massey et al. 1995)

Isotope	Release (Ci)	
	Immediate	Delayed
Bromine-83	0.44	--
Krypton-83m	444.0	610.0
Krypton-85 m	1056.0	11.2
Krypton-85	2.39	--
Krypton-87	2140.0	22.0
Krypton-88	3020.0	--
Iodine-130	0.00148	--
Iodine-131	2.35	--
Xenon-131m	24.2	1610.0
Iodine-132	35.5	3.55
Iodine-133	5.6	--
Xenon-133m	163.0	63.2
Xenon-133	5600.0	916.0
Iodine-134	7.4	6.4
Iodine-135	5.2	--
Xenon-135	2020.0	3780.0

Table 5-21. Dose and Consequences for the Four Fuel Element Rupture Accident at the Annular Core Research Reactor (Massey et al. 1995)

Dose and Consequences	Individual Impacts - Onsite and Offsite			
	Onsite Worker (300 m N)	Public Access Location (5400 m N)	Individual Resident (5400 m N)	
			All Pathways	External and Inhalation
TEDE (rem)	0.38	0.075	0.20	0.076
	Collective Impacts to Population within 80 km to the North (n = 133,266)			
	Median Atmospheric Dispersion		Bounding Atmospheric Dispersion	
	All Pathways	External and Inhalation	All Pathways	External and Inhalation
Collective TEDE (person-rem)	151	150	2350	2300
Fatal Cancers	0.075	0.075	1	1
Cancer Risk	4×10^{-6}	4×10^{-6}	6×10^{-6}	6×10^{-6}

large portion of the aircraft crashing directly into the 3.6-m (12-ft) diameter Annular Core Research Reactor pool and then impacting the core 9.1 m (30 ft) below water was evaluated but the probability was determined to be so low (about 1 in a billion per year), this crash was not analyzed (Massey et al. 1995).

It should also be noted that it would be possible for a single fuel element to rupture as a result of mechanical failure. The probability of this occurring is 0.001 per year of operation. The potential dose resulting from this type of accident would be one-fourth that shown in Table 5-21. The maximum public individual dose from a single fuel rupture would be 50 mrem for a resident located 5400 m (3.4 mi) from Technical Area V. The limiting MEI organ dose would be 1.0 rem to the thyroid with ingestion, or 13 mrem without ingestion. The fuel element rupture would result in less than 1 (0.30) latent cancer fatality if the accident occurs. This translates into an average annual accident risk of 3×10^{-5} or the chance of any individual in the affected population dying of cancer from a fuel element rupture would be about 1 in 30,000 per year of operation.

If a worker were in the Annular Core Research Reactor high bay when a single fuel element ruptured, the worker would be immediately notified of the rupture by various alarms and detectors in the reactor and reactor area. The worker would then immediately evacuate the area and not return until safe conditions were established or would use protective equipment. If the worker did remain in the high-bay for 5 min to perform a safety task, and the worker was assumed to be exposed to 10% of the total nobles and halogens immediately released into the high-bay atmosphere (1% of the total halogens and fission products being respirable), the worker would receive an estimated 80 rem (Massey et al. 1995).

The estimated radionuclide release from the 16.5 m Annular Core Research Reactor stack following a target rupture is shown in Table 5-22 and consequences for the accident are shown in Table 5-23. The maximum public individual dose from a target rupture accident would be 27 mrem for a resident located 5400 m (3.4 mi) from Technical Area V. The limiting MEI organ dose would be 0.38 rem to the thyroid with ingestion, 6.8 mrem without ingestion. This accident would result in less than 1 (0.24) latent cancer fatality if the accident occurs. This translates into an average annual accident risk of 2 x 10^{-5} or the chance of latent cancer fatalities in the population from a target rupture accident would be about 1 in 50,000 per year of operation.

5.15.1.4 Transfer of Irradiated Target from the Annular Core Research Reactor to the Hot Cell Facility

Two bounding accidents were considered during the transfer of the target from the reactor to the Hot Cell Facility/Chemistry and Metallurgy Research Facility/hot cells. An accident causing an uncontained target to rupture bounds the risk for offsite residents and population, and direct exposure of a worker to an unshielded target bounds the radiological risk to a worker. Other accidents were considered, but these two accidents bounded the risks.

Table 5-22. Radionuclides Released from the Annular Core Research Reactor During a Postulated Target Rupture Scenario (Massey et al. 1995)

Isotope	Stack Release (Ci)	
	Immediate	Delayed
Bromine-83	0.094	–
Krypton-83m	94.0	128.0
Krypton-85 m	223.0	2.0
Krypton-85	0.057	–
Krypton-87	450.0	4.0
Krypton-88	640.0	–
Iodine-130	0.00019	–
Iodine-131	0.022	–
Xenon-131m	0.468	155.0
Iodine-132	0.58	–
Iodine-133	1.2	–
Xenon-133m	28.3	13.2
Xenon-133	613.0	191.0
Iodine-134	1.3	–
Iodine-135	1.1	–
Xenon-135	113.0	798.0

Table 5-23. Dose and Consequences for the Target Rupture Accident at the Annular Core Research Reactor

Dose and Consequences	Individual Impacts - Onsite and Offsite			
	Onsite Worker (300 m N)	Public Access Location (5400 m N)	Individual Resident (5400 m N)	
			All Pathways	External and Inhalation
TEDE (rem)	0.089	0.016	0.027	0.016
	Collective Impacts to Population within 80 km to the North (n = 133,266)			
	Median Atmospheric Dispersion		Bounding Atmospheric Dispersion	
	All Pathways	External and Inhalation	All Pathways	External and Inhalation
Collective TEDE (person-rem)	33.0	33.0	485.0	480.0
Fatal Cancers	0.017	0.017	0.24	0.24
Cancer Risk	2×10^{-6}	2×10^{6}	2×10^{-6}	2×10^{-6}

The bounding impact for all target transfer operations would be represented by the rupture of a single target as the result of a manned transport accident while in transit between the Annular Core Research Reactor and the Hot Cell Facility. Although highly improbable (estimated probability is less than 1×10^{-6} per year), this accident scenario assumes the loss of all noble gas radionuclides and 1% of halogen radionuclides directly to the atmosphere (Table 5-24). Downwind dose estimates for a cask transport accident between the Annular Core Research Reactor and the Hot Cell Facility are presented in Table 5-25. It was assumed that a rupture occurs after a 21-kW, 7-day irradiation, and that all of the noble gases and 1% of the halogens were immediately released from one target into the atmosphere. The maximum public individual dose from a Mo-99 target transfer accident would be 130 mrem for a resident located 5400 m (3.4 mi) from Technical Area V. The limiting MEI organ dose would be 3.8 rem to the thyroid with ingestion, and 0.068 mrem without ingestion. This accident would result in less than 1 (0.32) latent cancer fatalities if the accident occurs. This number translates into an average annual accident risk.

The postulated accident scenario for direct exposure to an involved worker assumed that all safety features fail and that a worker is inadvertently exposed to an irradiated target. No shielding, other than the target cladding and air is present. The worker retreats to a safe distance. In the bounding scenario, the target is allowed to cool 2 hours. The worker is standing 1 m from the target for 10 s before the worker becomes aware of the danger, either visually or from audio/visual radiation alarms. The worker retreats at a walking speed of 2 m/s. The total dose to the worker was estimated to be about 30 rem (Massey et al. 1995).

Table 5-24. Radionuclides Released to the Atmosphere During a Postulated Target Rupture Scenario During Transfer (Massey et al. 1995)

Isotope	Transfer Release (Ci)
Bromine-83	0.94
Krypton-83m	94.0
Krypton-85m	220.0
Krypton-85	0.057
Krypton-87	450.0
Krypton-88	640.0
Iodine-130	0.0019
Iodine-131	2.2
Xenon-131m	0.47
Iodine-132	5.8
Iodine-133	12.0
Xenon-133m	28.0
Xenon-133	610.0
Iodine-134	13.0
Iodine-135	11.0
Xenon-135	110.0

Table 5-25. Dose and Consequences for Release from a Single Target Rupture at SNL/NM During Target Transfer Following Target Irradiation

Dose and Consequences	Individual Impacts - Onsite and Offsite			
	Onsite Worker (300 m N)	Public Access Location (5400 m N)	Individual Resident (5400 m N) All Pathways	Individual Resident (5400 m N) External and Inhalation
TEDE (rem)	0.1	0.018	0.13	0.018
	Collective Impacts to Population within 80 km to the North (n = 133,266)			
	Median Atmospheric Dispersion		Bounding Atmospheric Dispersion	
	All Pathways	External and Inhalation	All Pathways	External and Inhalation
Collective TEDE (person-rem)	40.0	38.0	640.0	590.0
Fatal Cancers	0.02	0.019	0.32	0.3
Cancer Risk	2×10^{-8}	2×10^{-8}	3×10^{-8}	3×10^{-8}

5.15.1.5 Target Processing at SNL/NM Hot Cell Facilities

Accidents evaluated for analysis during target processing included an airplane crash, a fire, target process spill, and release of process gases. The probability of an airplane crash into the Hot Cell Facility, a fire, and a process spill, as well as the respective potential doses from these accidents were much smaller than the probability and consequences from an operator inadvertently opening process valves, sending noble gases up the Hot Cell Facility stack. Thus, the operator error scenario was chosen to bound the risks from other accidents.

The bounding accident for target processing is a based on an analysis developed for the LANL hot cells at the Chemistry and Metallurgy Research Facility (LANL 1993e). An operator could inadvertently open the wrong valves at the wrong temperature, or mechanical failures of valves or transfer lines could occur. The loss of fission products would be inside the hot cells and most of the fission products would be contained on the charcoal or HEPA filters: Noble gases, however, would be vented to the SNL/NM Hot Cell Facility stack. The release consists of noble gases that are released through the 38-m (124.6-ft) Hot Cell Facility stack at SNL/NM. It was assumed the targets were irradiated for 7 days at 20 kW power, and they had cooled for 16 h before the release. A total of 1550 Ci of noble gases would be released; their proportions were assigned based on the above power rating of the targets. The frequency for this event would be once per year (p = 1.0) based on the number of targets being processed yearly and the estimated frequency of human error that would cause the release. The estimated release is shown in Table 5-26, and the doses are shown in Table 5-27. The maximum public individual dose from a Mo-99 target processing accident would be 0.74 mrem for a resident located 5400 m (3.4 mi) from Technical Area V. The limiting MEI organ dose would be 0.035 mrem to the lung. This accident would result in less than 1 (0.016) latent cancer fatality if the accident occurs. This figure translates into an annual accident risk of 2×10^{-3}, or the chance of any individual dying of cancer from a Mo-99 target rupture accident is about 1 in 500 per year of operation.

Table 5-26. Estimated Releases from the Hot Cell Facility Accident During Mo-99 Target Processing

Radionuclide	Release (Ci)
Krypton-83m	3.5
Krypton-85m	0.26
Krypton-87	0.074
Krypton-88	13.0
Xenon-133	600.0
Xenon-133m	95.0
Xenon-135	610.0
Xenon-135m	230.0

Table 5-27. Dose and Consequences for an Accidental Release from the Hot Cell Facility at SNL/NM During Mo-99 Target Processing

Dose and Consequences	Individual Impacts - Onsite and Offsite			
	Onsite Worker (300 m N)	Public Access Location (5400 m N)	Individual Resident (5400 m N)	
			All Pathways	External and Inhalation
TEDE (rem)	0.0038	0.00074	0.00074	0.00074
	Collective Impacts to Population within 80 km to the North (n = 133,266)			
	Median Atmospheric Dispersion		Bounding Atmospheric Dispersion	
	All Pathways	External and Inhalation	All Pathways	External and Inhalation
Collective TEDE (person-rem)	2.6	2.6	32.0	32.0
Fatal Cancers	0.0013	0.0013	0.016	0.016
Cancer Risk	1×10^{-3}	1×10^{-3}	2×10^{-3}	2×10^{-3}

An analysis was also performed for the processing of targets to extract iodine-125. If valves were opened in the wrong sequence, fission product gases could be released from the Hot Cell Facility stack. A probability of 0.1 was assumed for the frequency of occurrence because it would be caused by operator error (LANL 1993e). The number of iodine-125 targets being irradiated each year would be significantly lower than for Mo-99 processing; therefore, the accident frequency is lower for iodine-125 target processing.

In this scenario, 72 h after irradiation, cold trap valves would be left open when the gas is being transferred between decay storage vessels. The estimated release consists of 31 Ci of xenon-125. Iodine-125 and other radionuclides would be present, but filters at the stack would capture all the iodine-125, and the dose is dominated by xenon-125. Results of the dose calculations are shown in Table 5-28. The maximum public individual dose from a iodine-125 target processing accident would be 1.9 mrem for a resident located 5400 m (3.4 mi) from Technical Area V. The limiting MEI organ dose would be 63 mrem to the thyroid with ingestion and 0.12 mrem without ingestion. This accident would result in less than 1 (0.00075) latent cancer fatality, if the accident occurs, because the population would not be allowed to

Table 5-28. Dose and Consequences for an Accidental Release from the SNL/NM Hot Cell Facility During Iodine-125 Target Processing

Dose and Consequences	Individual Impacts - Onsite and Offsite			
	Onsite Worker (100 m N)	Public Access Location (5400 m N)	Individual Resident (5400 m N)	
			All Pathways	External and Inhalation
TEDE (rem)	0.000089	0.000026	0.0019	0.000027
	Collective Impacts to Population within 80 km to the North (n = 133,266)			
	Median Atmospheric Dispersion		Bounding Atmospheric Dispersion	
	All Pathways	External and Inhalation	All Pathways	External and Inhalation
Collective TEDE (person-rem)	0.084	0.084	1.5	1.5
Fatal Cancers	0.000042	0.000042	0.00075	0.00075
Cancer Risk	4×10^{-6}	4×10^{-6}	3×10^{-5}	3×10^{-5}

consume the dairy and beef products grown in the region until the risk had been appreciably reduced. This translates into an average annual accident risk of less than 3×10^{-5} or the chance of any individual dying of cancer from an iodine-125 target processing accident is about 1 in 10,000 per year of operation.

.15.2 Omega West Reactor/Chemistry and Metallurgy Research Facility: Los Alamos National Laboratory Alternative

5.15.2.1 Target Fabrication at the Chemistry and Metallurgy Research Facility

No effects are expected from the fabrication of targets at the Chemistry and Metallurgy Research Facility for the reasons explained in Section 5.15.1.1.

5.15.2.2 Target Irradiation at the Omega West Reactor - Air Release Scenarios

The Omega West Reactor Safety Evaluation Report (Smith and Bunker 1989) evaluated reactivity accidents, equipment failures, earthquakes, floods and tornadoes, and loss-of-coolant accidents, as well as the maximum credible accident. The maximum credible accident bounds the consequences from the other accident types and was chosen for inclusion in this FEIS. The maximum credible accident for the Omega West Reactor is assumed to be the blockage of coolant flow through a single fuel element by a single piece of material, resulting in melting of fuel (Smith and Bunker 1989). This scenario assumes that one element is completely blocked at the upper end boxes. First boiling and then steam voiding of the water remaining in the element would occur. It is assumed that 50% of the fuel would melt within seconds. This scenario could release 100% of the xenon and krypton gases, as well as iodine dissolved in the reactor water. The estimated frequency of the accident was 10^{-6} to 10^{-4} per year. The releases from the 45-m stack are shown in Table 5-29, and the dose consequences are shown in Table 5-30. The maximum public individual dose from a fuel element melt would be 5.5 rem for a resident located 1300 m (0.9 mi) from the Omega West Reactor.

Table 5-29. Radionuclides Released from the Omega West Reactor During a Postulated Fuel Melt Scenario (Smith and Bunker 1989)

Isotope	Release (Ci)
Iodine-131	120
Xenon-131m	24
Other iodines modeled as Iodine-134	1,600
Other noble gases modeled as Krypton-88	21,000

Table 5-30. Dose and Consequences for an Accidental Fuel Melt Release from the Omega West Reactor

Dose and Consequences	Individual Impacts - Onsite and Offsite			
	Onsite Worker (200 m NNW)	Public Access Location (300 m N)	Individual Resident (1300 m N) All Pathways	Individual Resident (1300 m N) External and Inhalation
TEDE (rem)	0.82	0.67	5.7[a]	0.48
	Collective Impacts to Population within 80 km to the Northwest (Affected Population = 4743)			
	Median Atmospheric Dispersion		**Bounding Atmospheric Dispersion**	
	All Pathways	**External and Inhalation**	**All Pathways**	**External and Inhalation**
Collective TEDE (person-rem)	91.0	91.0	940	930
Fatal Cancers	0.046	0.046	0.47	0.47
Cancer Risk	5×10^{-6}	5×10^{-6}	5×10^{-6}	5×10^{-6}

(a) Protective Action Guidelines would require intervention of locally grown food products.

The limiting MEI organ dose would be 170 rem to the thyroid with ingestion and 1.5 rem without ingestion. This accident would result in less than 1 (0.47) latent cancer fatality because the population would not be allowed to consume the dairy and beef products grown in the region until the risk had been appreciably reduced. This translates into an average annual accident risk of 5×10^{-6} or the chance of any individual dying of cancer from a fuel element melt accident is about 1 in 200,000 per year of operation.

Rupture of a target following irradiation would release radionuclides in the amounts shown in Table 5-22. The estimated dose and consequences are shown in Table 5-31. The maximum public individual dose from a Mo-99 target rupture accident would be 27 mrem for a resident located 1300 m (0.9 mi) from the Omega West Reactor. The limiting MEI organ dose would be 330 mrem to the thyroid with ingestion and 5.8 mrem without ingestion. This accident would result in less than 1 (0.02) latent cancer fatality if the accident occurs. This translates into an average annual accident risk of 2×10^{-7} or the chance of any individual dying of cancer from a Mo-99 target rupture accident is about 1 in 5 million per year of operation.

Table 5-31. Dose and Consequences for an Accidental Target Rupture from the Omega West Reactor

Dose and Consequences	Individual Impacts - Onsite and Offsite: Onsite Worker (200 m NNW)	Public Access Location (300 m N)	Individual Resident (1300 m N): All Pathways	Individual Resident (1300 m N): External and Inhalation
TEDE (rem)	0.033	0.028	0.027	0.017
	Collective Impacts to Population within 80 km to the Northwest (Affected Population = 4743)			
	Median Atmospheric Dispersion		**Bounding Atmospheric Dispersion**	
	All Pathways	**External and Inhalation**	**All Pathways**	**External and Inhalation**
Collective TEDE (person-rem)	3.5	3.5	33.0	33.0
Fatal Cancers	0.0018	0.0018	0.017	0.017
Cancer Risk	2×10^{-7}	2×10^{-7}	2×10^{-7}	2×10^{-7}

5.15.2.3 Target Irradiation at the Omega West Reactor - Liquid Release Scenario

A liquid release scenario was evaluated in conjunction with the target rupture scenario at the Omega West Reactor described previously (LANL 1993e). In this case, it was assumed that a leak in the reactor coolant circulation system occurred simultaneously with the target rupture, releasing radioactive materials to the ground and ultimately to an onsite stream. Release of fission gases to the 62,000 L (16,500 gal) tank was as described for the target rupture scenario, and the coolant leak was assumed to be diluted 2:1 by water in the stream. The TEDE was calculated for a hypothetical hiker who might drink 2 L of water from the stream after a delay of 24 h following release from the reactor. No adsorption or delay of radionuclides in the soil was assumed; only radioactive decay and dilution in the stream were accounted for in estimating the radionuclide intake by the hiker.

The TEDE to the hiker was estimated, using radionuclide intake-to-dose conversion factors as published by EPA (1988), to be 0.24 rem (see Table 5-32). The frequency of the accident is estimated as the product of the frequency of the target failure (about 0.1/yr) and the frequency of the leak (conservatively estimated as 0.05), or about 5×10^{-3}.

Table 5-32. Estimated Dose to an Individual Hiker from a Coolant Leak at the LANL Omega West Reactor

Radio-nuclides	Concentrations in Reactor Pool, Ci/L	Concentrations in Stream, Ci/L	Radionuclide Intake by Hiker, Ci	Effective Dose Equivalent, rem
Iodine-131	7.0×10^{-6}	2.1×10^{-6}	4.3×10^{-6}	0.23
Iodine-132	3.2×10^{-7}	8.9×10^{-11}	1.8×10^{-10}	1.2×10^{-7}
Iodine-133	4.6×10^{-6}	6.8×10^{-7}	1.4×10^{-6}	0.014
Iodine-134	3.8×10^{-7}	5.4×10^{-16}	1.1×10^{-15}	2.7×10^{-13}
Iodine-135	3.5×10^{-6}	1.0×10^{-7}	2.0×10^{-7}	4.5×10^{-4}
			Total	0.24

5.15.2.4 Target Irradiation at the Omega West Reactor - Flooding Potential

A recent safety evaluation described potential flooding from a 100-year rainfall event in addition to water from failure of the Los Alamos Dam and water-storage tanks. The peak discharge from this analysis was estimated at 63 m^3 (2260 ft^3) per second, which was approximately 30 m^3 (1060 ft^3) per second greater than the peak discharge at TA-2 from a 100-year rainfall event estimated without dam and storage tanks failure. Even with the excess flood waters, the estimate for overflow would not reach the finished floor elevation.

Becker (1991) performed an analysis in nearby Potrillo Canyon, 3 mi south of TA-2. The analysis indicates that over the last 80 years, only some runoff events were large enough to travel through the bottom half of the Potrillo Canyon watershed. These runoffs occurred in 1911, 1913, 1916, 1952, 1957, and 1968. The last breakthrough occurred in 1968 in Potrillo Canyon. The report also stated that individual rain events by themselves may not be related to runoff occurrence, but sequences of rainfall over time appear to be related to runoff events. This report also concluded that significant runoff events are not necessarily related to the results of catastrophic weather events. Although Potrillo Canyon is smaller than Los Alamos Canyon, Becker (1991) implies that a large runoff event to produce significant flow through the canyons is a relatively rare occurrence (for instance, 6 events in 80 years).

5.15.2.5 Target Irradiation at the Omega West Reactor - Falling Boulders

The Omega West Reactor sits in a canyon with a cliff face immediately above it. A retaining wall would be constructed sufficiently strong to stop a falling boulder, thus mitigating any potential impact on the building, if the reactor is restarted for production of medical isotopes.

Table 5-33. Dose and Consequences for an Accidental Release During Mo-99 Target Transfer at the Omega West Reactor

Dose and Consequences	Individual Impacts - Onsite and Offsite			
	Onsite Worker (200 m W)	Public Access Location (100 m W)	Individual Resident (1300 m N)	
			All Pathways	External and Inhalation
TEDE (rem)	0.037	0.003	0.12	0.019
	Collective Impacts to Population within 80 km to the Northwest Affected Population = 4743)			
	Median Atmospheric Dispersion		Bounding Atmospheric Dispersion	
	All Pathways	External and Inhalation	All Pathways	External and Inhalation
Collective TEDE (person-rem)	10.0	10.0	38.0	38.0
Fatal Cancers	0.05	0.05	0.019	0.019
Cancer Risk	5×10^{-8}	5×10^{-8}	2×10^{-7}	2×10^{-8}

The bounding target processing accident described in Section 5.15.1.5 was developed for the Chemistry and Metallurgy Research Facility. The release is the same as is shown in Table 5-26, but would be released from the 17-m Chemistry and Metallurgy Research Facility stack. The estimated dose and consequences are shown in Table 5-34. The maximum public individual dose from a Mo-99 target processing accident would be 9 mrem for a resident located 1010 m (0.6 mi) from the Chemistry and Metallurgy Research Facility. The limiting MEI organ dose would be 0.2 mrem to the lung. This accident would result in less than 1 (0.005) latent cancer fatality if the accident occurs. This number translates into an average annual accident risk of 5×10^{-4} or the chance of any individual dying of cancer from a Mo-99 target processing accident is about 1 in 2000 per year of operation.

The iodine-125 accident described in Section 5.15.1.5 was applied to the Chemistry and Metallurgy Research Facility. The dose and consequences are shown in Table 5-35. The maximum public individual dose from an iodine-125 target processing accident would be 5.7 mrem for a resident located 1010 m (0.6 mi) from the Chemistry and Metallurgy Research Facility. The limiting MEI organ dose would be 180 mrem to the thyroid with ingestion and 0.33 mrem without ingestion. This accident would result in less than 1 (0.00065) latent cancer fatality if the accident occurs. This number translates into an average annual accident risk of 7×10^{-6} or the chance of any individual dying of cancer from an iodine-125 target processing accident is about 1 in 100,000 per year of operation.

Table 5-34. Dose and Consequences for an Accidental Release from the Chemistry and Metallurgy Research Facility Hot Cells from Processing Mo-99 Targets

Dose and Consequences	Individual Impacts - Onsite and Offsite			
	Onsite Worker (100 m NNW)	Public Access Location (200 m E)	Individual Resident (1010 m N)	
			All Pathways	External and Inhalation
TEDE (rem)	0.030	0.030	0.0089	0.0089
	Collective Impacts to Population within 80 km to the East by Northeast (Affected Population = 26,760)			
	Median Atmospheric Dispersion		Bounding Atmospheric Dispersion	
	All Pathways	External and Inhalation	All Pathways	External and Inhalation
Collective TEDE (person-rem)	1.8	1.8	10.0	10.0
Fatal Cancers	0.0009	0.0009	0.005	0.005
Cancer Risk	9×10^{-4}	9×10^{-4}	5×10^{-4}	5×10^{-4}

Table 5-35. Dose and Consequences for an Accidental Release from the Chemistry and Metallurgy Research Facility Hot Cells from Processing of Iodine-125 Targets

Dose and Consequences	Individual Impacts - Onsite and Offsite			
	Onsite Worker (100 m W)	Public Access Location (100 m W)	Individual Resident (1010 m N)	
			All Pathways	External and Inhalation
TEDE (rem)	0.00069	0.00069	0.0057	0.00025
	Collective Impacts to Population within 80 km to the East-by-Northeast (Affected Population = 26,760)			
	Median Atmospheric Dispersion		Bounding Atmospheric Dispersion	
	All Pathways	External and Inhalation	All Pathways	External and Inhalation
Collective TEDE (person-rem)	0.14	0.048	1.3	0.53
Fatal Cancers	0.00007	0.0000028	0.00065	0.00027
Cancer Risk	7×10^{-6}	3×10^{-7}	7×10^{-6}	3×10^{-6}

5.15.3 Oak Ridge Research Reactor/Radioisotope Development Laboratory: Oak Ridge National Laboratory Alternative

5.15.3.1 Target Fabrication at Oak Ridge National Laboratory Hot Cells

No effects from the fabrication of Mo-99 targets are expected due to the reasons discussed in Section 5.15.1.1

5.15.3.2 Target Irradiation at Oak Ridge Research Reactor

The design of the Oak Ridge Research Reactor is similar to that of the Omega West Reactor. Both reactors use the same fuel configuration and would be run at the same power level for target irradiation. Therefore, the same release estimate (Table 5-29) was used for the potential release during a fuel melt accident but would be released from the 76-m (249.3-ft) Oak Ridge Research Reactor stack. Other accidents evaluated in the Oak Ridge Research Reactor SAR were found to be either incredible (100% fuel melt accident) or credible with significantly lower doses (reactivity or loss of coolant accidents) than postulated for the Omega West Reactor design basis accident (Binford et al. 1968). Thus, quantitative descriptions from the Omega West Reactor SAR were used in developing the maximum credible accident at the Oak Ridge Research Reactor. The consequences of the fuel melt accident are shown in Table 5-36.

Table 5-36. Dose and Consequences for an Accidental Fuel Melt Release from the Oak Ridge Research Reactor

Dose and Consequences	Individual Impacts - Onsite and Offsite			
	Onsite Worker (300 m W)	Public Access Location (400 m NE)	Individual Resident (5450 m E) All Pathways	Individual Resident (5450 m E) External and Inhalation
TEDE (rem)	0.17	0.14	0.42	0.037
	Collective Impacts to Population within 80 km to the East (Affected Population = 241,081)			
	Median Atmospheric Dispersion: All Pathways	Median Atmospheric Dispersion: External and Inhalation	Bounding Atmospheric Dispersion: All Pathways	Bounding Atmospheric Dispersion: External and Inhalation
Collective TEDE (person-rem)	5400.0	750.0	11000.0	1400.0
Fatal Cancers	3	0.38	6	0.70
Cancer Risk	3×10^{-4}	4×10^{-5}	6×10^{-5}	7×10^{-6}

The maximum public individual dose from a fuel element melt would be 420 mrem for a resident located 5450 m (3.4 mi) from Oak Ridge Reservation. The limiting MEI organ dose would be 13 rem to the thyroid with ingestion and 110 mrem without ingestion. This accident would result in 6 latent cancer fatalities if the accident occurs. This figure translates into an average annual accident risk of 6×10^{-5} or the chance of any individual dying of cancer from a fuel element melt accident is about 1 in 20,000 per year of operation.

The target rupture following irradiation at Oak Ridge Research Reactor uses the same estimated release as shown in Table 5-22. Consequences from the release are shown in Table 5-37. The maximum public individual dose from a Mo-99 target rupture accident would be 2 mrem for a resident located 5450 m (3.4 mi) from Oak Ridge Reservation. The limiting MEI organ dose would be 26 mrem to the thyroid with ingestion and 0.44 mrem without ingestion. This accident would result in less than 1 (0.031) latent cancer fatality if the accident occurs. This number translates into an average annual accident risk of 3×10^{-7} or the chance of any individual dying of cancer from a Mo-99 target rupture accident is about 1 in 3 million per year of operation

5.15.3.3 Target Transfer from the Oak Ridge Research Reactor to the Hot Cells

Two bounding accidents were considered during the transfer of the target from the reactor to the ORNL Hot Cell Facility. An accident causing an uncontained target to rupture bounds the risk for offsite residents and population, and direct exposure of a worker to an unshielded target bounds the radiological risk to a worker. Other accidents were considered, but the resulting consequences and risks were lower.

Table 5-37. Dose and Consequences for the Target Rupture Accident at Oak Ridge Research Reactor

Dose and Consequences	Individual Impacts - Onsite and Offsite			
	Onsite Worker (300 m W)	Public Access Location (400 m NE)	Individual Resident (5450 m E): All Pathways	Individual Resident (5450 m E): External and Inhalation
TEDE (rem)	0.099	0.091	0.002	0.0012
	Collective Impacts to Population within 80 km to the East (Affected Population = 241,081)			
	Median Atmospheric Dispersion: All Pathways	**Median Atmospheric Dispersion: External and Inhalation**	**Bounding Atmospheric Dispersion: All Pathways**	**Bounding Atmospheric Dispersion: External and Inhalation**
Collective TEDE (person-rem)	33.0	24.0	61.0	43.0
Fatal Cancers	0.017	0.012	0.031	0.022
Cancer Risk	2×10^{-6}	1×10^{-6}	3×10^{-7}	2×10^{-7}

The bounding impact for all target transfer operations would be represented by the rupture of a single target as the result of a manned transport accident while in transit between the Oak Ridge Research Reactor and the ORNL Hot Cell Facility. Although highly improbable (estimated probability is less than 1×10^{-6} per year), this accident scenario assumes the loss of all noble gas radionuclides and 1% of halogen radionuclides directly to the atmosphere (Table 5-24). Downwind dose estimates for a cask transport accident between the Oak Ridge Research Reactor and the ORNL Hot Cell Facility are presented in Table 5-38. It was assumed that rupture occurs after a 21-kW, 7-d irradiation, and that all of the noble gases and 1% of the halogens were immediately released from one target into the atmosphere at ground level. The maximum public individual dose from a Mo-99 target transfer accident would be 81 mrem for a resident located 5450 m (3.4 mi) from Oak Ridge Reservation. The limiting MEI organ dose would be 2.3 rem to the thyroid with ingestion and 40 mrem without ingestion. This accident would result in less than 1 (0.5) latent cancer fatality if the accident occurs. This number translates into an average annual accident risk of 5×10^{-7} or the chance of any individual dying of cancer from a target transfer accident is about 1 in 2 million per year of operation.

Due to the extremely high speeds and the impact severity necessary to breach the transportation cask, it is assumed that the worker who would be driving the transport vehicle would likely be killed by the impact of the mobile transport accident. The immediate fatality of the worker(s) involved in the transportation accident would bound the risk of the worker dying from a fatal cancer due to any dose received from the accident. Therefore, the dose to the worker was not estimated.

Table 5-38. Dose and Consequences for an Accidental Release from Target Rupture at Oak Ridge National Laboratory During Mo-99 Target Transfer

Dose and Consequences	Individual Impacts - Onsite and Offsite			
	Onsite Worker (300 m W)	Public Access Location (400 m NE)	Individual Resident (5450 m E)	
			All Pathways	External and Inhalation
TEDE (rem)	0.79	0.48	0.081	0.013
	Collective Impacts to Population within 80 km to the East (Affected Population =241,100)			
	Median Atmospheric Dispersion		Bounding Atmospheric Dispersion	
	All Pathways	External and Inhalation	All Pathways	External and Inhalation
Collective TEDE (person-rem)	150.0	25.0	1000.0	180
Fatal Cancers	0.075	0.0013	0.5	0.09
Cancer Risk	8×10^{-8}	1×10^{-9}	5×10^{-7}	9×10^{-9}

The risk to an involved worker would be identical to that discussed in Section 5.15.1.4 for the worker's direct exposure to the target. The total dose received by a worker so exposed would be about 30 rem.

5.15.3.4 Target Processing at Oak Ridge National Laboratory Hot Cells

Accidents evaluated for analysis during target processing included a fire, target process spill, and release of process gases. The probability of a fire and a process spill, as well as the respective potential doses from these accidents, was much smaller than the probability and consequences from an operator inadvertently opening process valves, sending noble gases up the hot cell facility stack. Thus the operator error scenario was chosen to bound the risks from other accidents.

The target processing accidents described in Section 5.15.1 were developed for the Chemistry and Metallurgy Research Facility, and were applied to the ORNL hot cells as a bounding case for Mo-99 and iodine-125 production. The release for the Mo-99 production accident is the same as is shown in Table 5-26, and the release for iodine-125 target processing is as described in Section 5.15.1.5. The dose and consequences are shown in Tables 5-39 and 5-40. The maximum public individual dose from a Mo-99 target processing accident would be 0.13 mrem for a resident located 5450 m (3.4 mi) from the ORNL Hot Cell Facility. The limiting MEI organ dose would be 0.005 mrem to the lung. This accident would result in less than 1 (0.0024) latent cancer fatality if the accident occurs. This figure translates into an average annual accident risk of 2×10^{-4} or the chance of latent cancer fatalities in the population from a Mo-99 target processing accident at Oak Ridge is about 1 in 4000 per year of operation.

Table 5-39. Dose and Consequences for the Accidental Release of Noble Gases from Mo-99 Target Processing at the ORNL Hot Cell Facility

Dose and Consequences	Individual Impacts - Onsite and Offsite			
	Onsite Worker (300 m W)	Public Access Location (400 m NE)	Individual Resident (5450 m E): All Pathways	Individual Resident (5450 m E): External and Inhalation
TEDE (rem)	0.00086	0.00071	0.00013	0.00013
	Collective Impacts to Population within 80 km to the East (Affected Population = 241,081)			
	Median Atmospheric Dispersion: All Pathways	**Median Atmospheric Dispersion: Without Ingestion**	**Bounding Atmospheric Dispersion: All Pathways**	**Bounding Atmospheric Dispersion: Without Ingestion**
Collective TEDE (person-rem)	2.5	2.5	4.8	4.8
Fatal Cancers	0.0013	0.0013	0.0024	0.0024
Cancer Risk	1×10^{-3}	1×10^{-3}	2×10^{-4}	2×10^{-4}

Table 5-40. Dose and Consequences for the Accidental Release of Noble Gases from Iodine-125 Target Processing at the ORNL Hot Cell Facility

Dose and Consequences	Individual Impacts - Onsite and Offsite			
	Onsite Worker (300 m W)	Public Access Location (400 m NE)	Individual Resident (5450 m E)	
			All Pathways	External and Inhalation
TEDE (rem)	0.00002	0.000016	0.00019	0.0000043
	Collective Impacts to Population within 80 km to the East (n= 241,081)			
	Median Atmospheric Dispersion		Bounding Atmospheric Dispersion	
	All Pathways	External and Inhalation	All Pathways	External and Inhalation
Collective TEDE (person-rem)	5.5	0.093	2.2	0.22
Fatal Cancers	0.0028	0.000047	0.011	0.00008
Cancer Risk	3×10^{-4}	5×10^{-6}	1×10^{-4}	8×10^{-7}

The maximum public individual dose from an iodine-125 target processing accident would be 0.19 mrem for a resident located 5450 m (3.4 mi) from ORNL Hot Cell Facility. This accident would result in less than 1 (0.01) latent cancer fatality if the accident occurs. The limiting MEI organ dose would be 6.3 mrem to the thyroid with ingestion and 0.012 mrem without ingestion. This number translates into an average annual accident risk of 1×10^{-4} or the chance of latent cancer fatalities in the population from an iodine-125 target processing accident is about 1 in 10,000/yr of operation.

5.15.4 Power Burst Facility/Test Area North: Idaho National Engineering Laboratory Alternative

5.15.4.1 Target Fabrication at Test Area North Hot Cells

No effects from target fabrication would be expected due to the reasons discussed in Section 5.15.1.1.

5.15.4.2 Target Irradiation at the Power Burst Facility

The design of the Power Burst Facility is similar to that of the Omega West Reactor. Therefore, the same estimated release (Table 5-29) was used for the potential fuel melt accident. The Power Burst Facility SAR evaluated the potential doses from a variety of design basis accidents, (for example, flow blockage accident, loss-of-coolant accident, loop coolant system blowdown, and fuel handling accident) (ANC 1971). In all cases, the design basis accident described in the Omega West Reactor SAR bounded the consequences, and, thus, quantitative descriptions from the Omega West Reactor SAR were used in developing the maximum credible accident at the Power Burst Facility.

The consequences of the fuel melt accident are shown in Table 5-41. The maximum public individual dose from a fuel element melt would be less than 1.6 rem for a resident located 12,400 m (7.7 mi) from the Power Burst Facility. The limiting MEI organ dose would be 50 rem to the thyroid with ingestion and 440 mrem without ingestion. This accident would result in 4 latent cancer fatalities if the accident occurs. This translates to an average annual accident risk of 4 x 10^{-5} or the chance of latent cancer fatalities in the population from a fuel element melt accident is about 1 in 30,000 per year of operation.

The target rupture following irradiation at the Power Burst Facility uses the same estimated release as in Table 5-22. Consequences from the release are shown in Table 5-42. The maximum public individual dose from a Mo-99 target rupture accident would be 5.9 mrem for a resident located 12,400 m (7.7 mi) from the Power Burst Facility. The limiting MEI organ dose would be 96 mrem to the thyroid with ingestion and 1.6 mrem without ingestion. This accident would result in less than 1 (0.008) latent cancer fatality if the accident occurs. This translates to an average annual accident risk of 8 x 10^{-8} or the chance of latent cancer fatalities in the population from a Mo-99 target rupture accident is about 1 in 10 million per year of operation.

Table 5-41. Dose and Consequences for the Fuel Melt Accident at Power Burst Facility

Dose and Consequences	Individual Impacts - Onsite and Offsite			
	Onsite Worker (300 m ESE)	Public Access Location (1000 m S)	Individual Resident (12,400 m SE) All Pathways	Individual Resident (12,400 m SE) External and Inhalation
TEDE (rem)	1.2	1.3	1.6[(a)]	0.099
	Collective Impacts to Population within 80 km to the East (n= 70, 150)			
	Median Atmospheric Dispersion		**Bounding Atmospheric Dispersion**	
	All Pathways	**External and Inhalation**	**All Pathways**	**External and Inhalation**
Collective TEDE (person-rem)	900.0	20.0	7300.0	170.0
Fatal Cancers	0.12	0.010	4.0	0.085
Cancer Risk	1 x 10^{-5}	1 x 10^{-6}	4 x 10^{-5}	9 x 10^{-7}

(a) Protective Action Guides would require intervention of locally grown food products.

Table 5-42. Dose and Consequences for the Target Rupture Accident at the Power Burst Facility

Dose and Consequences	Individual Impacts - Onsite and Offsite			
	Onsite Worker (300 m ESE)	Public Access Location (1000 m S)	Individual Resident (12,400 m SE)	
			All Pathways	External and Inhalation
TEDE (rem)	0.05	0.05	0.0059	0.003
	Collective Impacts to Population within 80 km to the East (Affected Population = 70,150)			
	Median Atmospheric Dispersion		Bounding Atmospheric Dispersion	
	All Pathways	External and Inhalation	All Pathways	External and Inhalation
Collective TEDE (person-rem)	2.2	0.58	16.0	2.7
Fatal Cancers	0.0011	0.00029	0.008	0.0014
Cancer Risk	1×10^{-7}	3×10^{-8}	8×10^{-8}	1×10^{-8}

5.15.4.3 Target Transfer from the Power Burst Facility to Hot Cells

Two bounding accidents were considered during the transfer of the target from the reactor to the hot cells. An accident causing an uncontained target to rupture bounds the risk for offsite residents and population, and direct exposure of a worker to an unshielded target bounds the radiological risk to an involved worker. Other accidents were considered, but the risks and consequences were lower.

The bounding impact for all target transfer operations would be represented by the rupture of a single target as the result of a manned transport accident while in transit between the Power Burst Facility and the nearby hot cell facility. Although highly improbable (estimated probability is less than 1×10^{-6} per year), this accident scenario assumes the loss of all noble gas radionuclides and 1% of halogen radionuclides directly to the atmosphere (Table 5-43). Downwind dose estimates for a cask transport accident between the Power Burst Facility and the INEL hot cell facility are presented in Table 5-43. It was assumed that rupture occurs after a 21-kW, 7-day irradiation, and that all of the noble gases and 1% of the halogens were immediately released from one target into the atmosphere at ground level. The maximum public individual dose from a Mo-99 target transfer accident would be 50 mrem for a resident located 12,400 m (7.7 mi) from the Power Burst Facility. The limiting MEI organ dose would be 1.5 rem to the thyroid with ingestion and 26 mrem without ingestion. This would result in less than 1 (0.07) latent cancer fatality if the accident occurs. This would translate to an average annual accident risk of 7×10^{-9} or the chance of any individual dying of cancer from a target transfer accident is about 1 in 100 million per year of operation.

Table 5-43. Dose and Consequences for the Accidental Release from Target Rupture at INEL Power Burst Facility During Mo-99 Target Transfer

Dose and Consequences	Individual Impacts - Onsite and Offsite			
	Onsite Worker (200 m S)	Public Access Location (1000 m S)	Individual Resident (12,400 m SE) All Pathways	Individual Resident (12,400 m SE) External and Inhalation
TEDE (rem)	4.8	0.32	0.05	0.0047
	Collective Impacts to Population within 80 km to the East (Affected Population = 70,150)			
	Median Atmospheric Dispersion		Bounding Atmospheric Dispersion	
	All Pathways	External and Inhalation	All Pathways	External and Inhalation
Collective TEDE (person-rem)	17.0	0.75	140.0	7.3
Fatal Cancers	0.085	0.000088	0.07	0.037
Cancer Risk	9×10^{-8}	9×10^{-11}	7×10^{-9}	4×10^{-9}

Due to the extremely high speeds and the impact severity necessary to breach the transportation cask, it is assumed the worker who would be driving the transport vehicle would likely be killed by the impact of the mobile transport accident. The immediate fatality of the worker(s) involved in the transportation accident would bound the risk of the worker dying from a fatal cancer due to any dose received from the accident. Therefore, the dose to the worker was not estimated.

The risk to an involved worker would be identical to that discussed in Section 5.15.1.4 for the worker's direct exposure to the target. The total dose received by the worker would be about 30 rem.

5.15.4.4 Target Processing

Accidents evaluated for analysis during target processing included a fire, target process spill, and release of process gases. The probability of a fire and a process spill, as well as the respective potential doses from these accidents, was much smaller than the probability and consequences from an operator inadvertently opening process valves, sending noble gases up the hot cell facility stack. Thus, the operator error scenario was chosen to bound the risks from other accidents.

The bounding target processing accidents described in Section 5.15.1.5 were developed for the Chemistry and Metallurgy Research Facility and are applied to the Power Burst Facility hot cells as a bounding case. The release for the Mo-99 production accident is the same as is shown in Table 5-26, and releases for iodine-125 target process accidents are assumed to be the same as described in 'ection 5.15.1.5. The dose and consequences are shown in Tables 5-44 and 5-45. The maximum public ındividual dose from a Mo-99 target processing accident would be 0.6 mrem for a resident located 12,400 m (7.7 mi) from the hot cells. The limiting MEI organ dose would be 0.021 mrem to the lung. This accident would result in less than 1 (5.5×10^{-4}) latent cancer fatality if the accident occurs. This number translates into an average annual accident risk of 6×10^{-5} or the chance of latent cancer fatalities in the population from a Mo-99 target processing accident is about 1 in 200,000 per year of operation.

The maximum public individual dose from a iodine-125 target processing accident would be 5.9 mrem for a resident located 12,400 m (7.7 mi) from the INEL hot cells. The limiting MEI organ dose would be 200 mrem to the thyroid with ingestion and 0.36 without ingestion. This accident would result in less than 1 (0.0006) latent cancer fatality if the accident occurs. This figure translates into an average annual accident risk of 6×10^{-6} or the chance of any individual dying of cancer from a iodine-125 target processing accident is about 1 in 200,000 per year of operation.

Table 5-44. Dose and Consequences for the Accidental Release of Noble Gases from INEL Hot Cells During Mo-99 Target Processing

Dose and Consequences	Individual Impacts - Onsite and Offsite: Onsite Worker (200 m S)	Public Access Location (1000 m S)	Individual Resident (12,400 m SE): All Pathways	External and Inhalation
TEDE (rem)	0.062	0.023	0.0006	0.0006
	Collective Impacts to Population within 80 km to the Southeast (Affected Population = 70,150)			
	Median Atmospheric Dispersion		**Bounding Atmospheric Dispersion**	
	All Pathways	**External and Inhalation**	**All Pathways**	**External and Inhalation**
Collective TEDE (person-rem)	0.082	0.082	1.1	1.1
Fatal Cancers	0.000041	0.000041	0.00055	0.00055
Cancer Risk	4×10^{-5}	4×10^{-5}	6×10^{-5}	6×10^{-5}

Table 5-45. Dose and Consequences for the Accidental Release of Noble Gases from INEL Hot Cells During Iodine-125 Target Processing

Dose and Consequences	Individual Impacts - Onsite and Offsite			
	Onsite Worker (200 m S)	Public Access Location (1000 m S)	Individual Resident (12,400 m SE)	
			All Pathways	External and Inhalation
TEDE (rem)	0.0015	0.00062	0.0059	0.000031
	Collective Impacts to Population within 80 km to the East (Affected Population = 70,150)			
	Median Atmospheric Dispersion		Bounding Atmospheric Dispersion	
	All Pathways	External and Inhalation	All Pathways	External and Inhalation
Collective TEDE (person-rem)	0.38	0.0062	1.2	0.40
Fatal Cancers	0.00019	0.0000031	0.0006	0.00021
Cancer Risk	2×10^{-5}	3×10^{-7}	6×10^{-6}	2×10^{-6}

5.15.5 Nonradiological Accidents

Nonradiological accidents might consist of the release of toxic or other hazardous materials to the environment, or of physical trauma during construction or operation of facilities. Both types of events are considered in this section

Substantial releases of hazardous or toxic materials to the environment would generally not be expected during operation of the facilities for medical isotope production because of the relatively small quantities of these materials involved in any of the processes. A previous evaluation determined that hypothetical accidents involving hazardous or toxic materials could produce hazardous concentrations of such compounds only in the immediate vicinity of the accident scene (Massey et al. 1995). In that analysis, concentrations of hazardous chemicals that might produce life-threatening or irreversible health effects would not occur beyond a distance of 100 m (328 ft), and concentrations that might produce less severe, temporary health effects would not occur beyond a distance of 300 m (984 ft). Concentrations that might cause transient irritation or a noticeable objectionable odor would not occur beyond a distance of 1000 m (3280 ft). Because these hypothetical releases typically involved spills of concentrated acids or other corrosive solutions, their effect would not be expected to be immediate, even in proximity to the spill, unless the release occurred during an explosion or fire. Therefore, it would be likely that nearby workers or other personnel would have some opportunity to take protective action. The medical isotope production processes and the quantities of hazardous chemicals needed would be similar at all of the facilities; therefore, the potential for major accidents involving toxic or hazardous chemicals are unlikely at any of the candidate sites.

Statistical estimates for industrial accidents during construction and operation of DOE facilities indicate that 1 fatality might be expected for every 9100 worker-years of construction activities or 1,000 worker-years of normal facility operation. The corresponding estimates for occupational injuries and illnesses are 1 for every 16 worker-years of construction or 31 worker-years of normal operations (DOE 1995b). Because of the limited construction activities associated with any of the alternatives considered in this FEIS, no fatalities would be expected; the labor requirements for operation are also sufficiently small so no fatalities would be anticipated for any reasonable duration of the project. Estimates of occupational injuries or illnesses as a result of construction amount to 6 to 7 per year at all sites. Normal operations might result in up to two occupational injuries or illnesses at any site (Table 5-46).

5.15.6 Secondary Impacts of Accidents

Secondary impacts of nonradiological accidents would likely not be extensive because the opportunity for major environmental contamination would be extremely small. The consequences of the accidents would consist of costs for cleanup, treatment, and disposal of hazardous materials. They also could result in temporary suspension of activities at isotope production facilities until the hazardous materials are contained.

Secondary impacts of radiological accidents have been evaluated qualitatively for this analysis. Although the levels of environmental contamination for specific accidents were not assessed directly, the dose to the offsite MEI provides a measure of the air concentration and radionuclide deposition at the site boundary. Therefore, the dose can be used as a semi-quantitative estimate of the level of environmental contamination from a given accident.

Table 5-46. Operational Injuries, Illnesses, and Fatalities for Facility Construction and Operation

	Labor (Worker-Years)		Industrial Accidents[a]			
			Injuries and Illnesses		Fatalities	
	Construction	Operations	Construction	Operations	Construction	Operations
SNL/NM	92	59	6	2	0.010	0.0019
LANL	92	45	6	1	0.010	0.0014
ORNL	113	62	7	2	0.012	0.0020
INEL	97	59	6	2	0.011	0.0019

(a) The following rates were assumed to apply to construction and operation of DOE facilities (DOE 1995b Vol. 2, Table F-4-7).

Consequence Rates per Worker-Year	Construction	Operations
Injury / Illness	0.062	0.032
Accidental Fatality	0.00011	0.000032

Accidents that result in estimated doses of less than 0.5 rem to the MEI would likely have few secondary impacts because the levels of offsite environmental contamination in these cases would be relatively small. Protective action guidelines would not require mitigating actions such as evacuation of residents surrounding the site or interdiction of food crops. However, in practice surveys of food and forage grown in the nearby area would likely be conducted to ensure the public and commercial agricultural operations that food products were safe for consumption. Other secondary impacts might include unavailability of facilities and costs for cleanup of contaminated facilities and surrounding areas within the affected site boundary.

Accidents that exceed estimated doses of 0.5 rem to the MEI would have some secondary impacts, with their extent and severity depending on the expected levels of environmental contamination. Protective action guidelines would require mitigating actions, such as evacuation of residents surrounding the site or interdiction of food crops depending on the nature and location of the accident. Other secondary impacts could include

- local (onsite) effects on individual members of some sensitive biota or ecosystems
- temporary closure of recreational and scenic areas, shorelines, and other affected lands (including restrictions on traditional fishing rights and recreational use of rivers for boating or fishing)
- temporary local restrictions on use of affected water supplies for domestic purposes
- possible loss of agricultural crops
- temporary restrictions on land use for agricultural purposes
- costs and exposure to workers associated with cleanup of facilities and environmental contamination
- temporary unavailability of facilities for production of medical isotopes, and possible temporary closure of nearby facilities.

5.16 Cumulative Impacts

The cumulative impacts of the proposed actions in conjunction with other past, ongoing, and reasonably foreseeable actions at the candidate sites are evaluated in this section. Cumulative impacts of the proposed action with other actions were considered to account for the possibility that consequences from several smaller activities might be significant when taken together, whereas the impacts of the individual activities were not. Categories of consequences associated with the proposed alternatives, that were not previously identified as having impacts, are not discussed further with regard to their cumulative effects.

5.16.1 Annular Core Research Reactor: Sandia National Laboratories/New Mexico and the Chemistry and Metallurgy Research Facility: Los Alamos National Laboratory Alternative

Activities identified for the SNL/NM and surrounding region that may contribute to cumulative environmental impacts include ongoing operations and future waste management activities at the laboratory (Massey et al. 1995).

5.16.1.1 Site Services and Resource Use

Consumption of 225 kWh of electricity at SNL/NM during the construction period, or use of about 400 MWh/yr for operation of the facilities, represents a small increase (less than 0.2%) in the site's annual consumption of electricity.

Increase in water use in the Albuquerque region is considered as one of the potential consequences in this EIS. SNL/NM obtains its water from onsite wells at KAFB, supplemented by water purchased from the Albuquerque municipal water system. The total water use from operation of the ACRR at SNL/NM would increase from the current average of 5000 gal/d to 29,000 gal/d (Section 5.1.13), compared to total water use at SNL/NM of 1,000,000 gal/d. This represents less than 3% increase in water use at SNL/NM, or 0.03% increase in water use for the region, and would not be expected to substantially impact availability or quality of water in the aquifer.

Modifications to existing facilities would not require sufficient resources in terms of labor or materials ɔ substantially impact other ongoing projects at the SNL/NM site or in the surrounding region. Operation ſ the facilities would require relatively small quantities of common laboratory chemicals, which would not be expected to impact their availability for other DOE or commercial enterprises. These resources would only be used in large quantities if that supplier were no longer in production. Consumption of highly enriched uranium for target fabrication or of reactor fuel-grade uranium for the irradiation facilities is also not expected to be a problem in light of the present surplus of these materials available to DOE and the relatively small quantities needed for the isotope production program.

The labor required for construction of facilities at SNL/NM and the workers employed during facility operations at 100% replacement capacity would represent less than 0.1% of the regional work force.

5.16.1.2 Waste Management

The 49 m^3 (1700 ft^3) of solid low-level radioactive waste that is expected to be generated during each year of operating the medical isotope program at 100% of the U.S. replacement capacity represents a 50% increase in the total quantity of low-level waste generated annually at the SNL/NM site (100 m^3 [3500 ft^3]). Disposal of that quantity of waste at the Nevada Test Site would not represent a substantial increase in the wastes currently managed at that site, which amounted to 460,000 m^3 in 1993 (1994b).

5.16.1.3 Air Quality

Radioactive air emissions from the Annular Core Research Reactor and hot cell facilities would increase the dose to the population around the SNL/NM site (from 0.027 person-rem in 1993 to about 13 person-rem/yr), which would result in less than 1 (0.007) latent cancer fatality. That total represents about a 13% increase in the annual public dose from all DOE operations, which amounted to 100 person-rem during 1994. Cumulative doses to the public during the 5-year period from 1990-1994 amounted to about 0.6 person-rem at SNL/NM and 470 person-rem from all DOE operations. The dose to the MEI would increase from 0.002 mrem to 0.17 mrem, although the sitewide receptor may be in a different location from the receptor for the Annular Core Research Reactor and Hot Cell Facilities. However, both the current and projected doses to the offsite resident would be below the EPA 10 mrem/yr standard.

For perspective, the dose from natural background radiation (including radon) to the 610,000 people within 80 km (50 mi) of SNL/NM would be approximately 180,000 person-rem/yr, which would result in an estimated 91 latent fatal cancers. The same population would be expected to experience about 1200 cancer fatalities in a year from all causes.

5.16.1.4 Occupational Health and Safety

Occupational doses at SNL/NM would increase by approximately 22-25 person-rem/year for facility operations and medical isotope shipments, compared to the worker dose levels of 2 person-rem/year at TA-V and about 10 person-rem for the entire site during 1994. That would represent less than a 2% increase in the total occupational dose incurred yearly by DOE workers, which amounted to about 1800 person-rem during 1994.

5.16.2 Omega West Reactor/Chemistry and Metallurgy Research Facility: Los Alamos National Laboratory Alternative

Actions identified for the LANL and surrounding region that may contribute to cumulative impacts include ongoing operations, construction and operation of the Dual Axis Radiographic Hydrodynamic Test (DARHT) facility, and future waste management activities at the laboratory (DOE 1995i).

5.16.2.1 Site Services and Resource Use

Consumption of electricity at LANL during the construction period would be minimal, and use of about 500 MWh/yr for operation of the facilities, would represent a small increase (less than 0.2%) in the site's annual consumption of electricity. Use of approximately 120,000 m^3 per year of water for reactor cooling would represent about 2% of the site's current consumption rate.

Modifications to existing facilities would not require sufficient resources in terms of labor or materials to substantially impact other ongoing projects at the LANL site or in the surrounding region. Operation of the facilities would require relatively small quantities of common laboratory chemicals and highly enriched uranium for targets and reactor fuel, which would not be expected to impact availability of these materials for other government or commercial uses as discussed in Section 5.16.1.1. The labor required for onstruction of facilities at LANL and the workers employed during facility operations at 100% replacement capacity would represent less than 0.1% of the regional work force.

5.16.2.2 Waste Management

The 18 m^3 (630 ft^3) of solid low-level radioactive waste that is expected to be generated during each year of operating the medical isotope program at 100% of the U.S. replacement capacity would represent less than a 1% increase in the total quantity of low-level waste generated annually at the LANL site (5800 m^3 [200,000 ft^3]). Disposal of that waste would not represent a substantial increase in the quantity of radioactive wastes currently managed at the site, which amounted to 220,000 m^3 in 1993 (DOE 1994b).

5.16.2.3 Air Quality

Radioactive air emissions from the Omega West Reactor and hot cell facilities would increase the dose to the population around the LANL site by about 0.7 person-rem/yr from 4 person-rem/yr in 1994, which would result in less than 1 (2×10^{-3}) latent cancer fatality. That total represents about a 0.7% increase in the annual public dose from all DOE operations, which amounted to 100 person-rem during 1994. Cumulative doses to the public during the 5-year period from 1990-1994 amounted to about 13 person-rem at LANL and 470 person-rem from all DOE operations. The dose to the MEI would increase by 0.2 mrem/yr, compared to 5.6 mrem/yr at the current levels, although the affected individuals from Omega West Reactor and the Chemistry and Metallurgy Research facility emissions are at different locations from those for other site emissions. However, both the current and projected doses to the offsite resident would be lower than the EPA 10 mrem/yr standard. Operation of the DARHT facility would likewise not substantially increase the current offsite dose from LANL activities.

For perspective, the dose from background radiation (including radon) to the 250,000 people within 80 km (50 mi) of LANL would be approximately 75,000 person-rem/yr, which would result in an estimated 38 latent fatal cancers. The same population would be expected to experience about 500 cancer fatalities in a year from all causes.

5.16.2.4 Occupational Health and Safety

Occupational doses at LANL would increase from the 1994 level of 180 person-rem/yr by about 10 person-rem/yr. The increase would represent less than 6% of the current annual occupational dose for the site, or 0.6% of the occupational dose for all DOE facilities (1800 person-rem in 1994).

5.16.3 Oak Ridge Research Reactor/Radioisotope Development Laboratory: Oak Ridge National Laboratory Alternative

Actions identified for the ORNL and the surrounding region that may contribute to cumulative impacts include ongoing operations, future waste management activities at the site, upgrades to existing facilities and site infrastructure, and potential construction of several new research complexes. This construction includes the proposed Uranium-Atomic Vapor Laser Isotope Separation Facility; an Environmental, Life, and Social Sciences Complex; and a Materials, Science, and Engineering Complex. The city of Oak Ridge anticipates construction of new residential and commercial enterprises in addition to a community golf course. A private company is also in the process of constructing a radioactive waste incinerator to the west of the reservation (DOE 1995b).

5.16.3.1 Site Services and Resource Use

Electricity used at ORNL during the construction period would be minimal, and use of about 500 MWh/yr for operation of the facilities, would represent a small increase (about 0.1%) in the site's annual consumption of electricity. Use of approximately 120,000 m^3 (3.1×10^7 gal) per year of water for reactor cooling would increase consumption at the site by about 1%.

Modifications to existing facilities would not require sufficient resources in terms of labor or materials to substantially impact other ongoing projects at the ORNL or in the surrounding region. Operation of the facilities would require relatively small quantities of common laboratory chemicals and enriched uranium for targets and reactor fuel, which would not be expected to impact availability of these materials for other government or commercial uses as discussed in Section 5.16.1.1. The labor required for construction of facilities at ORNL and the workers employed during facility operations at 100% replacement capacity would represent less than 0.1% of the regional work force.

5.16.3.2 Waste Management

The 68 m^3 (2400 ft^3) of solid low-level radioactive waste expected to be generated during each year of operating the medical isotope program at 100% of the U.S. replacement capacity represents less than a 5% increase in the total quantity of solid low-level waste generated annually at the ORNL (6,900 m^3 [240,000 ft^3] in 1992). Management of that waste would not represent a substantial increase in the quantity of radioactive wastes currently handled at the site. Low-level waste generated from Mo-99 production would be shipped to the Nevada Test Site for disposal, and would not represent a substantial increase in wastes managed at that site (460,000 m^3 in 1993) (DOE 1994b).

5.16.3.3 Air Quality

Radioactive air emissions from the Oak Ridge Research Reactor and hot cell facilities would increase the collective dose to the population around the ORNL by 15 person-rem compared to 43 person-rem for the current site operations. At that level, no latent cancer fatalities (2.9×10^{-2}) would be expected in the population in the vicinity of the ORNL. That total represents about a 15% increase in the annual public dose from all DOE operations, which amounted to 100 person-rem during 1994. Cumulative doses to the ublic during the 5-year period from 1990-1994 amounted to about 170 person-rem at Oak Ridge Reservation and 470 person-rem from all DOE operations. The potential increases in public dose from medical isotope production are minimal compared to the 17,000 person-rem estimated for historic Oak Ridge Reservation operations between 1944 and 1987 (DOE 1988). The dose to the MEI would increase by 0.3 mrem over the current levels, although the affected individuals from Oak Ridge Research Reactor and hot cell operations may be at a different location than for other facility operations. However, both the current and projected doses to the offsite resident would be lower than the EPA 10 mrem/yr standard.

For perspective, the dose from natural background radiation (including radon) to the 910,000 people within 80 km (50 mi) of ORNL would be approximately 270,000 person-rem/yr, which would result in an estimated 140 latent fatal cancers. The same population would be expected to experience about 1800 cancer fatalities in a year from all causes.

5.16.3.4 Occupational Health and Safety

Occupational doses at ORNL would increase from the 1994 level of 71 person-rem/yr by at most 25 person-rem/yr. The increase would represent about 35% of the current annual occupational dose for the site, or less than 2% of the occupational dose for all DOE facilities (1800 person-rem in 1994). Production of medical isotopes would not substantially increase the cumulative historic doses to workers at the Oak Ridge Reservation, which were estimated at 19,000 person-rem between 1943 and 1977 (BEIR 1990).

5.16.4 Power Burst Facility/Test Area North: Idaho National Engineering Laboratory Alternative

Actions identified for the INEL and surrounding region that may contribute to cumulative effects include ongoing operations, future waste management activities at the site, planned decontamination and decommissioning of several obsolete facilities, replacement of underground fossil fuel storage tanks, and upgrades of site infrastructure and irradiated nuclear fuel handling facilities at Argonne National Laboratory-West. Planned construction in the region of a new housing development and several commercial facilities would also occur within the foreseeable future (DOE 1995b).

5.16.4.1 Site Services and Resource Use

Electricity used at INEL during the construction period, or use of about 500 MWh/yr for operation of the facilities, represents a small increase (about 0.2%) in the site's annual consumption of electricity. Use of approximately 120,000 m^3 (3.1×10^7 gal) per year of water for reactor cooling would increase consumption at the site by less than 2%.

Modifications to existing facilities would not require sufficient resources in terms of labor or materials to substantially impact other ongoing projects at the INEL or in the surrounding region. Operation of the facilities would require relatively small quantities of common laboratory chemicals and enriched uranium for targets and reactor fuel, which would not be expected to impact availability of these materials for other government or commercial uses as discussed in Section 5.16.1.1. The labor required for construction of facilities at INEL and the workers employed during facility operations at 100% replacement capacity would represent less than 0.05% of the regional work force.

5.16.4.2 Waste Management

The 80 m^3 (2800 ft^3) of solid low-level radioactive waste that is expected to be generated during each year of operating the medical isotope program at 100% of the U.S. replacement capacity would represent less than a 10% increase in the total quantity of low-level waste generated annually at the INEL (900 m^3 [32,000 ft^3] projected in 1995). Disposal of that waste would not represent a substantial increase in the quantity of radioactive wastes currently managed at the site, which amounted to 147,000 m^3 in 1993 (see Section 4.4.14.2).

5.16.4.3 Air Quality

Radioactive air emissions from the Power Burst Facility and hot cell facilities would increase the dose to the population around the INEL by about 1.2 person-rem compared to 0.3 person-rem for current operations, which would not be expected to result in latent cancer fatalities (7.5×10^{-4}). That total represents about a 1% increase in the annual public dose from all DOE operations, which amounted to 100 person-rem during 1994. Cumulative doses to the public during the 5-year period from 1990-1994 amounted to about 0.5 person-rem at INEL and 470 person-rem from all DOE operations. The dose to the MEI would amount to 0.1 mrem. However, both the current and projected doses to the offsite resident would be lower than the EPA 10 mrem/yr standard.

For perspective, the dose from natural background radiation (including radon) to the 120,000 people within 80 km (50 mi) of INEL would be approximately 36,000 person-rem/yr, which would result in an estimated 18 latent fatal cancers. The same population would be expected to experience about 240 cancer fatalities in a year from all causes.

5.16.4.4 Occupational Health and Safety

Occupational doses at INEL would increase from the 1994 level of 240 person-rem/yr by at most 25 person-rem/yr. The increase would represent about 10% of the current annual occupational dose for the site, or less than 2% of the occupational dose for all DOE facilities (1800 person-rem in 1994).

5.16.5 Cumulative Impacts of Transportation

The cumulative impacts of transportation are similar for shipments from all of the candidate sites, and the majority of the consequences occur during shipments to pharmaceutical suppliers beyond the borders of the production sites. Annual collective doses to the transport crews would range from 23 to 24 person-rem/yr, those for the public would range from 26 to 53 person-rem, and the combined total would not be xpected to result in any latent cancer fatalities for any reasonable duration of the project. The consequences of any of the alternatives would be small compared to estimates of total annual transportation consequences for shipment of radioactive materials, such as those from industrial, medical, and commercial nuclear power facilities -- about 5600 person-rem to transport workers and 4200 person-rem to the general public (a total of 4 estimated latent cancer fatalities per year of such shipments). The impacts of the alternatives evaluated in this EIS would also be lower than the transportation impacts of reasonably foreseeable actions, such as transportation of commercial spent nuclear fuel and DOE high-level defense waste to a geologic repository and disposal of transuranic waste at the Waste Isolation Pilot Plant in Carlsbad, New Mexico. These activities represent a total of up to 11,000 person-rem to workers and 50,000 person-rem to the general population (estimated 29 latent cancer fatalities) for both actions (DOE 1995b).

5.17 Unavoidable Adverse Environmental Impacts

Adverse environmental impacts associated with medical isotope production would be largely due to operation of the reactor and hot cell facilities at full capacity, whereas previously they had been shut down or used intermittently, and from transportation of the separated products to pharmaceutical manufacturers where they are prepared for final distribution to end users. Unless the current supplier of medical isotopes for the U.S. were unable to continue operating, production would be at a fraction of the capacity evaluated in this EIS, and the consequences would be lower than those presented also. If production to meet 100% ᶜ the current U.S. demand were required, consequences at the selected site would be larger; however, they ould amount to relocation of impacts that are presently occurring to supply U.S. needs from the region adjacent to the Canadian supplier to that surrounding the selected DOE facility.

Modifications to existing facilities that would be necessary to implement the project would not be sufficiently extensive to result in significant excavation or construction, and would occur in previously developed areas of the candidate sites. Therefore, impacts on land use, socioeconomics, cultural resources, aesthetic and scenic resources, geological resources, water quality, ecological resources, community noise levels, and construction resources would be minimal or nonexistent.

5.18 Relationship Between Short-Term Uses of the Environment and the Maintenance and Enhancement of Long-Term Productivity

The alternatives considered in this EIS include use of existing DOE reactors and support facilities to develop a domestic supply of medical isotopes in the event they were not available from the current supplier. Some of the facilities have alternate research missions that require part-time operation; whereas, others are inactive and may eventually be scheduled for decommissioning. Alternate uses for these facilities might include support for other DOE projects, or they could be deactivated and decommissioned.

If the facilities were decommissioned, the land previously occupied by them might be used for construction of other DOE facilities, or it could be reclaimed for other uses.

Because the candidate facilities are part of larger active DOE complexes, release of the land for commercial, residential, recreational, or agricultural purposes appears to be impractical over the short term. Certain types of future use (such as for residential or agricultural purposes) might ultimately be restricted because of possible contamination with radionuclides or hazardous chemicals, or the perception of such contamination. For that reason, use of the candidate facilities to provide a backup source of medical isotopes would not further limit future use of the facilities, or the land on which they stand, beyond the restrictions that already exist.

Upgrading and operating existing facilities for medical isotope production may contribute to their long-term productivity and make possible other missions that would not be viable without cooperative support. Use of the INEL Power Burst Facility for medical cancer therapy is an example of a project that has been proposed in the past and which could be carried out concurrently with the isotope production mission, resulting in cost savings for both programs. Use of the facilities for isotope production would also be compatible with simultaneous use for research in many cases. In addition, refurbishing existing facilities to extend their useful life would result in lower environmental impacts than construction of new facilities either by DOE or by a private enterprise. Therefore, use of existing DOE facilities to provide a backup supply of medical isotopes could be considered an alternative that optimizes both near-term productivity of the facilities and long-term protection of the environment.

5.19 Irreversible and Irretrievable Commitment of Resources

This section addresses the irretrievable commitment of resources that would likely be used to implement the proposed EIS alternatives. Irretrievable use of a resource occurs when a resource is irreplaceably lost and cannot be replenished.

Modifications to existing facilities in order to implement the medical isotope production project would require use of relatively small quantities of construction materials and labor, which would not be likely to impose a burden on regional resources. Operation of the facilities would utilize common laboratory chemicals in modest quantities and enriched uranium for targets and reactor fuel, none of which are in limited supply. These resources would only be consumed in significant quantities if the current isotope supplier were not operating. A comparison of resources needed to implement the alternatives considered in this EIS is listed in Table 5-47.

Table 5-47. Resources Required to Prepare and Operate DOE Facilities for Production of Medical Radioisotopes

Consequence Category	Unit of Measure	Alternatives			
		SNL/NM-ACRR LANL-CMR	LANL OWR/CMR	ORNL ORRR/RDL	INEL PBF/TAN
Resource Use - Construction					
Electricity	kilowatt-hours	230	negligible	4	450
Concrete	cubic meters	1200	0	20	2400
Construction Steel	tonnes	0.21	0	negligible	0.39
Stainless Steel	tonnes	1.0	0.2	3.5	1.5
Resource Use - Operations					
Water	1000 m^3/yr	40	120	120	120
Electricity	megawatt-hours/yr	400	500	500	500
Materials - Target Fabrication					
Highly enriched uranium	kg/yr	4-36[a]	3[a]	3-26[a]	3-26[a]
Stainless Steel	tonnes/yr	0.5	0.4	0.4	0.4
Chemicals - Isotope Recovery					
Sulfuric acid, 2N	liters	(b)	120	Same as LANL	
Sulfuric acid, 0.1N	liters		36		
Hydrochloric acid, reagent grade	liters		1.2		
Nitric acid, reagent grade	liters		6		
Sodium hydroxide, 0.2N	liters		24		
Sodium iodide	grams		120		
Silver Nitrate	grams		600		
Benzoin-α-oxime	kilograms		2.4		
Molybdenum trioxide	grams		24		
Potassium permanganate	grams		100		
Rhodium trichloride	grams		24		
Potassium hexachlororuthenate	grams		24		
Hydrogen peroxide	liters		2.4		
Calcium oxide	liters		12		
Calcium sulfate "drierite"	liters		36		
Molecular sieve type 13X	liters		36		

Table 5-47. (contd)

Consequence Category	Unit of Measure	Alternatives SNL/NM-ACRR LANL-CMR	LANL OWR/CMR	ORNL ORRR/RDL	INEL PBF/TAN
Reactor Fuel					
Kilograms of uranium used in fuel	kilograms U/yr	16	32	32	32
Socioeconomics					
Primary Employment					
Construction/modifications	worker-years	92	92	113	97
Routine operations	workers	59	45	62	59
Costs					
Construction/modifications	million dollars	19.6	19.6	21.0[(c)]	17.2[(c)]
Routine operations	million dollars	12.8	11.0	9.6[(c)]	8.4[(c)]

(a) Minimum values assume 90% recovery of highly enriched uranium after isotope extraction. Uranium recovery would occur at LANL, and could be implemented at other sites. However, consequence analyses presented in other sections do not assume uranium recovery at sites other than LANL.

(b) Consumption of chemicals for target processing assumes irradiation of targets to a power of 20 kW. At SNL/NM, production rates corresponding to 100% replacement of U.S. needs would likely require processing of a greater number of targets at lower power. In that case, the quantity of chemicals used to process the targets would increase by about 40%.

(c) As explained in Section 5.22, the cost estimates for ORNL and INEL are expected to contain greater uncertainties than those presented for SNL/NM and LANL.

ACRR - Annular Core Research Reactor; CMR - Chemistry and Metallurgy Research Facility; OWR - Omega West Reactor; ORRR - Oak Ridge Research Reactor; PBF - Power Burst Facility; RSL - Radioisotope Development Laboratory; TAN - Test Area North.

5.20 Potential Mitigation Measures

Mitigation measures typically applied to the operation of small research reactors and to the activities necessary to fabricate, irradiate, and process the Mo-99 targets would be applied throughout the project. These measures include filtration of air emissions from target fabrication, irradiation, and processing activities in accordance with applicable requirements and ALARA principles. No impacts were identified for any alternative on land use, cultural resources, geologic resources, ecological resources, community noise levels, socioeconomics, or aesthetic and scenic resources; therefore, mitigation measures for potential impacts in these categories would not be necessary.

5.21 Environmental Justice

As a result of Executive Order 12898 (February 11, 1994), federal agencies are responsible for identifying and addressing the possibility of disproportionately high and adverse environmental impacts of their programs and activities on minority and low-income populations. This section considers the location of minority and low-income populations surrounding the potential sites for the production of Mo-99 and onsiders their susceptibility to disproportionately adverse environmental consequences of alternatives considered in this FEIS. Impacts along transportation routes for either routine operations or accidents to even the MEI located at 100 m (328 ft) from the release site are estimated to be insignificant (Section 5.11). Because the consequences for any individual of any group from transportation are insignificant, minority and low-income individuals are not considered to be adversely and disproportionately affected along those routes.

For purposes of this analysis, minority populations are defined as all non-white individuals, plus Hispanic whites, as reported in the 1990 census. Low-income persons are defined as living in households in the 1990 Census that reported an annual income less than the U.S. official poverty level. The poverty level varies by size and relationship of the members of the household. It was $12,674 for a family of four at the 1990 Census. Nationally, in 1990, 24.2% of all persons were minorities and 13.1% of all households had incomes less than the poverty level.

No agreed-upon standard yet exists within the emerging federal guidance on environmental justice for what constitutes an area that has a minority or low-income population large enough to act as a test for disproportionate impact. For example, it has not been decided in the case of minority residents whether the standard ought to be 50% minority residents, more than the national average of minority residents (24.2%), more than the state average, or some other number that takes into account other regional population characteristics. This decision is even more problematic for defining low-income residents, since less income is needed to maintain a given living standard in areas with a relatively low cost of living. Several different definitions have been proposed, but each potential definition has strengths and weaknesses. ierefore, figures in this section employ a graduated shading scheme that indicates those areas of small and roughly equal numbers of housing units that have heavy concentrations of minority and low-income residents, as well as those areas that have lighter concentrations of such residents. Shaded areas generally indicate those census block groups that have higher than the national average percentages of minority and low-income populations, with darker shading showing heavier concentrations.

5.21.1 Annular Core Research Reactor: Sandia National Laboratories/New Mexico and the Chemistry and Metallurgy Research Facility: Los Alamos National Laboratory Alternative

Figures 5-2 and 5-3 and Table 5-48 show the geographic distribution of minority and low-income population within census block groups (areas defined for monitoring census data of approximately 250 to 550 housing units) that are within 80 km (50 mi) of the Annular Core Research Reactor. The two figures also show the location as the Annular Core Research Reactor. Although target production occurs at LANL under the preferred alternative, no environmental consequences are expected from target production. Thus, the remainder of this section focuses on SNL/NM.

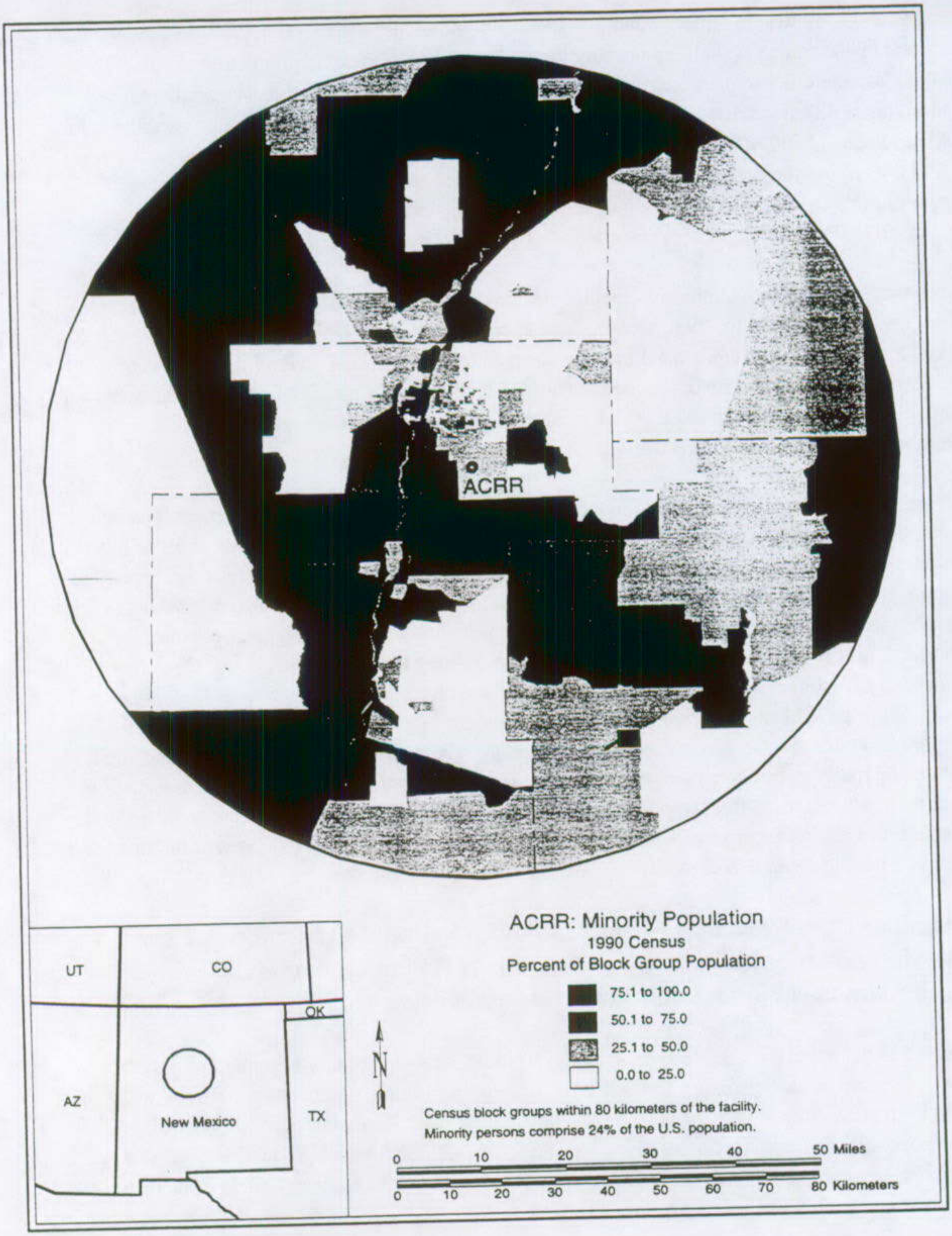

Figure 5-2. Minority Population - Annular Core Research Reactor

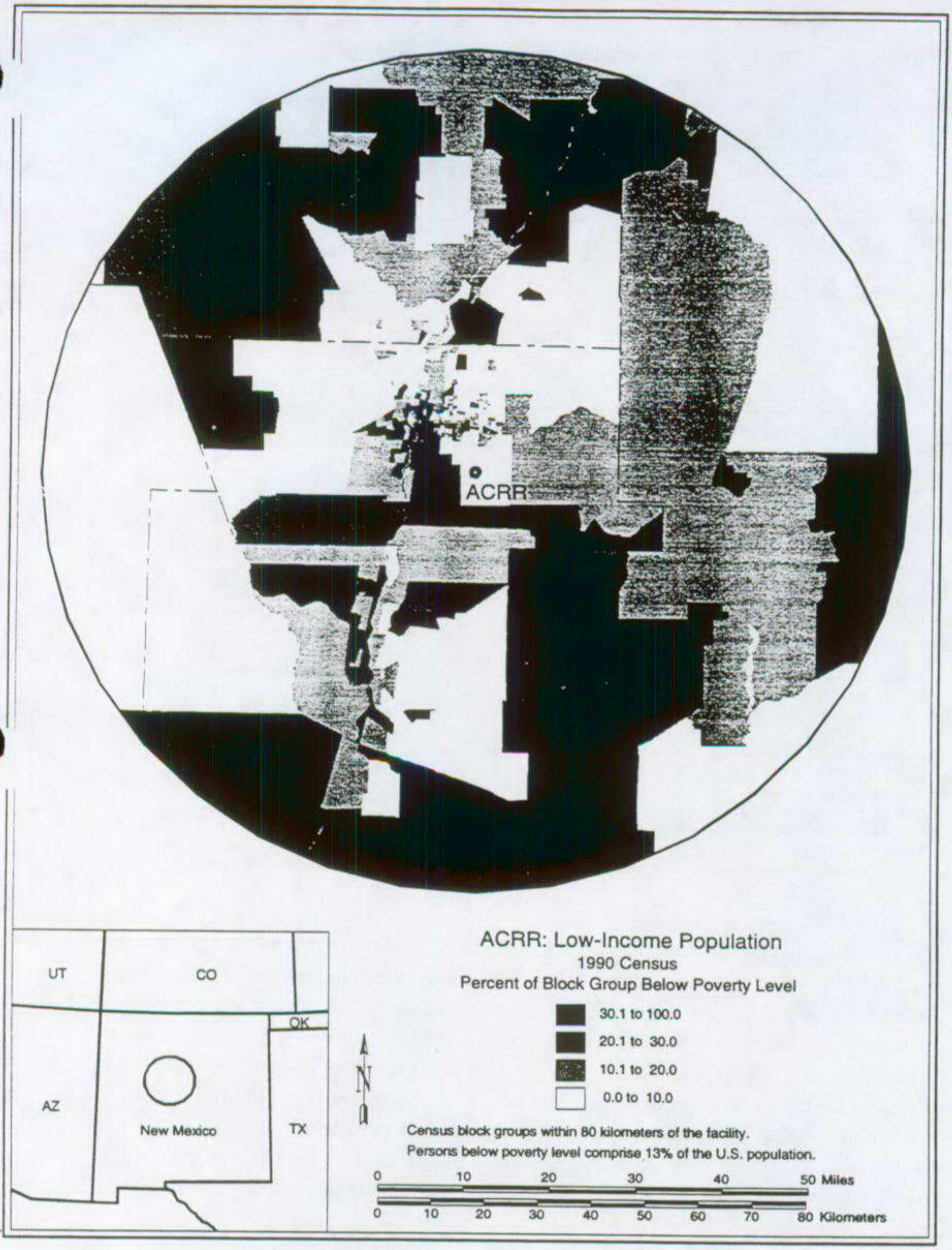

Figure 5-3. Low-Income Population - Annular Core Research Reactor

Table 5-48. Location of Minority and Low-Income Populations Surrounding the Annular Core Research Reactor by Distance and Direction (1990 Census Data)

	Total Minority Population			Low-Income Persons		
	0-16 km (0-10 mi)	16-48 km (10-30 mi)	48-80 km (30-50 mi)	0-16 km (0-10 mi)	16-48 km (10-30 mi)	48-80 km (30-50 mi)
N	70,445	39,274	362	7,657	3,346	1,130
NNE	37,051	6,182	3,303	3,717	328	1,606
NE	3,211	4,656	3,689	245	324	524
ENE	745	4,915	557	98	525	81
E	735	5,053	740	104	844	165
ESE	723	1,778	1,280	105	449	279
SE	534	490	742	71	153	177
SSE	359	384	1,049	57	121	439
S	308	1,105	590	53	336	230
SSW	310	16,295	2,691	59	4,551	637
SW	222	15,643	74	86	3,249	43
WSW	1,865	703	16	494	328	0
W	6,199	3,843	21	1,746	1,069	62
WNW	13,676	16,435	16	6,238	5,752	327
NW	34,730	40,611	21	13,335	7,330	8
NNW	59,944	62,741	143	12,442	6,524	728
Total, 0-80 km (0-50 mi)			466,316			87,444

Figure 5-2 and Table 5-48 together indicate the largest numbers of minority populations are located to the northwest to northeast, and highest concentrations of minority populations generally are located west, southwest, west southwest, and south of the Annular Core Research Reactor, with several pockets at a greater distance, beyond 48 km (30 mi) from the Annular Core Research Reactor. The more concentrated minority populations to the south and west are residents of the Isleta, Laguna, and Acoma Pueblos, and of Canoncito (a land grant). Lighter scatterings of minority populations are located to the north (including the Sandia Pueblo, north of Albuquerque) and east, and still other pockets of minorities at greater distances. Figure 5-3 shows that low-income residents are similarly distributed, with high concentrations of poverty-level households to the southwest and west southwest of the Annular Core Research Reactor.

Although some minority and low-income populations live relatively close to the Annular Core Research Reactor, Sections 5.7 and 5.8 indicate it is very unlikely that routine operations would affect them with radiological and non-radiological health impacts and other risks. These risks would be insignificant for any offsite population for any alternative discussed in this section. Therefore, it is unlikely that any minority or low-income population would be disproportionately affected by routine operations of either of the process variations at the Annular Core Research Reactor.

While very unlikely, some worst-case accident scenarios, the effects of which are described in Section 5.15, could result in significant air releases of radionuclides that, in turn, could slightly affect some offsite populations (up to 1 fatal cancer within 80 km [50 mi] of the facility). Whether the effect on minority and low-income residents would be disproportionate would depend very much on atmospheric conditions (especially wind directions) at the time of such a release. Prevailing winds are from the north, while most of the concentrations of minority- and low-income areas are located to the south and west of the KAFB. However, the wind blows from the south, southeast, or east southeast about one-third of the time (Appendix D). Winds from the north, northwest, or west northwest would carry any airborne release to the south, southeast, or east southeast. A small, but still potentially disproportionate, number of minority and low-income persons could be affected in the event of rarer northeasterly and easterly winds, depending on the exact wind direction and speed. (However, the closest community to the Annular Core Research Reactor is Four Hills, a middle- to upper-income nonminority community, with the next closest community being mixed low-to-middle income housing at KAFB.) The maximum reasonably foreseen impact scenario for an accident discussed in Section 5.15 is one in which the wind is from the south and carries an airborne release over Albuquerque to the immediate north of the Annular Core Research Reactor. In that case, the higher-income majority population is more likely to be disproportionately affected.

No reasonably foreseen water-related radiological accident identified in Section 5.15 has any significant consequences for any downstream population or source of groundwater, so it is unlikely that minority or low-income populations would be adversely and disproportionately affected through this pathway.

Radiological accidents that exceed 0.5 rem to the MEI could have some secondary impacts due to environmental contamination and mitigative actions under protective action guidelines (Section 5.15). These secondary impacts could include loss of access to crops and possible loss of some agricultural crops and loss of income by minority and low-income farm workers. It is not clear whether such impacts would be disproportionate.

Non-radiological accidental releases would not cause impacts at the nearest point of public access (Section 5.15). No reason exists for minorities and low-income persons to be disproportionately affected.

5.21.2 Omega West Reactor/Chemistry and Metallurgy Research Facility: Los Alamos National Laboratory Alternative

Figures 5-4 and 5-5 and Table 5-49 show the geographic distribution of minority and low-income population within census block groups (areas defined for monitoring census data of approximately 250 to 550 housing units) that are within 80 km (50 mi) of the Omega West Reactor. The two figures also show the location of the Omega West Reactor.

Figure 5-4 and Table 5-49 together indicate the largest numbers and heaviest concentrations of minority populations generally are located to the immediate west northwest to east northeast and west southwest to east southeast of the Omega West Reactor facility at distances between 0 and 48 km (0 and 30 mi). Several close-in Pueblos occupied by Native Americans are located southwest, west southwest, and south of the Omega West Reactor facility, with several pockets of minorities at a greater distance) beyond 48 km (30 mi) from the Omega West Reactor facility. Lighter scatterings of minority populations are located to the north and east. Figure 5-5 shows that low-income residents are similarly distributed, with the largest numbers and highest concentrations to the west, north, and east of the facility.

Although some minority and low-income populations live relatively close to the Omega West Reactor facility, Sections 5.7 and 5.8 indicate it is very unlikely that routine operations would affect them with radiological and non-radiological health impacts and other risks. These risks would be insignificant for any offsite population for any alternative discussed in this section. Therefore, it is unlikely that any minority or low-income population would be disproportionately affected by routine operations at the Omega West Reactor facility.

At Omega West Reactor facility, a fuel melt-related release could result in significant air or water releases of radionuclides that, in turn, could slightly affect any offsite populations (less than one fatal cancers within 80 km [50 mi] of Omega West Reactor) (Section 5.15). Whether the effect on minority and low-income residents would be disproportionate would depend very much on atmospheric conditions (especially wind directions) at the time of such a release. The maximum reasonably foreseen accident has the emission plume drifting to the northwest. The prevailing wind at Omega West Reactor is from the west (Appendix D). The wind blows from the west over half of the time. Only rarely does it blow from the northeast (where the pueblos would be affected in the event of a release) or from the south or southeast (affecting minority groups to the north and northwest). Most of the concentrations of minority and low-income areas are located to the north and east. Therefore, disproportionate impacts on minorities and low-income persons are likeliest when the wind is from the south, southeast or southwest. However, this direction from the Omega West Reactor includes the city of Los Alamos, which contains an overwhelmingly high-income majority population. Thus, it is unlikely that minority or low-income populations would be disproportionately affected.

No reasonably foreseen water-related radiological accident in Section 5.15 has any significant consequences for any downstream population, including recreationists near the Omega West Reactor and

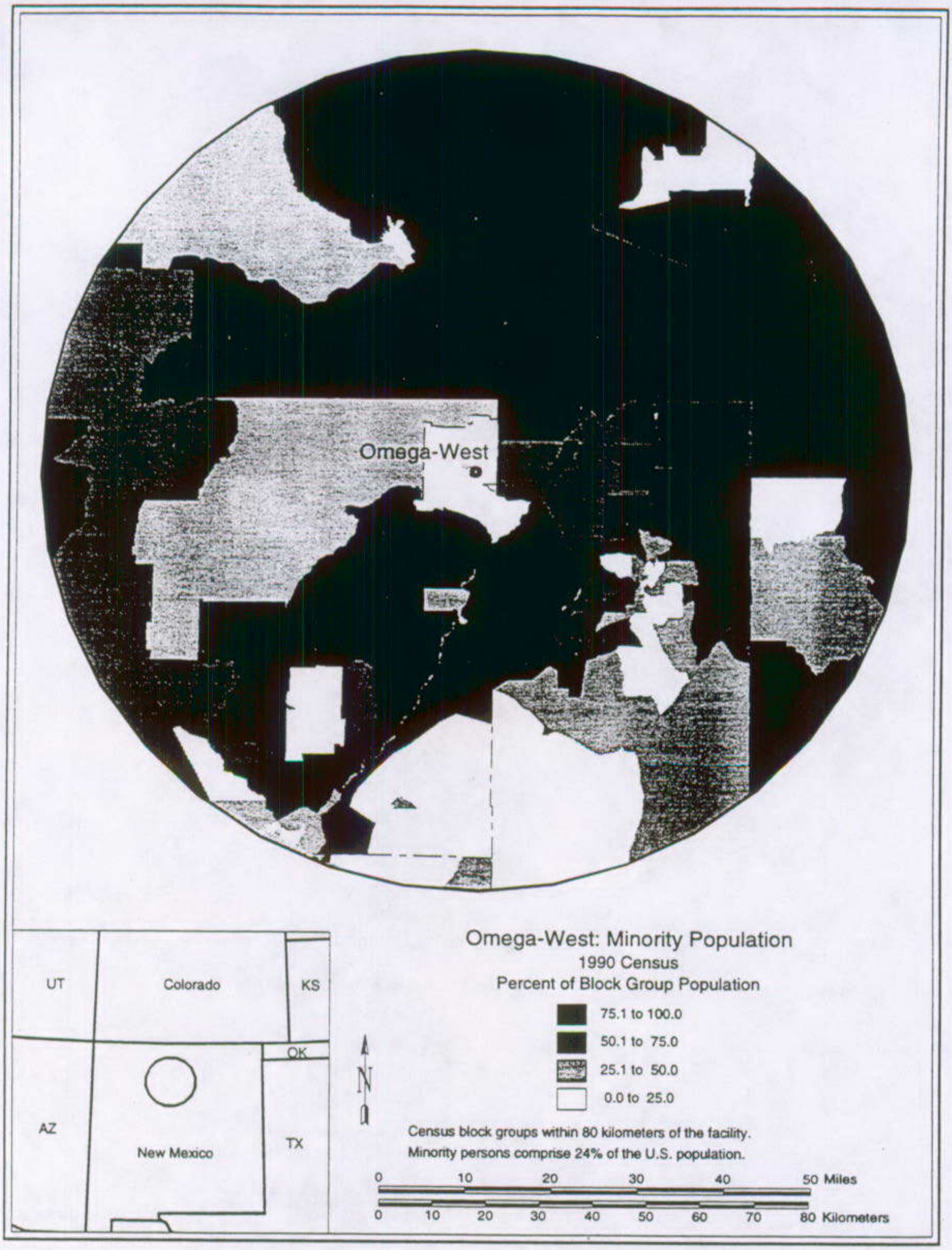

Figure 5-4. Minority Population - Omega West Reactor

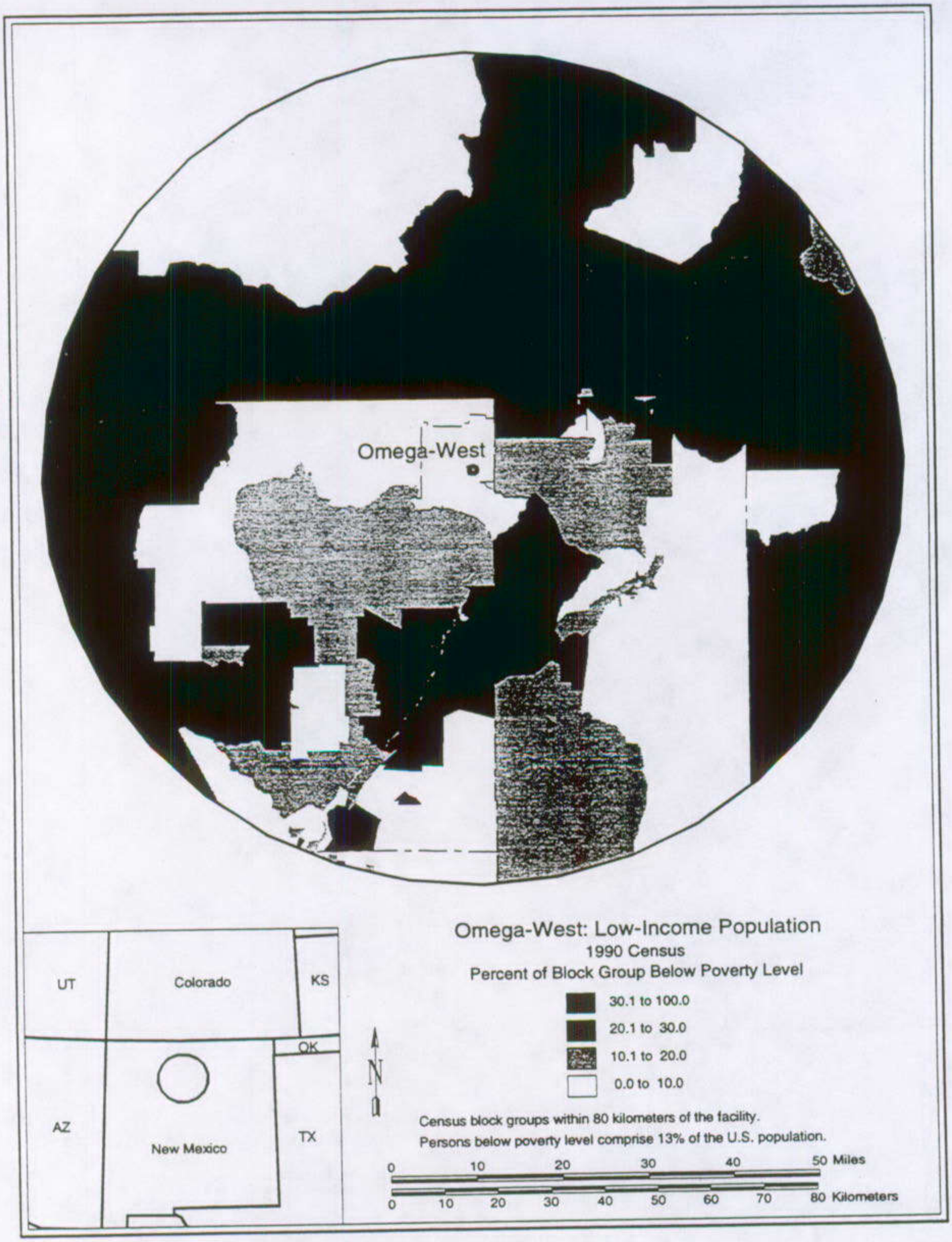

Figure 5-5. Low-Income Population - Omega West Reactor

Table 5-49. Location of Minority and Low-Income Populations by Distance and Direction from Omega West Reactor (1990 Census Data)

	Total Minority Population			Low Income Persons		
	0-16 km (0-10 mi)	**16-48 km (10-30 mi)**	**48-80 km (30-50 mi)**	**0-16 km (0-10 mi)**	**16-48 km (10-30 mi)**	**48-80 km (30-50 mi)**
N	939	746	539	47	343	225
NNE	883	1,335	553	90	484	226
NE	703	10,085	4,171	123	3,552	1,817
ENE	975	11,145	2,144	61	2,997	1,011
E	954	2,501	825	74	460	399
ESE	1,165	9,987	2,192	100	978	620
SE	4,324	47,943	3,798	85	7,458	384
SSE	419	3,809	1,591	10	862	231
S	147	537	4,152	5	761	385
SSW	161	366	37,312	3	871	4,188
SW	290	68	204	4	265	473
WSW	433	792	75	11	130	226
W	466	321	63	14	48	335
WNW	1,668	82	1,259	54	62	637
NW	3,209	100	309	77	110	53
NNW	1,091	189	246	41	139	27
Total, 0-80 km (0-50 mi.)			167,018			31,528

sources of ground water, so it is unlikely that minority or low-income populations would be disproportionately affected through this pathway.

Radiological accidents that exceed 0.5 rem to the MEI could have some secondary impacts due to environmental contamination and mitigative actions under protective action guidelines (Section 5.15). These secondary impacts could include loss of access to the pueblos for Native American populations, as well as possible loss of some agricultural crops and loss of income by minority and low-income farm workers. It is unclear whether such impacts would be disproportionate.

Non-radiological accidental releases would not impact the nearest point of public access (Section 5.15). No reason exists for minorities and low-income persons to be disproportionately affected.

5.21.3 Oak Ridge Research Reactor/Radioisotope Development Laboratory: Oak Ridge National Laboratory Alternative

Figures 5-6 and 5-7 and Table 5-50 show the geographic distribution of minority and low-income population within census block groups (areas defined for monitoring census data of approximately 250 to 550 housing units) that are within 80 km (50 mi) of the Oak Ridge Research Reactor. The two figures also show the location of the Oak Ridge Research Reactor.

Figure 5-6 and Table 5-50 together indicate the largest numbers and highest concentrations of minority populations generally are located immediately to the northeast of the facility in the city of Oak Ridge with one further small pocket at a greater distance in Knoxville and beyond 48 km (30 mi) from the Oak Ridge Research Reactor. Figure 5-7 shows that low-income populations are much more prevalent, with one pocket in the city of Oak Ridge, and significant low-income areas generally lying to the northwest at 16 to 48 km (10 to 30 mi) distance. Lighter scatterings of minority populations are located to the east and southeast.

Although some minority and low-income populations live in relatively close proximity to the Oak Ridge Research Reactor, Sections 5.7 and 5.8 indicate it is very unlikely that routine operations would affect them with radiological and non-radiological health impacts and other risks. These risks would be insignificant for any offsite population for any alternative discussed in this section. Therefore, it is unlikely that any minority or low-income population would be disproportionately affected by routine operations of the Oak Ridge Research Reactor

A fuel melt accident scenario, the effects of which are described in Section 5.15, could result in significant air releases of radionuclides that, in turn, could affect some offsite populations (up to 6 fatal cancers within 80 km [50 mi] of the Oak Ridge Research Reactor). Whether the effect on minority and low-income residents would be disproportionate would depend on atmospheric conditions (especially wind directions) at the time of such a release. The only close concentrations of minorities areas are located to the north and east. Therefore, significant impacts on minorities and low-income persons are most likely when the wind is from the southwest, a reasonably common occurrence at Oak Ridge (Appendix D). Indeed, the maximum reasonably foreseen accident shows the emissions plume drifting to the east. However, this direction from the Oak Ridge Research Reactor includes the area of West Knoxville, which also contains several high-income and majority populations. Thus, it is uncertain whether minority or low-income populations would be disproportionately affected.

No reasonably foreseen water-related radiological accident has been identified for the Oak Ridge Research Reactor (Section 5.15), so it is unlikely that minority or low-income populations would be adversely and disproportionately affected through this pathway.

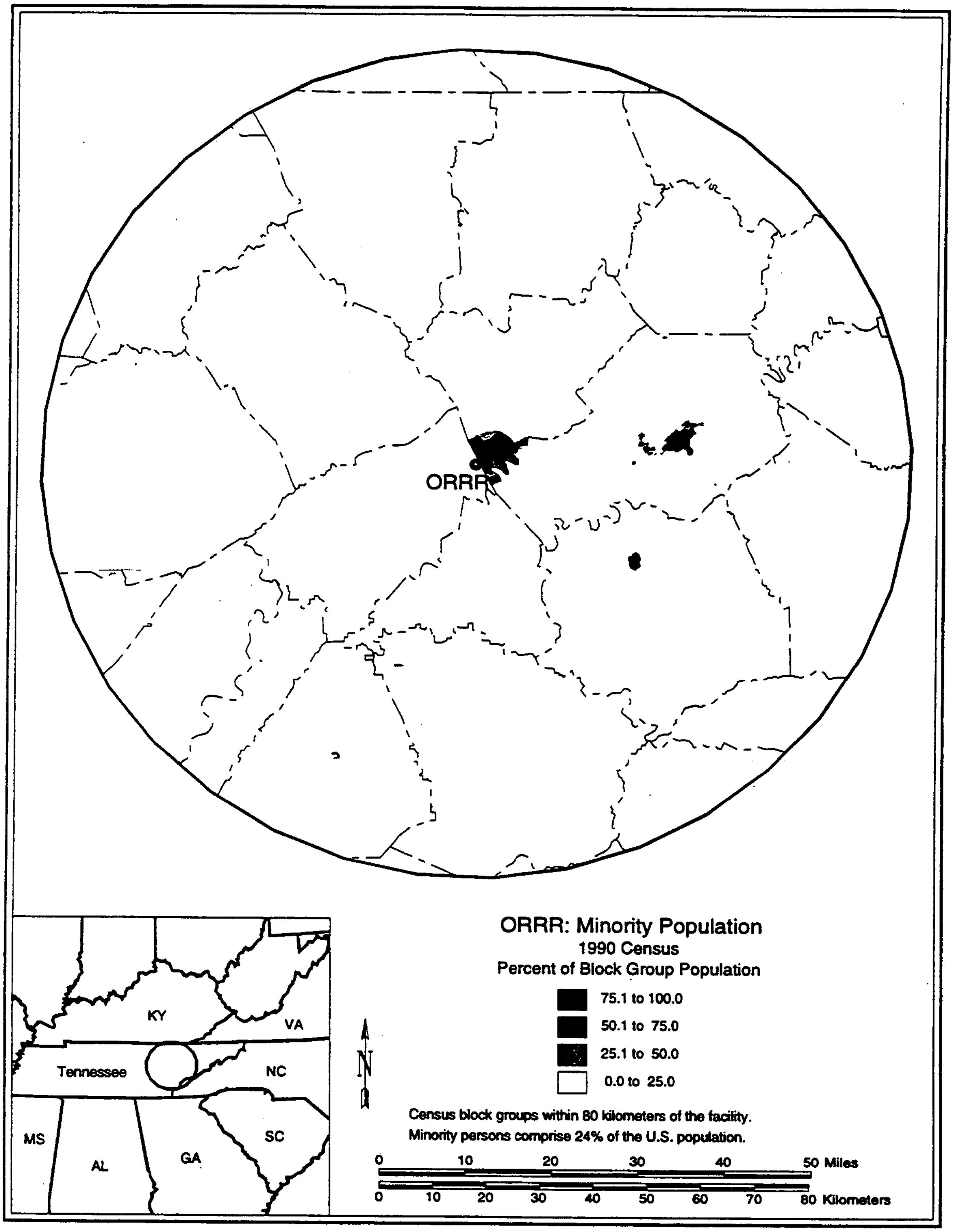

Figure 5-6. Minority Population - Oak Ridge Research Reactor

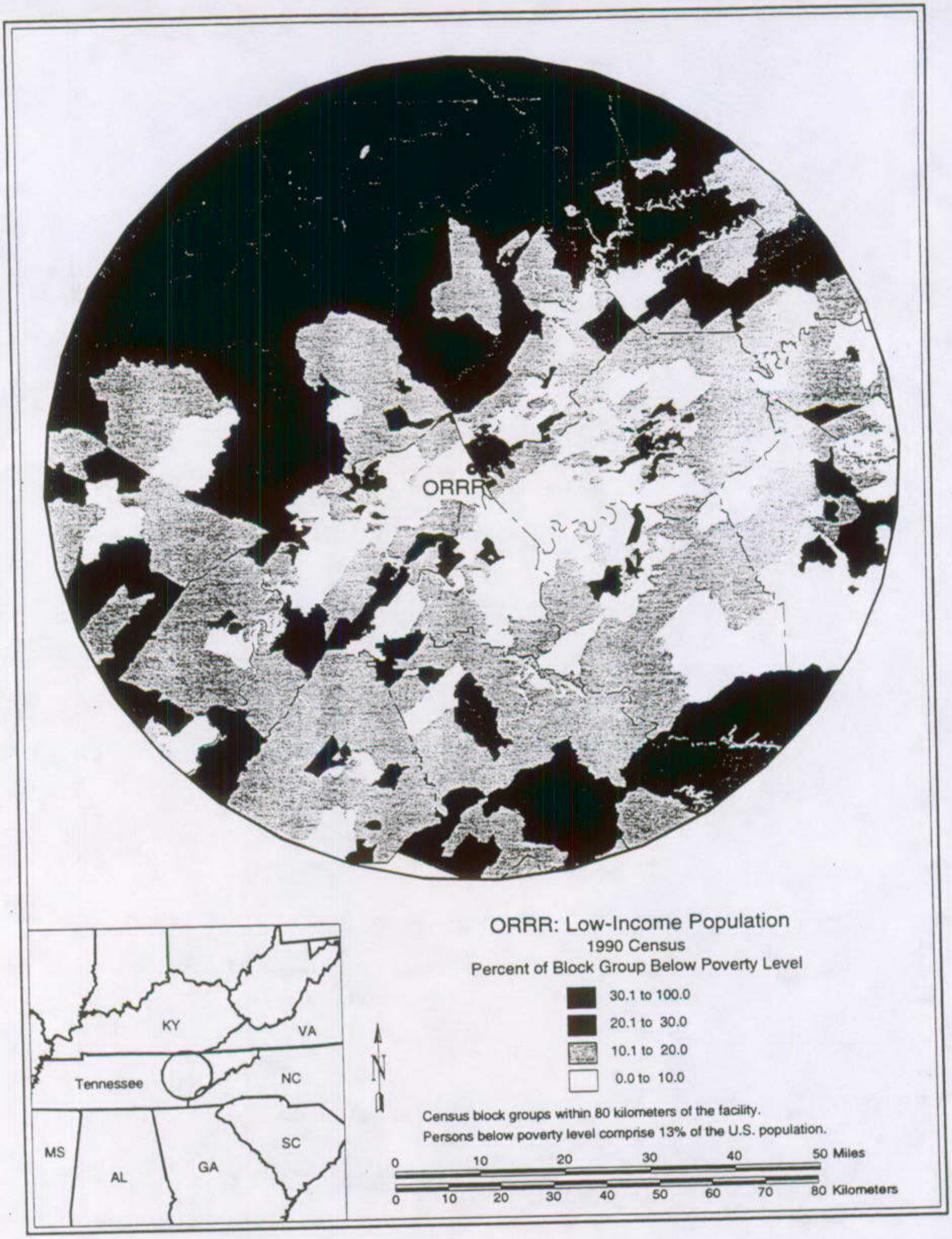

Figure 5-7. Low-Income Population - Oak Ridge Research Reactor

Table 5-50. Location of Minority and Low-Income Populations Surrounding the Oak Ridge Research Reactor by Distance and Direction (1990 Census Data)

	Total Minority			**Low-Income Persons**		
	0-16 km (0-10 mi)	**16-48 km (10-30 mi)**	**48-80 km (30-50 mi)**	**0-16 km (0-10 mi)**	**16-48 km (10-30 mi)**	**48-80 km (30-50 mi)**
N	5,714	2,762	7,932	714	652	3,096
NNE	11,944	20,390	23,125	1,787	3,993	7,117
NE	7,700	26,877	12,524	605	3,987	2,946
ENE	3,892	87,529	32,984	504	9,669	5,225
E	3,140	153,333	41,396	337	31,958	5,562
ESE	8,368	61,800	20,347	548	5,338	2,563
SE	8,352	38,279	2,391	255	4,805	486
SSE	4,407	10,582	3,085	302	1,357	707
S	2,967	19,356	13,227	445	3,142	2,477
SSW	1,152	13,519	35,396	142	2,151	6,504
SW	1,276	6,251	15,675	119	936	2,569
WSW	1,832	20,094	9,880	134	3,393	1,792
W	1,549	12,493	25,170	106	2,758	4,473
WNW	1,667	5,896	7,597	223	1,032	1,967
NW	1,984	6,444	10,405	305	1,093	3,527
NNW	3,921	2,141	14,494	582	551	4,035
Total, 0-80 km (0-50 mi)			818,745			134,933

Radiological accidents that exceed 0.5 rem to the MEI could have some secondary impacts due to environmental contamination and mitigative actions under protective action guidelines (Section 5.15). These secondary impacts could include possible loss of some agricultural crops and loss of income by minority and low-income farm workers. It is unclear whether such impacts would be disproportionate.

Non-radiological accidental releases would not cause impacts at the nearest point of public access (Section 5.15). No reason exists for minorities and low-income persons to be disproportionately affected.

5.21.4 Power Burst Facility/Test Area North: Idaho National Engineering Laboratory Alternative

Figures 5-8 and 5-9 and Table 5-51 show the geographic distribution of minority and low-income population within census block groups (areas defined for monitoring census data of approximately 250 to 550 housing units) that are within 80 km (50 mi) of the Power Burst Facility. The two figures also show the location of the Power Burst Facility.

Figure 5-8 and Table 5-51 together indicate that the only significant concentrations of minority populations are generally located to the far southeast of the Power Burst Facility, at a distance beyond 48 km (30 mi) from the Power Burst Facility. Figure 5-9 shows that small numbers of low-income residents are more universally distributed in the region, with pockets containing a few low-income households in the census block group containing the Power Burst Facility and in the block group immediately to the south. The nearest population is near Howe, Idaho, about 30 km (19 mi) northwest of the Power Burst Facility, and at Atomic City, 11 km (7 mi) south southeast.

Although some low-income populations live relatively close to the northwest and southeast of the Power Burst Facility, Sections 5.7 and 5.8 indicate it is very unlikely that routine operations would affect them with radiological and non-radiological health impacts and other risks. These risks would be insignificant for any offsite population for any alternative discussed in this section. Therefore, it is unlikely that any minority or low-income population would be disproportionately affected by routine operations at Power Burst Facility.

Although unlikely, a fuel rupture accident scenario whose effects are described in Section 5.15 could result in significant air releases of radionuclides that, in turn, could affect offsite populations (up to 4 fatal cancers within 80 km [50 mi]). The windflow across the site is from the southwest. Because the minority and low-income pockets are mostly to the south and because of their distance from the facility, neither minority populations nor most low-income persons are likely to be affected. Some possibility of harm to low-income and minority populations is present when the wind is from the north or northwest, which rarely occurs (Appendix D). The maximum reasonably foreseen accident shows the emissions plume drifting straight east toward Idaho Falls, which is a high-income majority community.

No reasonably foreseen water-related radiological accident has been identified for the Power Burst Facility (Section 5.15), so it is unlikely that minority or low-income populations would be adversely and disproportionately affected through this pathway.

Radiological accidents that exceed 0.5 rem to the MEI could have some secondary effects due to environmental contamination and mitigative actions under protective action guidelines (Section 5.15). These secondary impacts could include possible loss of some agricultural crops and loss of income by minority and low-income farm workers. It is unclear whether these losses would be disproportionate.

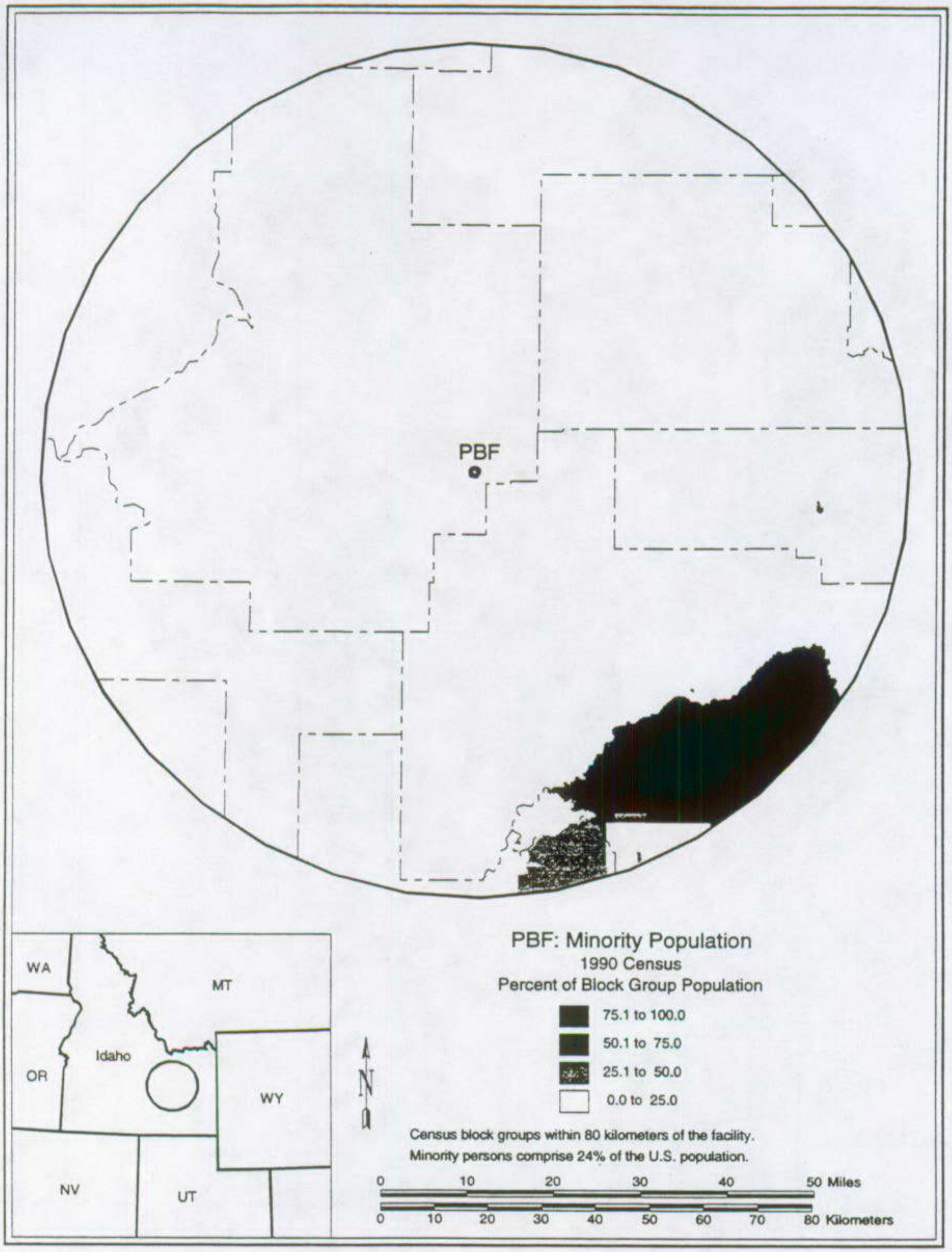

Figure 5-8. Minority Population - Power Burst Facility

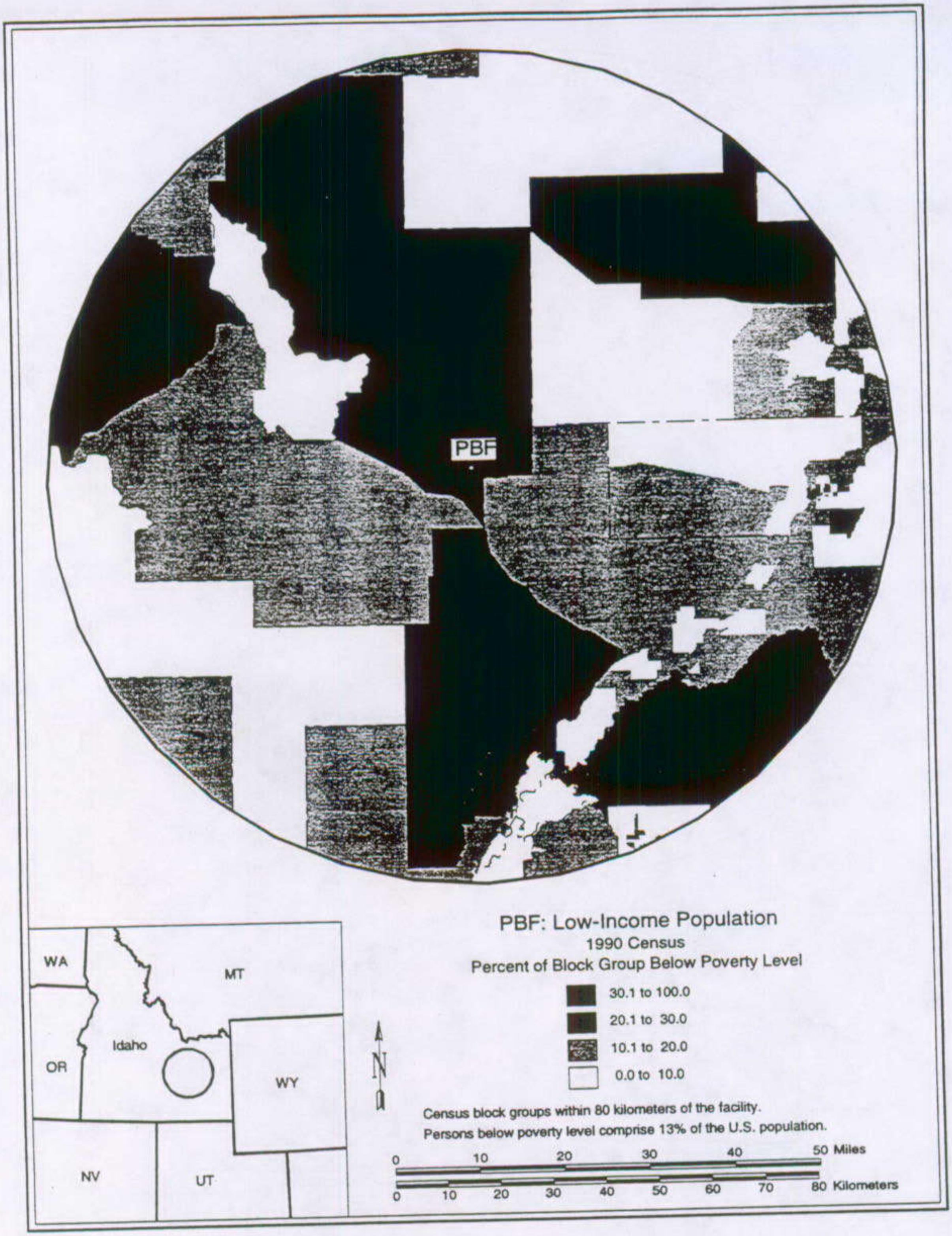

Figure 5-9. Low-Income Population - Power Burst Facility

Table 5-51. Location of Minority and Low-Income Populations Surrounding Power Burst Facility by Distance and Direction (1990 Census Data)

	Total Minority Population			Low-Income Persons		
	0-16 km (0-10 mi)	16-48 km (10-30 mi)	48-80 km (30-50 mi)	0-16 km (0-10 mi)	16-48 km (10-30 mi)	48-80 km (30-50 mi)
N	5	46	170	2	13	15
NNE	5	215	431	2	37	87
NE	7	316	752	2	40	180
ENE	19	332	7,214	3	37	1,011
E	23	739	68,380	3	92	7,246
ESE	36	607	11,469	5	82	1,330
SE	39	787	16,121	5	64	2,504
SSE	36	430	24,358	5	103	3,212
S	22	293	2,624	7	109	605
SSW	22	183	373	6	50	70
SW	15	134	293	3	21	30
WSW	13	144	233	2	24	27
W	8	180	607	2	27	68
WNW	5	586	448	2	61	78
NW	5	227	1,120	2	29	212
NNW	5	44	90	2	13	26
Total, 0-80 km (0-50 mi)			140,121			17,528

Non-radiological accidental releases would not cause impacts at the nearest point of public access (Section 5.15). No reason would exist for minorities and low-income persons to be disproportionately affected.

5.22 Costs

An important consideration when comparing alternative ways to achieve a given result is the cost of each alternative. All estimated costs included in the EIS for the proposed project were derived from cost data provided by the alternative sites. In the case of SNL/NM, they come from the Mo-99 SNL/NM Integrated Project Schedule, Pre-Baseline FY96 Schedule. For LANL, they are from the Project Planning

Study-Los Alamos National Laboratory Mo-99 Project. For ORNL, they are from the schedule for Mo-99 production utilizing the Oak Ridge Research Reactor, and from INEL, they are from the labor requirements for the Mo-99 Power Burst Facility reactor startup estimates.

All cost analyses were performed based on the operational capabilities required by each of the alternative sites to produce 100% of the U.S. demand for Mo-99. Cost estimates for each alternative include estimated expenditures to 1) prepare the reactor facility for startup, 2) operate the reactor to irradiate targets, 3) prepare the hot cell facility for processing irradiated targets, 4) process the targets to obtain the desired product, 5) prepare the target fabrication facility for production, and 6) fabricate targets. Preparation costs include estimated expenditures associated with site specific process verification and document preparation. Operating costs include estimated expenditures associated with radioactive waste management processes.

All estimated costs were based on facility preparation and operation costs specific to the production of Mo-99 which would be incurred at each alternative site following a Record of Decision selecting that site. Costs incurred at SNL/NM and LANL in FY 1995 and FY 1996 for facility cleanup of legacy materials, development of the Cintichem target fabrication and Mo-99 processing capabilities, and reactor and hot cell facility operation and management, through April 1996, were excluded from costs reported in this EIS. Some of these costs were incurred to develop information that would be required for and used by any site selected. Other costs were incurred for activities which would have been performed whether or not SNL/NM and LANL were selected for the proposed medical isotopes project. These adjustments resulted in a large reduction in estimated preparation costs for SNL/NM, compared with earlier estimates that included all FY 1995 and FY 1996 estimated expenditures and standby operating costs for these facilities.

The cost of providing fuel can be significant for a reactor that is operating at full power approximately 6/7 of the time. Some of the candidate reactors in this analysis have varying amounts of residual fuel remaining from prior operations, thus reducing their startup costs and their operational costs in the early years. Other reactors would require additional new fuel before startup. The costs for the initial new fuel are contained in the preparation costs, with the on-going costs for replacement fuel contained in the annual operating costs.

Some differences among the sites' estimates can be attributed to the differences in the level of detail included in their cost estimates. For example, the target preparation costs at INEL and ORNL were rather small, about $500 thousand, while an analysis of the LANL detailed project plan suggests a cost more like $2 million. Among the estimated hot cell preparations costs provided, some differences also appeared.

In the case of the Power Burst Facility, an additional $450 thousand have been added to reactor modification costs, beyond what was reported in the Draft EIS, to account for removal of the central irradiation channel, manufacturing and installation of the central target grid plate, removal of transient rods, manufacture and installation of target holders in vacant transient rod locations, modifications of the central channel cooling flow path, and modification of the control system to eliminate transient operation. In addition, preparation of an updated Safety Analysis Report for the Power Burst Facility was the major component of the $1.6 million document preparation cost estimate for INEL. Independent sources within DOE believe the cost to prepare and update the SAR would more likely be about $3.0 million. Changes in costs figures, from those presented in the draft EIS for SNL and LANL, reflect updates in costs and allocations.

Nearly all of the facilities considered in these analyses have a considerable history of support to earlier DOE or U.S. Department of Defense (DOD) programs, thus the decommissioning costs should be supported in proper proportion by those earlier programs. In any event, estimates of decommissioning costs were not generally available for all candidate facilities. For this reason, decommissioning costs are not included in the comparison of candidate sites.

The costs and numbers of full-time equivalent employees (FTEs) for the various aspects of the project, as derived from information provided by staff at the individual sites, are presented for comparison in Table 5-52. As shown in the table, the estimated preparation costs range from $17.2 million to $21.0 million, and the estimated annual operating costs range from $8.4 million to $12.8 million. The estimated SNL/NM facilities operating costs are the highest, with their estimated preparation costs second lowest. LANL preparation costs are also second (equivalent to those at SNL), but estimated operating costs are just below SNL operating costs. The estimated ORNL facilities preparation costs are the highest, with their estimated operating costs next to lowest. The estimated INEL facilities preparation costs are the lowest, with their estimated operating costs also the lowest.

Overall, estimated expenditures for preparation and operation costs carry some level of uncertainty due to unknown future changes in regulation and in the rate of inflation. The level of uncertainty is somewhat greater in the case of estimated expenditures for ORNL and INEL, due to cost projections made at a more macro level than for the other two sites. It is also expected that those estimated costs would tend to increase if a more detailed estimating effort was performed. The SNL/NM and LANL estimates, however, are based on detailed analyses of the many activities that would be necessary, and those estimates should have smaller uncertainties.

Table 5-52. Comparison of Estimated Project Costs at Candidate Sites

	SNL/NM	LANL	ORNL	INEL
Reactor				
Prep (10^6\$)	4.4	10.3	16.4	10.3
FTEs (no.)	21.0	46.0	85.0	69.0
Opn (10^6\$/y)	6.1	6.5	5.6	5.0
FTEs (no./y)	26.0	22.0	37.0	34.0
Hot Cell				
Prep (10^6\$)	12.9	6.2	2.4	4.8
FTEs (no.)	60.0	33.0	16.0	16.0
Opn (10^6\$/y)	5.1	2.7	3.0	2.7
FTEs (no./y)	28.0	14.0	20.0	20.0
Target				
Prep (10^6\$)	1.1 LANL	1.1	0.53	0.5
FTEs (no.)	5.0	5.0	4.0	4.0
Opn (10^6\$/y)	1.6 LANL	1.6	1.0	0.7
FTEs (no./y)	8.0 LANL	8.0	5.0	5.0
Documents				
Prep (10^6\$)	1.2	2.0	1.7	1.6
FTEs (no.)	6.0	8.0	8.0	8.0
Opn (10^6\$/y)	(a)	0.2	0.06	(a)
Total Prep (10^6\$)	19.6	19.6	21.0	17.2
Yearly Opern. (10^6\$/y)	12.8	11.0	9.6	8.4

(a) Included in reactor and hot cell operations cost estimates.

6.0 Regulatory Framework

The Council on Environmental Quality's National Environmental Policy Act regulations (40 CFR 1502.25[b]) require that final environmental impact statements (FEIS) list all federal permits, licenses, and other entitlements that must be obtained to implement an alternative under consideration in the FEIS. These permit and license requirements, as well as the regulatory framework affecting the various alternatives are discussed in this section.

The principal federal permit, license, or entitlement needed to implement an alternative under consideration in this FEIS is approval from the appropriate regional EPA office under the requirements at 40 CFR 61.07 and 61.08 relating to the EPA national emission standards for hazardous air pollutants. EPA approval would be needed for all but the no action alternative, because offsite projected exposure to the maximally exposed individual would exceed 1% of the EPA 0.1 mSv/yr standard for emissions of radionuclides from DOE facilities (see 40 CFR 61.96(b) and Chapter 6.16). For the SNL, Oak Ridge, and INEL alternatives, approval from EPA would be needed because projected emissions from the target processing facilities at each of these sites will exceed 1% of the 0.1 mSv/yr standard (see Tables 5-3, 5-6, and 5-8). For the alternative involving restart of the OWR reactor at LANL, EPA approval would be needed because projected emissions from the reactor will exceed 1% of the 0.1 mSv/yr standard (see Table 5-5).

Two other conditional approvals may be needed. If DOE were to choose to have a private vendor supply targets for use in a DOE reactor (See Section 3.1.2), the private vendor would need to obtain a license from the NRC or an Agreement State (See Section 6.19). In addition, each pharmaceutical manufacturer of Tc-99 generators desiring to purchase molybdenum-99 (Mo-99) from DOE may need to seek FDA approval to add DOE as a Mo-99 manufacturer; a pharmaceutical manufacturer or supplier purchasing iodine-125, iodine-131, or xenon-133 from DOE may need to obtain FDA approval to market these products (see Section 6.2).

6.1 Radiological Safety Oversight

DOE facilities for target fabrication, target irradiation, the recovery of Mo-99 and other isotopes, and for waste storage and disposal are not subject to the licensing and regulatory requirements of the U.S. Nuclear Regulatory Commission (NRC). This exemption derives from the exclusion in Section 110(a) of the Atomic Energy Act and that Section 11 of the Act excludes DOE from the definition of *person*. Contractors who operate U.S. government facilities for DOE are also exempt from NRC licensing (10 CFR 30.12, 50.11).

In lieu of NRC licensing and safety oversight, all DOE nuclear facilities are constructed and operated in compliance with applicable mandatory DOE directives.[a] DOE directives are issued under the authority of Section 161(i)(3) of the Atomic Energy Act, which authorizes DOE to manage activities authorized by the Act.

Many DOE directives affecting radiological safety apply to operation of the facilities associated with the alternatives under consideration in this EIS. Among the more significant directives are the following:

- DOE Order 420.1, "Facility Safety"
- DOE Order 425.1, "Startup and Restart of Nuclear Reactors"
- DOE Order 460.2, "Departmental Materials Transportation and Packaging Management"
- DOE Order 5400.5, "Radiation Protection of the Public and the Environment"
- DOE Order 5480.4, "Environmental Protection, Safety, and Health Protection Standards"
- DOE Order 5480.20A, "Personnel Selection, Qualification, Training, and Staffing Requirements at DOE Reactor and Non-Reactor Nuclear Facilities"
- DOE Order 5480.22, "Technical Safety Requirements"
- DOE Order 5480.23, "Nuclear Safety Analysis Reports"
- DOE Order 5480.28, "Natural Phenomena Hazards Mitigation"
- DOE Order 5480.30, "Nuclear Reactor Safety Design Criteria"
- DOE-STD-0100T, "Licensed Reactor Nuclear Safety Criteria Applicable to DOE Reactors."

On December 9, 1991, DOE published a notice of proposed rulemaking (56 FR 64316) to add a new part (10 CFR Part 830) to its regulations establishing a body of rules for DOE contractor and subcontractor activities to ensure safe operation of DOE's nuclear facilities. The proposed rule contained nine specific sections covering 1) safety analysis reports, 2) unreviewed safety questions, 3) quality assurance requirements, 4) defect identification, 5) conduct of operations, 6) technical safety requirements, 7) training, 8) maintenance, and 9) operational occurrences, as well as general provisions for the application of these rules. A final rule on the quality assurance requirements and the general provisions for their application was published in the *Federal Register* on April 5, 1994 (59 FR 15843). The rulemaking remains open with respect to all areas other than the quality assurance requirements (60 FR 45382; August 31, 1995). As the regulations become final, the nuclear safety management requirements in 10 CFR 830 will be generally applicable to the activities being considered in this EIS.

DOE has issued a proposed rule to add a new part (10 CFR Part 834) covering radiation protection of the public and the environment (58 FR 16268; March 25, 1993). Notices reopening the comment period

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(a) Mandatory DOE directives are issued in the following categories: policy statements, regulations, orders, notices, and manuals. Many final and proposed DOE directives can be accessed at the following Internet addresses: http://www.hr.doe.gov/refshelf.html, gopher://nattie.eh.doe. gov:2011/1, and gopher://dewey.tis.inel.gov:2011/1.

on the proposed rule until October 13, 1995 were issued on August 31, 1995 (60 FR 45381) and September 13, 1995 (60 FR 47498). When issued in final form, this rule will apply to any alternative ·lected for implementation.

6.2 Food and Drug Administration Approvals

The Cintichem process to manufacture Mo-99 is approved by the U.S. Food and Drug Administration (FDA). No direct approvals from the FDA to manufacture Mo-99 for commercial use at a DOE government-owned contractor-operated (GOCO) reactor will be needed. However, each pharmaceutical manufacturer of metastable technetium-99 (Tc-99m) generators desiring to purchase Mo-99 from DOE may need to seek FDA approval to add DOE as a manufacturer of the Mo-99 used in the manufacturer's Tc-99 generators.

A pharmaceutical manufacturer or supplier purchasing the isotopes iodine-125, iodine-131, and xenon-133 from DOE may need to obtain FDA approval to market these products.

6.3 Transportation Requirements

Transportation of all radioactive and other hazardous materials associated with any alternative selected for implementation will comply with applicable DOE directives and the regulations of the U.S. Department of Transportation (DOT). DOE Order 460.2 "Departmental Materials Transportation and Packaging ·anagement" will apply to all transport of unirradiated targets, irradiated targets, spent nuclear fuel, waste ·oducts, and the transport of Mo-99 and other isotopes to carriers for distribution to pharmaceutical manufacturers.

Transportation of unirradiated targets, irradiated targets, spent nuclear fuel, waste products, and Mo-99 and other isotopes that is conducted entirely on DOE property, to which public access is controlled at all times through the use of gates and guards, is subject to DOE 460.2, but is not directly subject to the DOT regulatory requirements. DOE transport of these materials over public highways will be subject to applicable DOT regulations, as well as to DOE 460.2. The DOT has requirements for marking, labeling, placarding, providing emergency response information, and the training of hazardous material transport personnel in 49 CFR 172. Specific packaging requirements for radioactive materials are in 49 CFR 173 Subpart I. These requirements invoke the NRC packaging requirements for radioactive material at 10 CFR 71. The DOT requirements for truck transportation of radioactive and other hazardous materials are in 49 CFR 177 and 49 CFR 397. Requirements affecting the shipment of Mo-99 and other isotopes by air are in 49 CFR 175. Compliance with the 49 CFR 175 requirements will be the responsibility of the air carrier chosen to transport the Mo-99 and other isotopes.

6.4 Occupational Safety and Radiation Exposure

The occupational safety requirements of the U.S. Department of Labor's Occupational Safety and Health Administration (OSHA) are not directly applicable to DOE's government-owned contractor-operated facilities by virtue of Section 4(b)(i) of the Occupational Safety and Health Act of 1970. However, DOE Order 440.1, "Worker Safety and Health Program," requires DOE elements to implement a written worker protection program that 1) provides a place of employment free from recognized hazards that are causing or are likely to cause death or serious physical harm to their employees; and 2) integrates all requirements contained in DOE 440.1; 29 CFR Part 1960, "Basic Program Elements for Federal Employee Occupational Safety and Health Programs and Related Matters;" and other related site-specific worker protection activities.

DOE's radiation protection standards, limits, and program requirements for protecting occupational workers from ionizing radiation resulting from the conduct of DOE activities are in 10 CFR Part 835. All activities associated with any alternative will be conducted consistent with the Part 835 requirements. The annual total effective dose equivalent limit for general employees is 0.05 Sv (5 rem) (10 CFR 835.202[a][1]). DOE Notice 441.1, issued September 29, 1995, establishes radiological protection program requirements for DOE activities that, combined with 10 CFR 835 and its associated implementation guidance, form the basis of a comprehensive program for protection of individuals from the hazards of ionizing radiation in controlled areas. DOE Notice 441.1 requires approval by the appropriate DOE Secretarial Officer or designee before an individual receives in excess of 0.02 Sv (2 rem) in any year. DOE policy is to maintain radiation exposure in controlled areas as low as reasonably achievable through facility and equipment design and administrative controls (10 CFR 835.1001).

6.5 Radiation Exposure to Members of the Public

Activities associated with any of the alternatives under consideration in this EIS will be managed in accordance with Section II of DOE Order 5400.5, which provides that DOE activities shall be conducted so that exposure of members of the public to radiation sources as a consequence of all routine DOE activities shall not cause an effective dose equivalent exceeding 1 mSv/yr (100 mrem/yr). Activities will be conducted in compliance with the requirement that radiation exposure to any member of the public authorized to enter the controlled area where activities associated with implementation of any alternative are conducted will not exceed 1 mSv/yr (100 mrem/yr) total effective dose equivalent (10 CFR 835.208). Air emissions resulting from the implementation of any alternative will comply with the 0.1 mSv/yr (10 mrem/yr) standard at 40 CFR 61.92. DOE will also ensure that DOT radiation level limitations for packaging in 49 CFR 173.441 and requirements related to radioactive contamination on the external surfaces of each package offered for shipment in 49 CFR 173.443 are met.

6.6 Noise

Federal efforts to regulate noise derive largely from the Noise Control Act of 1972 (42 USC 4901-4918). Under this act, federal agencies, such as DOE, are to carry out their programs to further the purpose of the act to promote an environment for all Americans that is free from noise that jeopardizes health or welfare (42 USC 4903[a]). Beyond the general obligation in the Noise Control Act, no specific requirements in the Noise Control Act or in any regulations implemented under the act prohibit or regulate the activities that would be conducted under any of the alternatives under consideration in this EIS. The Noise Control Act also requires federal agencies to meet state and local requirements relating to the abatement of noise (42 USC 4903[b]).

OSHA has issued regulations to regulate the noise exposure of occupational workers (29 CFR 1910.95). These regulations are applicable to operations at the facilities under consideration in this EIS by virtue of DOE Order 5480.4.

6.7 Floodplains and Wetlands

DOE policy is to avoid, to the extent possible, the long- and short-term adverse impacts associated with the destruction of wetlands and the occupancy and modification of floodplains and wetlands (10 CFR 1022.3). Executive Order 11988 requires federal agencies to avoid direct or indirect support of floodplain development when a practicable alternative exists. Executive Order 11990 directs federal agencies to minimize the detrimental impact of their actions on wetland, areas and avoid new construction in wetlands unless no practicable alternative exists.

6.8 Species Protection

The Endangered Species Act of 1973 requires that federal agencies not take any action that is likely to jeopardize the continued existence of any endangered species or threatened species or result in destruction or adverse modification of critical habitat for such species (16 USC 1536[a][2]). Unless otherwise permitted by regulation, the Migratory Bird Treaty Act (16 USC 703) makes it unlawful to pursue, hunt, take, capture, or kill (or to attempt any of the preceding) any migratory bird or nest or eggs of such bird. The Bald and Golden Eagle Protection Act (16 USC 668) protects bald and golden eagles.

6.9 Native American, Archaeological, and Historic Preservation Statutes

The DOE American Indian Tribal Government Policy is set forth in DOE Order 1230.2. DOE commits in the order to consult with tribal governments to ensure that tribal rights and concerns are considered prior to DOE taking actions that may affect tribes. DOE also commits to avoid unnecessary interference with traditional tribal religious practices.

The American Indian Religious Freedom Act (42 USC 1996) establishes that it is United States policy to protect and preserve for American Indians their inherent right of freedom to believe, express, and exercise their traditional religions, including access to sites, use and possession of sacred objects, and the freedom to worship through ceremonies and traditional rites. The Native American Graves Protection and Repatriation Act provides that tribal descendants shall own Native American human remains and cultural items discovered on federal lands after November 16, 1990 (25 USC 3002). When items are discovered during an activity on federal lands, the activity is to cease and appropriate tribal governments are to be notified. Work on the activity can resume 30 days after the receipt of certification that notice has been received by the tribal governments.

The Archaeological Resources Preservation Act of 1979 prohibits the excavation of material remains of past human life that have archaeological interest, and are at least 100 years old, without a permit from the appropriate federal land manager or an exemption (16 USC 470bb, 470ee).

The National Historic Preservation Act authorizes the Secretary of the Interior to maintain a National Register of Historic Places (16 USC 470a[a][1]). Federal agencies are to take into account the effect of their actions on properties included in or eligible for inclusion in the Register and afford the Advisory Council on Historic Preservation a reasonable opportunity to comment on such actions (16 USC 470f).

6.10 Environmental Justice

Section 2-2 of Executive Order 12898 (59 FR 7629; February 16, 1994) requires each federal agency to conduct its programs, policies, and activities affecting human health or the environment so that they do not have the effect of excluding persons (including populations) from participating in, denying persons (including populations) the benefits of, or subjecting persons (including populations) to discrimination under such programs, policies, and activities.

6.11 Recreational Fisheries

Executive Order 12962 (60 FR 30769; June 7, 1995) requires federal agencies to evaluate the effects of their actions on aquatic systems and recreational fisheries.

6.12 Chemical and Material Storage

Under any alternative, chemical and material storage will be conducted according to DOE directives. In particular, DOE Order 5480.4 ("Environmental Protection, Safety, and Health Protection Standards") requires compliance by DOE and its contractors with National Fire Protection Association Codes and Standards and the Occupational Safety and Health Standards at 29 CFR 1910 issued by OSHA.

6.13 Waste Management

Implementation of any alternative, except the no action alternative, will result in the generation of small quantities of low-level radioactive waste, incidental mixed waste (combined radioactive and hazardous waste), and spent nuclear fuel.

Solid waste, such as nonradioactive waste not classified under Subtitle C of the Resource Conservation and Recovery Act (RCRA [42 USC 6901]) as hazardous waste, will be disposed of in DOE-owned landfills or in non-DOE landfills operated according to the requirements in Subtitle D of the RCRA and applicable state and local requirements.

Low-level radioactive waste will be stabilized and temporarily stored at the DOE site of generation. It will be disposed of at a DOE disposal site operated according to the requirements in Chapter III of DOE Order 5820.2A ("Radioactive Waste Management").

Mixed waste will be temporarily stored at the DOE site of generation. It will ultimately be treated and disposed of at a DOE site according to 1) the site treatment plan for the selected site developed in response to the Federal Facility Compliance Act (42 USC 6939c[b]), and 2) DOE Order 5400.3 ("Hazardous and Radioactive Mixed Waste Program"). The availability of proposed site treatment plans for various DOE sites was announced April 5, 1995 (60 FR 17346).

Spent nuclear fuel will be temporarily stored at the DOE site of generation. Storage will be according to applicable DOE directives. Ultimate storage will be consistent with the Record of Decision on the Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programmatic EIS (60 FR 28680; June 1, 1995). Thus, aluminum clad spent nuclear fuel, such as the fuel from the Omega West Reactor and the Oak Ridge Research Reactor, will eventually be shipped to the DOE Savannah River Site. Non-aluminum clad fuel, such as the fuel from the Annular Core Research Reactor and the Power Burst Facility, will eventually be shipped to or retained at Idaho National Engineering Laboratory (INEL).

6.14 Emergency Planning and Community Right-to-Know

Executive Order 12856 (58 FR 41981; August 6, 1993) requires executive branch agencies, such as DOE, to comply with the Emergency Planning and Community Right-To-Know Act (42 USC 11001-11050). The act has notification, emergency planning, and reporting requirements for entities that use or store certain hazardous substances in amounts exceeding designated quantities. INEL, Los Alamos National Laboratory (LANL), Oak Ridge National Laboratory (ORNL), and Sandia National Laboratories/ New Mexico (SNL/NM) comply with the act. Their compliance will be supplemented with any additional notification, planning, or reporting requirements that may arise as a result of implementing any alternative.

6.15 Pollution Prevention

Executive Order 12856 also requires that executive branch agencies comply with Section 6607 of the Pollution Prevention Act (42 USC 131067). DOE will comply with any source reduction and recycling reporting requirements in Section 6607 that are triggered by implementation of any alternative.

6.16 Radioactive Air Emissions

All reactor and hot cell operations considered in this EIS will have radioactive air emissions. Radioactive emissions from DOE facilities are subject to the U.S. Environmental Protection Agency (EPA) National Emission Standards for Hazardous Air Pollutants requirements at 40 CFR Part 61. In particular, Subpart A ("General Provisions,") and Subpart H ("National Emission Standards for Emissions of Radionuclides Other Than Radon From Department of Energy Facilities") are applicable to all alternatives, except the no action alternative.

Subpart H provides that emissions of radionuclides to the ambient air from a DOE facility are not to exceed those amounts that would cause any member of the public to receive in any year an effective dose equivalent of 0.1 mSv/yr (10 mrem/yr) (40 CFR 61.92). For all new construction or modifications to existing facilities where the estimated effective dose equivalent will exceed 1% of the 0.1 mSv/yr standard, an application for approval of construction or modification must be submitted to the appropriate regional EPA office under the procedures at 40 CFR 61.07 (40 CFR 61.96[b]). DOE will follow the procedures in 40 CFR 61 Subparts A and H for any alternative selected for implementation.

Both radioactive and nonradioactive air emissions from any alternative selected for implementation will eventually be covered in the sitewide operating permit for the selected DOE site(s). Operating permits are issued by state permitting authorities whose operating permit program has been approved by the EPA under the program requirements at 40 CFR Part 70 or by the EPA under regulations to be codified at 40 CFR Part 71 for states without an approved operating permit program.

6.17 Nonradioactive Air Emissions

Nonradioactive air emissions from any alternative selected for implementation will be emitted in very small quantities and are not expected by themselves to trigger any air permit requirements, including requirements relating to prevention of significant deterioration permits in attainment areas (40 CFR 52.21) and nonattainment permits in nonattainment areas (40 CFR 51.165).

The EPA's general conformity rule requires that federal agencies prepare a written conformity analysis and determination covering compliance with an applicable state implementation plan for proposed activities where the total of direct and indirect emissions of a nonattainment or maintenance criteria pollutant caused by the activity will exceed the threshold emission levels shown at 40 CFR 93.153(b). Of the sites under consideration in this EIS, the only site that is located in an area that has nonattainment status for a criteria pollutant is SNL/NM, which is in an area that is nonattainment for carbon monoxide. The threshold emission level for carbon monoxide is 100 tons/yr. Carbon monoxide emissions from the SNL/NM Mo-99 production alternative would be below this level. Consequently, a conformity analysis and determination is not required.

6.18 Liquid Discharges to the Ground or Publicly Owned Treatment Works

Liquid wastes will normally be solidified and treated and disposed of consistently with the waste management procedures identified in Section 6.13. When possible, wastewater will be decontaminated d reused. Wastewater that is not solidified or reused will be treated to remove radionuclides. For all but ..ie no action alternative, some wastewater containing small residual quantities of radionuclides after treatment will require periodic disposal to the ground, a publicly owned treatment works, or both. Any discharge of contaminated wastewater to the ground will comply with any applicable state or local permit requirements and applicable DOE directives including DOE Order 5400.5 ("Radiation Protection of the Public and the Environment") and DOE Order 5480.4 ("Environmental Protection, Safety, and Health Protection Standards.") Any discharge of contaminated wastewater to a publicly owned treatment works will comply with applicable DOE directives and the EPA regulations at 40 CFR 403 concerning pretreatment requirements for discharges to such treatment works.

6.19 Special Requirements for Targets Supplied to DOE by a Private Vendor

The DOE is considering contracting with a private vendor to supply targets for use in a DOE reactor. Permit and license requirements applicable to such a private vendor would differ somewhat from those affecting target fabrication at a DOE facility.

A private vendor supplying targets to DOE would need to be licensed by the NRC (10 CFR 70.3) or an Agreement State, if the target fabrication facility is located in an Agreement State and the quantity of highly enriched uranium used in the target manufacturing process is insufficient to form a critical mass (10 CFR 150.10, 150.11). Conditions for approval of a license application are listed at 10 CFR 70.23. Radiation exposure to occupational workers and the public as a result of target fabrication activities would need to be in compliance with the NRC requirements at 10 CFR 20 or comparable Agreement State requirements. All transportation of targets to the DOE irradiation facility would need to be in compliance with the NRC packaging requirements at 10 CFR 71 and all applicable DOT requirements. Low-level radioactive waste generated by the private vendor would be shipped to a commercial low-level waste disposal site licensed by the NRC under the requirements at 10 CFR 61 or by an Agreement State.

6.20 Environmental Review and Consultation

Preparation of the MIPP-EIS was coordinated with other governmental agencies to integrate the NEPA process and to comply with other environmental review requirements in accordance with DOE's NEPA regulations, the Council on Environmental Quality regulations, and other statutes, such as the *Fish and Wildlife Coordination Act* (16 USC 661 et seq.), the *National Historic Preservation Act* of 1966 (16 USC 470 et seq.), and the *Endangered Species Act* of 1973 (16 USC 1531 et seq.).

Copies of the Draft EIS were sent to appropriate Native American tribes, and Federal, state, county, and city agencies, as well as advisory groups. Copies were also sent to all other agencies and persons who have requested them. Recipients of copies of the Draft EIS included, but were not necessarily limited to, the following organizations or groups:

Native American Groups

- Cochiti Pueblo
- Isleta Pueblo
- Jemez Pueblo
- Nambe Pueblo
- Picuris Pueblo
- San Felipe Pueblo
- San Ildefonso Pueblo
- San Juan Pueblo
- Sandia Pueblo
- Santa Clara Pueblo
- Santo Domingo Pueblo
- Taos Pueblo
- Tesuque Pueblo

Federal Agencies

- U.S. Air Force, Kirtland Air Force Base
- U.S. Department of the Interior, U.S. Fish and Wildlife Service
  - Boise Field Office
  - Cookeville Field Office
  - New Mexico Ecological Services State Office
- U.S. Environmental Protection Agency
- U.S. Food and Drug Administration

State Agencies

- Idaho Department of Fish and Game
- State of New Mexico Department of Public Safety
- State of New Mexico Environment Department
- State of New Mexico Energy, Minerals and Natural Resources Department
- State of New Mexico Department of Fish and Game
- State of Tennessee Department of Environment and Conservation
- State of Tennessee Department of Economic and Community Development
- State of Idaho Department of Health and Welfare
- Tennessee Wildlife Resources Agency

7.0 Glossary of Terms

In this section, glossary terms are defined in the context used in this FEIS.

6-day curie. The conventional unit defined as the amount of radioactivity that will result in 1 curie remaining after a 6-day period of decay.

accelerator. A device for imparting kinetic energy to charged particles, such as electrons, protons, deuterons, and helium ions. Common types of accelerators are the cyclotron, synchrotron, synchro-cyclotron, betatron, linear accelerator, and Van de Graff electrostatic generator.

activity (radioactivity). Activity is a measure of the quantity of a radioactive substance. The SI unit of measure is the becquerel (Bq), which is equal to one disintegration (nuclear transformation) per second. The common unit of activity is the curie (Ci) which is equal to 37 billion disintegrations per second - this number of disintegrations is approximately the disintegration rate of one gram (0.04 oz) of radium from which the original definition came. One Ci equals 3.7×10^{10} Bq and is the unit of activity used in this Environmental Impact Statement (EIS).

aerosolize. The process of converting a solid or a liquid into a gaseous suspension of fine particles (an aerosol).

air lock. An intermediate chamber between the outer air and a working chamber, generally for the ırpose of accommodating transfer of materials while maintaining chamber isolation.

air quality. The quality of air as determined by comparison of the quantity of pollutants in the air with applicable standards.

air quality standards. The prescribed quantity of pollutants in the outside air that cannot be exceeded legally during a specified time in a specified area.

alluvium. Clay, silt, sand, gravel, or similar material deposited by running water.

ambient air. The surrounding atmosphere, usually the outside air, as it exists around people, plants, and structures. It is not the air in immediate proximity to emission sources.

aqueous. Relating to or resembling water.

aquifer. A water-bearing stratum of permeable rock, sand, or gravel.

aquitard. A bed of low permeability adjacent to an aquifer; may serve as a storage unit for ground water, although it does not yield water readily.

as low as reasonably achievable (ALARA). An approach to radiological control to manage doses (individual and collective) received by the work force and to the general public at levels as low as is reasonable, taking into account social, technical, economic, practical, and public considerations. As normally used in this document, ALARA is not a dose limit, but a process with the objective of attaining doses as far below the applicable controlling limits as is reasonably achievable, taking into account social and economic considerations.

attainment area. An area considered to have air quality as good as, or better than, the national ambient air quality standards, as defined in the Federal Clean Air Act. An area may be an attainment area for one pollutant and a non-attainment area for others.

background radiation. Radiation resulting from cosmic rays entering from space and from naturally occurring radionuclides of cosmic or primordial origin. Background radiation varies with location, depending on altitude and natural radioactivity present in the surrounding geology. Background radiation sometimes includes that from worldwide fallout from weapons testing (about 4 mrem/yr), but is not included in this FEIS.

beryllium (Be). A rare metal (average atomic mass of about 9 atomic mass units) used most commonly in the manufacture of beryllium-copper alloys for numerous industrial and scientific applications. It is on the EPA's list of priority metals for hazardous air pollutants.

bound, bounding. A description of the evaluation process that provides a reasonable upper limit to potential consequences or impacts.

breccia. A coarse-grained rock composed of angular broken rock fragments held together by a naturally occurring mineral cement.

°C. Degree Celsius. °C = 5/9 x (°F - 32).

cancer. Any malignant new growth of abnormal cells or tissue.

charcoal filter. Used to trap fission product gases from nuclear reactors and radiochemical operations. These filters, also known as activated-carbon absorbers, are made of tightly packed beds of absorbent carbon granules.

Ci. *See curie.*

collective dose. The sum of the individual doses to all members of a specific population.

concentration. The amount of a substance contained in a unit quantity (mass or volume) of a sample.

onglomerate. A coarse-grained sedimentary rock composed of rounded fragments larger than 2 mm (0.08 in.) in diameter set in fine-grained sand or silt. It is commonly cemented naturally by a mineral cement.

control rod. Any rod used to control the reaction rate in a nuclear reactor, typically by absorption or reflection of neutrons.

core. In a nuclear reactor, the region containing the fissionable material. The body of fuel or moderator and fuel in a nuclear reactor.

criteria pollutants. Six pollutants (ozone, carbon monoxide, total suspended particulates, sulfur dioxide, lead, and nitrogen oxide) known to be hazardous to human health and for which the EPA sets National Ambient Air Quality Standards under the Clean Air Act.

criticality. A state in which a self-sustaining nuclear chain reaction is achieved.

cumulative impacts (effects). The sum of environmental impacts, by category, for past, proposed, and reasonably foreseeable future actions.

curie (Ci). A unit of radioactivity equal to 37,000,000,000 (3.7×10^{10}) disintegrations per second.

'BA. Decibel on the A-weighted scale (*see decibel and decibel, A-weighted*).

decibel. An expression of sound pressure level that is referenced to a pressure of 10 micropascals expressed on a logarithmic scale, $1 \text{ dB} = 20 \log_{10} (p/20)$, where p is the sound pressure in micropascals. Twenty micropascals approximates the minimum audible sound pressure level in humans (*see also decibel, A-weighted*).

decibel, A-weighted. The A-weighted decibel (dBA) is an expression of adjusted pressure levels by frequency that accounts for human perception of loudness. Consequently, dBA is most often used when evaluating human noise disturbance. For example, at a frequency of 500 Hz, 60 dB are reduced by 3.2 dB to give an A-weighted pressure level of 56.8 dBA. Lower frequencies are reduced more because they are less of an annoyance to humans, and higher frequencies are reduced less because they are more of an annoyance (*see also decibel*).

decay, radioactive. The spontaneous transformation of an unstable atom to a lower, more stable energy state, often with the emission of particulate or electromagnetic radiation (alpha, beta, gamma, or x-radiation).

decommission. To formally remove a facility, or facilities, from service.

decontamination. Process of removing radioactive contamination and materials from personnel, equipment, or areas.

depleted uranium. A mixture of uranium isotopes where uranium-235 represents less than 0.7% of the uranium by mass.

dose (radiation dose). In terms of public health and safety, radiation dose is a measure of the amount of ionizing radiation absorbed by the body or body tissue. The unit of absorbed dose in SI units is the gray (Gy) and is equal to the deposition of one joule of energy per kilogram of tissue and in common units is the rad, which is equal to the deposition of 100 ergs per gram of tissue.

Various forms of radiation have different impacts on tissues and different tissues have different responses in terms of overall impact on the body. The source of radiation may originate outside the body, or inside the body as a result of inhalation, ingestion, adsorption, or injection. Adsorbed dose by itself is generally not sufficient as a measure of detriment or impact. As a consequence, a total effective dose equivalent (TEDE) has been defined to take into account these differences and which yields a single risk-based value. Typically, TEDE, as used in this FEIS, includes the 50-yr committed dose from radionuclides internal to the body and the radiation dose received from external sources from one year's exposure (multiple exposures and cumulative dose are taken into account as appropriate). The special name of the unit of total effective dose equivalent is the sievert (Sv) in SI units and the rem in common units. One Sv equals 100 rem. (The fundamental units of effective dose equivalent are such that one sievert is equal to one joule of energy per kilogram of absorbing medium).

Typically, the TEDE (usually referred to simply as dose in this FEIS) is calculated for a maximally exposed individual (MEI) and for populations of interest. The MEI is that hypothetical individual who, by virtue of food consumption patterns, place of residence, *et cetera*, tends to receive the maximum dose for a given release of radionuclides to air, water, or ground. In this FEIS, the MEI dose is reported in rem or mrem (one-one thousandth of a rem). Population doses are based on doses to individuals using more typical assumptions for exposure and intake. The doses for individual members of the population are added together to obtain the collective dose to the population. In this EIS, population dose is reported in person-rem.

dose equivalent. Some types of radiation, such as neutron and alpha, deposit their energy more densely in affected tissue than gamma radiation and, thereby, cause more damage to tissue. This term, measured in units of rem, is used to take into account this difference in tissue damage. The units of dose equivalent are the rem and sievert (Sv) (*see dose*).

dose rate. The radiation dose delivered per unit time (for example, rad/h).

dosimeter. Instrument used to detect and measure an accumulated dosage of radiation.

ecology. The science dealing with the relationship of all living things with each other and with the environment.

ecosystem. A complex of the community of living things and the environment forming a functioning whole in nature.

effective dose equivalent. A concept used to estimate the biological effect of ionizing radiation. It is the sum over all body tissues of the product of absorbed dose, the quality factor (to account for the different penetrating abilities of the various types of radiation), and the tissue weighing factor (to account for the different radiosensitivity of the various tissues of the body) (*see dose*).

effluent. Typically, liquid released from process control.

EIS. Environmental impact statement; a document required by Council on Environmental Quality regulations for implementing the procedural provisions of the National Environmental Policy Act (NEPA) of 1969, as amended, for proposed major federal actions involving potentially significant environmental impacts.

element. One of the known chemical substances that cannot be divided into simpler substances by chemical means. All isotopes of an element have the same atomic number (number of protons) but have a different number of neutrons, and thus different atomic weights.

emission standards. Legally enforceable limits on the kinds and quantities of air contaminants that can be mitted into the atmosphere.

endangered species. Any species that is in danger of extinction throughout all or a significant portion of its range, other than the Class Insecta determined by the Secretary to constitute a pest whose protection under the provisions of the Endangered Species Act would present an overwhelming and overriding risk to man..

enriched uranium. Uranium in which the abundance of the U-235 isotope is increased above the naturally occurring amount of 0.71%.

environment. The sum of all external conditions and influences affecting the life, development, and ultimately the survival of an organism or ecological community.

environmental monitoring. The act of measuring, either continuously or periodically, some quantity of interest, such as radioactive material in the air.

ephemeral stream. A stream carrying water only during and immediately after periods of rainfall or snowmelt.

epicenter. The point on the earth's surface directly above the focus of an earthquake.

erosion. A general term for the natural processes by which earth materials are loosened, dissolved, or worn away and moved from one place to another. Typical processes are wind and water as they carry away soil.

| **eutectic**. An alloy or solution that has the lowest possible constant melting point.

extraction. First step performed in the chemical separation of the molybdenum-99 from the other fission products that are produced during the irradiation of uranium-235. Additional chemical separations are then performed to purify the molybdenum-99 product.

°F. Degree Fahrenheit. °F = (°C x 9/5) + 32.

fault. A fracture or a zone of fractures within a rock formation along which vertical, horizontal, or transverse slippage of the earth's crust has occurred in the past.

fission. Splitting of a heavy nucleus into two approximately equal parts (rarely three unequal parts), which are nuclei of lighter elements accompanied by the release of energy and generally one or more neutrons. Fission can occur spontaneously or can be induced by nuclear bombardment.

fissionable. Atoms capable of being split or divided (fissioned) by the absorption of thermal neutrons. The most common fissionable materials are uranium-233, uranium-235, and plutonium-239.

fission products. Nuclides resulting from the fission process.

forb. A general term for a weed or broad leaf flowering plant as distinguished from grasses and sedges.

formation. A body of rock identified by lithic characteristics and stratigraphic position. Formations may be combined into groups or subdivided into members.

| **fuel meat**. The portion of the fuel that will fission.

gamma radiation. Short wavelength electromagnetic radiation (photons of nuclear origin with a range of wave lengths from about 10^{-8} to 10^{-11} cm (0.01 to 10 MeV), emitted from the nucleus of an atom.

GENII. A computer program used to estimate doses to individuals and populations from releases of radioactive materials.

geology. The science that deals with the earth; the materials, processes, environments, and history of the planet, especially the lithosphere, including the rocks, their formation, and structure.

glove box. A sealed box with gloves attached and passing through openings into the box, so that workers can handle materials inside without inhalation of contaminants.

gram (g). One 1-thousandth of a kilogram, nearly equal to the mass of one cubic centimeter of water.

ground water. All subsurface water, especially the part that is in the zone of saturation.

habitat. The part of the physical environment in which a plant or animal lives.

half-life (radiological). The time in which half the atoms of a radioactive substance disintegrate to another nuclear form. Half-lives vary from small fractions of a second to billions of years.

halogen. Elements of chemical group VII (that is, having a valence shell that lacks one electron). These chemically reactive elements include fluorine, chlorine, bromine, iodine, and astatine.

hazardous waste. Waste that contains hazardous constituents but no radionuclides. Hazardous waste is generated at most U.S. Department of Energy installations in a variety of quantities and forms. For the most part, hazardous waste is sent to commercial treatment and disposal facilities.

high efficiency particulate air (HEPA) filter. Disposable, extended pleated-medium dry-type filter with: 1) a rigid casing enclosing the full depth of the pleats, 2) a minimum particle removal efficiency of 99.97% for thermally generated monodisperse dioctyl phlatate (DOP) smoke particles with a diameter of 0.3 micrometer, as measured in the laboratory, and 3) a maximum pressure drop of 1-in. water gauge hen clean and operated at its rated airflow capacity.

high-level waste. The highly radioactive waste material that results form the reprocessing of spent nuclear fuel, including liquid waste produced directly from reprocessing and any solid waste derived from the liquid that contains a combination of transuranic and fission product nuclides in quantities that require permanent isolation. High-level waste may include other highly radioactive material that the U.S. Nuclear Regulatory Commission, consistent with existing law, determines by rule requires permanent isolation.

hot cell. A heavily shielded room in which highly radioactive materials can be handled, generally by remote control.

intensity (earthquake). A numerical rating used to describe the effects of earthquake ground motion on people, structures, and the earth's surface. The numerical rating is based on an earthquake intensity scale such as the modified Mercalli Scale commonly used in the United States.

interbed. A typically thin bed of one kind of rock material occurring between or alternating with beds of another material.

ion. An atom or molecule that has gained or lost one or more electrons to become electrically charged.

ionizing radiation. Any electromagnetic or particulate radiation capable of producing ions, directly or indirectly, during its passage through matter.

irradiation. Exposure to radiation; typically exposure to neutron radiation that might be present near or within the core of a nuclear reactor.

isomer. An isomer is simply an isotope with additional energy in the nucleus. Most isomers decay and keep the same number of protons and neutrons in the nucleus, thereby retaining their isotopic status, but with less energy in the nucleus. Some isomers undergo beta decay, thereby changing both their isotopic and elemental status.

isotope. One of several nuclides having the same number of protons in their nuclei, and hence having the same atomic number, but differing in the number of neutrons, and therefore in the mass number (such as, uranium-235, uranium-238, thus isotopes of uranium).

lacustrine. Belonging to or produced by lakes.

laser. A device for generating coherent electromagnetic radiation in the ultraviolet, visible, or infrared regions of the spectrum.

latent cancer fatalities. Deaths ultimately caused by a radiation-induced cancer. The cancer becomes evident years after the radiation exposure. Latent cancer fatalities can be calculated for the public by using the risk conversion factor of 5×10^{-4} deaths per person-rem. In the tables in this document, latent cancer fatalities less than one in a population are shown as "none" followed by the actual calculated value (in parentheses).

light water . ordinary water.

linear accelerator . A device in which atomic particles travel in a straight line as their velocity is increased. A particle accelerator that accelerates electrons, protons, or heavy ions in a straight line by the action of alternating voltages.

liter. A unit of volume equivalent to 1.057 U.S. quarts.

low-income community. A community where 25% or more of the population is identified as living in poverty.

low-level mixed waste. Waste that includes low-level waste that also is contaminated with hazardous constituents regulated under Subtitle C of the RCRA. Until the late 1980s most low-level mixed waste vas routinely disposed of by shallow land burial. Low-level mixed waste is currently not disposed of by the U.S. Department of Energy. It can however, be stored for 1 year in facilities that meet specified requirements.

low-level waste. All radioactive waste not classified as high-level waste, mixed waste, and transuranic waste. Low-level waste ranges from low-activity waste that can be disposed of by shallow land disposal techniques to high-activity waste that requires disposal techniques providing greater confinement. Low-level waste is disposed of at Savannah River Site, Oak Ridge Reservation, Idaho National Engineering Laboratory, the Nevada Test Site, Los Alamos National Laboratory, and Hanford.

maximally exposed individual (MEI). A hypothetical individual who, by virtue of location and lifestyle, receives the maximum exposure to effluent from a facility.

medical isotope. A radioactive isotope that is used for the purpose of medical treatment or diagnosis. Some medical isotopes are technetium-99m, iodine-125, iodine-131, xenon-133, and cobalt-60. These isotopes can be prepared into a variety of chemical forms, depending on the specific medical need.

metastable. Changing readily either to a more stable or less stable condition.

migration. The movement of a material through the soil or ground water.

ıixed waste. Waste that contains a radioactive component regulated under the Atomic Energy Act and a azardous component regulated by the EPA under the RCRA.

National Register of Historic Places. A list maintained by the National Park Service of architectural, historic, archeological, and cultural sites of local, state, or national importance.

natural background radiation. Radiation originating from naturally occurring sources. Principal sources of background radiation are primordial radionuclides such as uranium, thorium, and potassium-40 and cosmic radiation. Radiation may be produced or enhanced by man-made means, such as activation or nuclear fission.

NEPA. National Environmental Policy Act of 1969 as amended.

neutralize. To make chemically neutral, or to adjust the pH to approximately 7.

noble gas. Elements of chemical group VIII (those having a complete valence shell). These chemically inert elements include isotopes of helium, neon, argon, krypton, xenon, and radon, which typically exist as gases at normal pressures and temperatures.

nonhazardous waste/industrial and sanitary waste solid. Solid sanitary waste (for instance, garbage, rubble, or debris) regulated under Subtitle D of the RCRA and liquid sanitary waste regulated under the Clean Water Act. Sanitary waste is generated at all U.S. Department of Energy sites and is disposed of onsite and offsite at departmental, public, or private facilities.

North American demand. Term used to define the total demand for medical radioisotopes for the North American Continent (including the United States, Canada, and Mexico). This term defines the production requirement (approximately 16,400 curies from the reactor) to satisfy 100% of the North American Mo-99 annual demand.

NO_x. Oxides of nitrogen, primarily nitrogen oxide (NO) and nitrogen dioxide (NO_2). These oxides are produced in the combustion of fossil fuels, and can constitute an air pollution problem.

nuclear weapon. The general name given to any weapon in which an explosion can result from the energy released by reactions involving atomic nuclei, either fission, fusion, or both.

nuclear stockpile. The total aggregation of the nation's nuclear weapons that are in the custody of the U.S. Department of Defense. This quantity is defined in the nuclear weapons stockpile memorandum.

nuclear reaction. An interaction between a photon, particle, or nucleus and a target nucleus, leading to the emission of one or more particles and photons.

nuclide. A species of atom, characterized by its nuclear constitution (number of protons and number of neutrons).

numerical notation. Various means of expressing numerical values, particularly very large or very small values. Examples of types of numerical notation include scientific, exponential, or floating point. (*see Units of Measure preceding Section 1.0*)

outfall. Place where liquid effluent enter the environment and are monitored.

oxide. A compound in which an element has chemically combined with oxygen.

ozone. A molecule of oxygen in which three oxygen atoms are chemically attached to each other.

particulates. Solid particles and liquid droplets small enough to become airborne.

perched water. A body of ground water separated from an underlying body of ground water by an unsaturated zone.

perennial stream. A stream that contains water at all times except during extreme drought.

permeability. Ability of liquid to flow through rock, ground water, soil, or other substance.

erson-rem. Unit of collective dose, collective committed effective dos equivalent, etc.

pH. A measure of the hydrogen ion concentration in aqueous solution. Pure water has a pH of 7, acidic solutions have a pH less than 7, and basic solutions have a pH greater than 7.

physiographic. Pertaining to the physical features of the earth's surface, such as land forms or bodies of water.

PM_{10}. Particulate matter with a 10-micron, or less, aerodynamic diameter.

pollution. The addition of an undesirable agent to the environment in excess of the rate at which natural processes can degrade, assimilate, or disperse it.

probability. The chance that a given event will occur.

Puye Formation. A stratigraphic unit composed of basalts, interflow breccias, conglomerates, sandstones, and siltstones that underlies Los Alamos National Laboratory.

rabbit. A mechanical device allowing access to a reactor without shutting it down.

radiation. The emitted particles or photons from radioactive atoms. Emission and propagation of energy ʾrough space or through a material in the form of waves; for instance the emission and propagation of .ectromagnetic waves.

radiation dose. (*see dose*)

radioactive waste. Materials from nuclear operations that are radioactive or are contaminated with radioactive materials and for which there is no practical use or for which recovery is impractical (*see low-level waste*).

radioactive air emissions. Air effluent that contains a radioactive component.

radioactivity. The property possessed by some elements (such as uranium) of spontaneously emitting alpha or beta particles, and sometimes gamma rays by disintegration of the nucleus of the atoms.

radiography. The technique of producing a photographic image of an opaque specimen by transmitting a beam of x-rays or gamma rays through it onto an adjacent photographic film; the image results from variations in thickness, density, and chemical composition of the specimen.

radioisotope. A radioactive isotope.

radiological impact. Refers to impacts on human health due to external exposure, or intake of radioactive materials into the body. These impacts are typically described in terms of dose, damage to body organs, or the induction of cancer.

radionuclide. A nuclide that is radioactive.

radiopharmaceuticals. Term used to describe products that include radioactive materials (medical isotopes) and are prepared, produced, or packaged by the pharmaceutical industry for use in nuclear medicine.

reactor. A system in which nuclear fission may be sustained in a self-supporting chain reaction. It includes fissionable material, such as uranium, and moderating material, such as graphite or water, provision for heat removal, and control elements.

recharge. The processes involved in adding water (that is, rainwater) to an aquifer.

rem. The common unit of dose equivalent, effective dose equivalent, for a single individual, used in the field of radiation dosimetry.

RIMS. Regional Input-Output Modeling System. A software package produced by the U.S. Department of Commerce to evaluate community impacts of economic activities.

risk. The term risk has many interpretations; however, for present purposes, risk means the product of the probability of an event occurring, or the estimated frequency of an event, over the period of interest and the consequences of the event, if it were to occur.

runoff. The portion of rainfall, melted snow, or irrigation water that flows across the ground surface and eventually returns to streams.

seismicity. The relative frequency and distribution of earthquakes.

shield, shielding. Material used to absorb radiation, thereby reducing its intensity."

Sievert (Sv). A unit of any of the quantities expressed as dose equivalent. The dose equivalent in sieverts is equal to the absorbed dose in grays multiplied by the quality factor (1 Sv = 100 rem).

spent nuclear fuel. Fuel that has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated by reprocessing, and is typically stored in water pools. Iost spent fuel is stored in water pools, which requires constant maintenance. Spent fuel requires permanent isolation in a geologic repository.

stabilization. The action of making a material more stable by converting its physical or chemical form or placing it in a more stable environment (such as, converting metallic uranium to uranium dioxide).

steel confinement box. For the purpose of Mo-99 production, a steel confinement box is a box consisting of shielding used to protect personnel outside the box from exposure to radiation, manipulators for working inside the box remotely (without handling the materials directly), and a ventilation system that filters all air exhausted from the box.

strata. Layers of rock usually in a sequence.

stringer. An irradiation container for targets.

target. Cylindrical sealed elements irradiated in a reactor core for the purpose of generating radionuclides, either from fission or by absorption of neutrons (neutron activation). Fission targets contain enriched uranium plated on the inner cylinder wall for the purpose of generating numerous radionuclides from fission of uranium-235. Absorption (activation) targets contain isotopes by which neutron absorption produces the desired radionuclide.

'reatened species. Any species that is likely to become an endangered species within the foreseeable .ture throughout all or a significant portion of its range.

TEDE. Total Effective Dose Equivalent. (*see dose*).

toxicological impact. Impact on human health, due to exposure to, or intake of, chemical materials. These impacts are typically described in terms of the damage to organs or the induction of cancer.

transuranic waste. Material contaminated by emitting transuranic nuclides (atomic number greater than 92) with half-lives greater than 20 years and in concentrations greater than 100 nanocuries per gram of material.

tritium. A radioactive isotope of hydrogen; its nucleus contains one proton and two neutrons.

tuff. A type of rock formed of compacted volcanic fragments.

units of measure. The principal units of measurement used in the FEIS are SI units, a metric system, accepted by the International Organization for Standardization as the legal standard at a meeting in

Elsinore, Denmark in 1966. SI is the abbreviation for Systeme International d' Unites. In that system, almost all units are made up of combinations of six basic units, of which length in meters, mass in kilograms, and time in seconds are of importance in this FEIS.

In this FEIS, values given in SI units are followed by values given in common units in parentheses.

uranium (U). A heavy (average atomic mass of about 238 atomic mass units), silvery-white metal with 14 radioactive isotopes.

x-ray. A penetrating electromagnetic radiation, which may be generated by accelerating electrons to high velocity and suddenly stopping them by collision with a target material, or by transition of atoms to lower energy states.

8.0 List of Preparers and Contributors

This list identifies individuals who were principal preparers of and contributors to this Final Environmental Impact Statement (FEIS). Many other individuals contributed to FEIS preparation and review. Wade Carroll, Deputy Associate Director, Office of Isotope Production and Distribution, DOE Office of Nuclear Energy, Science and Technology, directed its preparation. Michael D. McKinney, of DOE's Pacific Northwest National Laboratory (managed by Battelle), provided overall project management and document preparation support. Emmett B. Moore was responsible for technical support to Pacific Northwest National Laboratory staff working on the FEIS. Glen T. Hanson of Battelle's Albuquerque Office provided technical review.

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Appendix A

Molybdenum-99 Production and Separation Performance Characteristics

Appendix A

Molybdenum-99 Production and Separation Performance Characteristics

Performance Characteristics and Assumptions

The approach to determine if a facility would be acceptable for molybdenum-99 (Mo-99) generation is based on the ability of that facility to irradiate targets, chemically process targets, verify product purity, package the product, ship the product, and manage the waste produced from the process. Several parameters are not independent, and many are fostered from one primary parameter, which is the integrated target power required for 100% production of the domestic demand.

Approximately 3000 6-day curies per week must reach the pharmaceutical houses for distribution to the regional radiopharmaceutical distributors. They, in turn, distribute to the clinics and hospitals using a *just-in-time* distribution method. A 6-day curie (which is an unusual unit of measure) is defined as the amount of material that will result in 1 curie of material remaining after a 6-day (144-h) decay. Therefore, approximately 13,600 actual curies must reach the pharmaceutical houses each week to achieve the 3000 6-day curie requirement.

To determine the number of curies removed from the reactor, an assessment must be made regarding the time required to move material from the reactor and deliver the extracted product to the pharmaceutical house. After a target is removed from the reactor, it must cool radioactively to reduce the total radiation. ˙me is required to transport the target to the processing facility, to remove the target from the transporter .ıield into the processing hot cell, to process the target material, to package the processed material, and to ship the material to the city of destination(s). Time is also required to transport the material from the airport to the pharmaceutical company.

Assuming 1 h to remove the target, 6 h to radioactively cool, 2 h to load in the transport assembly and transport to the hot cells, 1 h to unload from the transport cask to the hot cell, 8 h to process, 1 h to sample for purity and package, 1 h for ground transportation, 8 h for air transport, and another hour for ground transportation at the pharmaceutical city, a total of 29 h is achieved. No contingency is assumed in this estimate.

The chemical separation process is not perfect. Discussions with various chemists at Battelle and with John Brasier of Idaho National Engineering Laboratory (INEL), who has performed the process, indicate the separation process should produce approximately a 95% yield. This yield would increase the integrated target power required to produce 100% of the U.S. demand.

Very simplistic calculations can show that if a 95% process yield is assumed and the time described is 24 h, the integrated target power must be 460 kW. The same yield assumption and 36 h yield 521 kW, and 30 h requires 490 kW of integrated target power. A total of 30 h and 490 kW of integrated target power is considered the reasonable time and power to be assumed in assessing the various facilities.

The power in a single target is not very flux dependent, in that increased uranium loading in the target can adjust the target power to the level desired. The increased loading could probably be performed, within certain bounding values, during electroplating. The limiting consideration for single target power is the ability of the facility to thermally cool the target. The heat flux from a single target is approximately 2.19 watts/cm^2 per kW of target power. For comparison a commercial BWR pin, at the maximum licensed linear heat generation rate, is approximately 100 watts/cm^2.

The process waste generation, by volume, is a function of the number of targets required to produce the full U.S. demand. If a given facility can run at higher target powers, the volume of process waste generated decreases. However, target power also impacts hot cell operation. Hot cells are licensed to handle certain curie contents, usually at a specified level of emitted gamma energy. Some cells could process several high powered targets at once. Certain other cells may be capable of processing only a single target, and may require additional cooling time in excess of 6 h to be capable of processing a single high power target.

A rough calculation based on American National Standards Institute (ANSI) decay heat standards, and collaborated by ORIGEN calculations, indicate the following approximate relationship. For a target after a 6-day irradiation, the total activity, in curies, per kW of target power versus cooling time is given by the following approximating polynomial: $KCi/KW = 1.141-0.0905(t) +0.00375(t^2)$ where t is in hours. This calculation yields the following approximate values: 4 h-0.84KCi/KW, 6 h-0.73KCi/KW, 8 h-0.66KCi/KW, 10 h-0.61KCi/KW, and 12 h-0.595KCi/KW. For example, a 20 kW target allowed to cool for 8 h contains approximately 13,200 total curies. This total impacts the number of targets that can be processed in a single batch, and must be assessed on a site-by-site basis.

Reactor fuel utilization must be considered. The fuel burned to produce the neutrons required for target irradiation is basically encapsulated radioactive material. Nuclear fuel has the fission products contained within the cladding, and is special in radioactive material handling. It is advantageous to burn less fuel to produce the neutrons required for irradiation of the targets.

The site's ability to handle waste streams must be considered. The additional impact that production of Mo-99 would have on the site waste handling process must be considered. Shipping of waste must also be considered. It is advantageous to dispose of waste at the same site where the waste is produced, precluding the necessity of waste shipping.

Irradiation time has a strong effect on specific activity. All of the molybdenum isotopes from Mo-95 to Mo-100 are produced from fission. Because of the removal coefficient of Mo-99, effectively a 4-day exponential lifetime, it equilibrates rapidly. The other molybdenum isotopes produced from fission continue to build, making the Mo-99 curie content per gram of molybdenum material decrease with increased irradiation times. Long irradiation times driven by schedule needs are clearly disadvantageous.

Part, or all, of the above issues were considered when assessing the viability of a particular option. These issues were not pursued in great depth. Detailed technical considerations of the items were not performed as a function of the selection criteria, but rather a qualitative assessment for reasonability was performed.

Cintichem Process Description

Target Fabrication. Target elements are manufactured by electroplating the inner wall of a stainless .eel tube with 20 g of enriched uranium oxide. The target cylinder is then evacuated, back-filled with helium and the end fittings are welded onto the target body.

Target Irradiation. Targets are placed in the reactor's central core region (or appropriate flux trap) and irradiated around the clock for approximately 7 days. Targets are loaded and removed from the core on a staggered schedule to assure daily (or frequent periodic) batches of isotopes for processing. They are then transferred to a hot cell facility for chemical separation.

Chemical Separation and Purification. The chemical recovery of Mo-99 from the targets proceeds only after a minimum decay period of approximately 6 h. The steps in the process include the dissolution of the uranium coating, the separation of the molybdenum from other fission products, and the purification of the molybdenum.

Dissolution of the Uranium Coating. A manifold and cold trap are installed to recover the noble gases and iodine from the target fill gas. The manifold and cold trap are then removed and an acid solution is added to dissolve the uranium coating. The targets are rotated and heated to aid dissolution. At this point, the manifold, cold trap, and an iodine trap are reinstalled to recover the iodine and remaining gases. These items are then sent to xenon and iodine recovery cells. The liquid remaining (the target solution) is drained into a container. The target solution then contains approximately 92 g of fission products, target fuel, and acid solution.

Separation of the Molybdenum from Other Fission Products. A series of steps is conducted to place molybdenum in the form of solid molybdenum oxide. First, rinse water is added to the target and ained into the container of target solution. The target is then placed into a low activity disposal ɔntainer.

A series of chemicals is added to the target solution. These chemicals are listed in the order of addition: 4 g of iodine carrier, 0.51 g nitric acid and 0.01 g silver nitrate (mixed), 1 g hydrochloric acid, 1 g molybdenum carrier, 1 g potassium permanganate solution, 1 g rhodium carrier solution 0.7 g, ruthenium carrier solution, and 20 g of benzoin alpha oxime solution. The target solution is agitated after the addition of each chemical. The total volume of the target solution and molybdenum precipitant at the end of this process is 147 g.

The target solution is then poured through a molybdenum precipitant into another container. The empty target solution container is cleaned with 20 g of sulfuric acid cleaning solution, which is then again poured though the molybdenum precipitant, and into the container with the target solution. This procedure is repeated three times and the empty target solution container is sent to a low activity disposal container.

Molybdenum precipitant in rinsed with 10 g sulfuric acid cleaning solution and drained into an acid wash container. The solution in the acid wash container is poured into the molybdenum precipitant and then drained back into the same container. This acid wash container is then sent to low activity disposal.

Purification of Molybdenum. Molybdenum precipitant is injected with 10 g of molybdenum suspension solution and drained into a new container. This solution is poured through an ion resin exchange filter and back into the new container. The ion resin exchange filter is sent to low activity disposal containers. The container with the molybdenum is then ready to send to the pharmaceutical shipment cask.

Appendix B

Analysis of Transportation Impacts

Appendix B

Analysis of Transportation Impacts

B.1 Transportation

This appendix evaluates the transportation impacts associated with the production of medical isotopes. The alternatives evaluated have been described in Section 3. Potential transportation impacts could include external radiation exposures during routine transport and internal and external exposures due to vehicular accidents that result in a release of radioactive materials. Nonradiological impacts from routine and vehicular accidents are also addressed. The nonradiological routine impacts are due to pollutants emitted by the transport vehicles and the vehicular accident impacts are due to traumatic fatalities.

For each alternative, the routine and accidental radiological and nonradiological impacts associated with transporting unirradiated targets from the target fabrication site to the reactor; transporting irradiated targets from the reactor to a processing facility for separation; and transporting the separated medical isotope from the processing facility to the pharmaceutical distributor were evaluated. Impacts associated with transporting the wastes generated during processing were also addressed. The impacts of transporting spent nuclear fuel are not addressed, because each of the reactor facilities has available spent fuel storage capacity (see Section 5.14). Therefore, no near term impacts are associated with the transport of spent nuclear fuel from the reactor facilities to an interim or permanent offsite storage facility. The environ-ntal impacts of managing DOE's spent nuclear fuel inventory are addressed in Massey and Coats 995).

B.1.1 Methods and Assumptions

The following sections describe the methods and assumptions used to evaluate potential impacts of each of the medical isotope alternatives. The analysis focuses on the activities associated with transportation of the unirradiated and irradiated targets, medical isotopes, and process waste.

B.1.1.1 Shipping Scenarios

A total of five transportation scenario alternatives are addressed in this evaluation. The alternatives, based on handling or operation location, are shown in Table B-1. It was assumed that all overland transportation would be performed by truck. For example, unirradiated targets would be transported from the fabrication facility to the irradiation facility by truck and final product would be transported to and from the airport by truck. For all alternatives, it was assumed that maximums of 52 target shipments/yr and 1140 purified medical isotopes shipments/yr would be required to meet the demand, (that is, 100% of the U.S. market). Of the 1140 shipments, 1035 shipments would contain 3 packages each of Mo-99,

Table B-1. Transport Scenarios Based on Handling or Operation Location

Target Fabrication	Target Irradiation	Separations	Airport	Final Destination Airport (Distributor)
LANL	LANL	LANL	Albuquerque International Airport	Boston, MA (DuPont-Merck)
				Chicago, IL (Amersham Mediphysics)
				St. Louis, MO (Mallinckrodt Medical)
				Ottawa, Canada (Nordion)
LANL/SNL/NM	SNL/NM	SNL/NM	Albuquerque International Airport	Same as Above
ORNL	ORNL	ORNL	McGhee Tyson Airport	Same as Above
INEL	INEL	INEL	Idaho Falls Airport	Same as Above

LANL - Los Alamos National Laboratory
SNL/NM - Sandia National Laboratories/New Mexico
ORNL - Oak Ridge National Laboratory
INEL - Idaho National Engineering Laboratory

xenon-133, and iodine-131, and 105 shipments would contain 3 packages of iodine-125. It was also assumed, based on the total number of targets shipped and that a representative waste cask would contain processing waste from 14 irradiated targets, a maximum of 90 waste shipments would be made per year.

The following paragraphs describe each of the scenarios based on target fabrication, irradiation and separations location, and final destination. Most flights would require connecting flights between the original airport and the destination airport. The transportation scenarios from the final destination (airport) to the distributor are common to all alternatives and are discussed only in the initial alternative.

Los Alamos Target Fabrication, Irradiation, Separations, and Shipments from Albuquerque International Airport. This scenario assumes the targets would be fabricated at LANL in the Chemistry and Metallurgy Research Facility located in TA-3 and transported approximately 6.5 km (4 mi), via truck on existing site roads, to the Omega West Reactor located in TA-2. Following irradiation in the Omega

West Reactor, the targets would be transported via truck to the Chemistry and Metallurgy Research Facility, using the same route, for separation and purification of the medical isotopes. Waste generated during separation is assumed to be low-level solid waste, and would be transported approximately 8 km (5 mi) to an onsite disposal facility in TA-54.

The purified medical isotopes would be packaged and transported by truck to Albuquerque International Airport for transport to DuPont-Merck, Amersham Mediphysics, Mallinckrodt Medical, or Nordion. The total shipping distance from TA-3 to Albuquerque International Airport is approximately 153 km (95 mi). Of the total distance, 18 km (12 mi) are on existing site roads, and the remaining 135 km (83 mi) are on public roadways.

For shipments to DuPont-Merck, the nearest commercial airport is Logan International in Boston, Massachusetts. The total flight distance from Albuquerque International Airport to Logan International is approximately 3200 km (1970 mi). The package containing the purified medical isotopes would be transferred to a truck and transported 35 km (22 mi) to the DuPont-Merck facility located in Billerica, Massachusetts.

For shipments to Amersham Mediphysics, the nearest commercial airport is O'Hare in Chicago, Illinois. The total flight distance from Albuquerque International Airport to O'Hare is approximately 1800 km (1120 mi). The package containing the purified medical isotopes would be transferred to a truck and transported 32 km (20 mi) to the Amersham Mediphysics facility located in Arlington Heights, Illinois.

For shipments to Mallinckrodt Medical, the nearest commercial airport is St. Louis International in St. Louis, Missouri. From Albuquerque International Airport to St. Louis, the total flight distance is approximately 2200 km (1350 mi). The package containing the purified medical isotopes would be transferred to a truck and transported 13 km (8 mi) to the Mallinckrodt facility located in Hazelwood, Missouri.

For shipments to Nordion, the nearest commercial airport is Ottawa, Canada. It was assumed that shipments to Nordion would be from Albuquerque International Airport to a distribution hub and at the hub the isotope packages would be transferred to a plane departing for Ottawa, Canada. The estimated total flight distance is approximately 3000 km (1872 mi). At the Ottawa airport, the package would be transferred to a truck and transported to Nordion. The air transport portion of this alternative is similar (approximately the same distance) to the DuPont-Merck alternative and was not specifically evaluated. That is, the expected impacts would be similar to the impacts associated with delivery of the isotopes to Logan International.

Los Alamos Target Fabrication, Sandia National Laboratories Irradiation, Separations, and Shipments from Albuquerque International Airport. This scenario assumes the targets would be fabricated at LANL in the Chemistry and Metallurgy Research Facility located in TA-3 and transported approximately 176 km (110 mi), via truck on existing LANL and Sandia National Laboratories/New Mexico (SNL/NM) site roads (28 km [17 mi]) and public roads (148 km [92 mi]), to the SNL/NM Annular Core Research Reactor. Following irradiation in the Annular Core Research Reactor, the irradiated targets would be transferred to the adjacent SNL/NM Hot Cell Facility, for separation and purification of the medical isotopes. The Annular Core Research Reactor and the Hot Cell Facility are located in Technical Area V. Waste generated during separation is assumed to be low-level solid waste and would be transported approximately 1099 km (683 mi) to the Nevada Test Site for disposition.

The purified medical isotopes would be packaged and transported by truck to Albuquerque International Airport for transport to DuPont-Merck, Amersham Mediphysics, or Mallinckrodt Medical. The total shipping distance from Technical Area V to Albuquerque International Airport is approximately 17 km (11 mi). Of the total distance, 9 km (6 mi) are on existing site roads, and the remaining 8 km (5 mi) are on public roadways.

For shipments to DuPont-Merck, Amersham Mediphysics, Mallinckrodt Medical, and Nordion the air transportation routes and final destinations (airports) would be the same as discussed previously for LANL. Transportation of the package containing the purified medical isotopes to the distributors from the destination airport would also be the same as for shipments from LANL.

Sandia National Laboratories Target Fabrication, Irradiation, Separations, and Shipments from Albuquerque International Airport. This scenario assumes the targets would be fabricated at the SNL/NM in the Hot Cell Facility located in Technical Area V and transferred to the Annular Core Research Reactor, also located in Technical Area V. Following irradiation in the Annular Core Research Reactor, the irradiated targets would be returned to the adjacent Hot Cell Facility, for separation and purification of the medical isotopes. Waste generated during separation is assumed to be low-level solid waste and would be transported approximately 1099 km (683 mi) to the Nevada Test Site for disposition.

The purified medical isotopes would be packaged and transported by truck to Albuquerque International Airport for transport to DuPont-Merck, Amersham Mediphysics, or Mallinckrodt Medical. The total shipping distance from Technical Area V to Albuquerque International Airport is approximately 17 km (11 mi). Of the total distance, 9 km (6 mi) are on existing site roads, and the remaining 8 km (5 mi) are on public roadways.

For shipments to DuPont-Merck, Amersham Mediphysics, Mallinckrodt Medical, and Nordion, the air transportation routes and final destinations (airports) would be the same as discussed previously for LANL. Transportation of the package containing the purified medical isotopes to the distributors from the destination airport also would be the same as for shipments from LANL.

Oak Ridge National Laboratory Target Fabrication, Irradiation, Separations, and Shipments from McGhee Tyson Airport. This scenario assumes the targets would be fabricated at the ORNL in the Radioisotope Development Laboratory and transferred to the Oak Ridge Research Reactor. Following irradiation in the Oak Ridge Research Reactor, the irradiated targets would be returned to the Radioisotope Development Laboratory, for separations and purification of the medical isotopes. Waste generated during separation is assumed to be low-level solid waste and would be transported approximately 3300 km (2050 mi) to the Nevada Test Site for disposal.

The purified medical isotopes would be packaged and transported by truck to McGhee Tyson Airport for transport. The total shipping distance from the Radioisotope Development Laboratory to McGhee Tyson Airport is approximately 40 km (25 mi). Of the total distance, 11 km (7 mi) are on existing site roads, and the remaining 29 km (18 mi) are on public roadways.

For shipments to DuPont-Merck, Amersham Mediphysics, Nordion, and Mallinckrodt Medical, the final destinations (airports) would be the same as discussed previously for LANL. The total flight distances are shown in Table B-2. Transportation of the package containing the purified medical isotopes from the airport to the distributors also would be the same as for shipments from LANL.

For shipments to Nordion, the nearest commercial airport is Ottawa, Canada. It was assumed that shipments to Nordion would be from McGhee Tyson Airport to a distribution hub and at the distribution hub the isotope packages would be transferred to a plane departing for Ottawa, Canada. The total flight distance is approximately 1380 km (858 mi). At the airport, the package would be transferred to a truck and transported to Nordion. The air transport portion of this alternative is similar (approximately the same distance) to the DuPont-Merck alternative and was not specifically evaluated. That is, the expected impacts would be similar to the impacts associated with delivery of the isotopes to Logan International.

Idaho National Engineering Laboratory Target Fabrication, Irradiation, Separations, and Shipments from Idaho Falls Airport. This scenario assumes the targets would be fabricated at the INEL in a hot cell facility located in the Test Area North. The unirradiated targets would be shipped by truck on existing INEL site roads from the Test Area North, approximately 53 km (33 mi) to the Power Burst Facility. Following irradiation in the reactor, the targets would be transported via truck, to the Test Area North, for separation and purification of the medical isotopes, using the same route. Waste generated during separation is assumed to be low-level solid waste and would be transported approximately 44 km (27 mi) to a disposal site west of the Idaho Chemical Processing Plant.

The purified medical isotopes would be packaged and transported by truck to Idaho Falls Airport for transport to DuPont-Merck, Amersham Mediphysics, or Mallinckrodt Medical. The total shipping distance from the Test Area North to Idaho Falls Airport is approximately 120 km (75 mi). Of the total distance, 40 km (25 mi) are on existing site roads, and the remaining 80 km (50 mi) are on public roadways.

For shipments to DuPont-Merck, Amersham Mediphysics, Nordion, and Mallinckrodt Medical, the final destinations (airports) would be the same as discussed in previously for LANL. The total flight distances are shown in Table B-2. Transportation of the package containing the purified medical isotopes from the airport to the distributors also would be the same as for shipments from LANL.

For shipments to Nordion, the nearest commercial airport is Ottawa, Canada. It was assumed that shipments to Nordion would be from Idaho Falls Airport to a distribution hub and at the distribution hub the isotope packages would be transferred to a plane departing for Ottawa, Canada. The total flight distance is approximately 3350 km (2080 mi). At the airport, the package would be transferred to a truck and transported to Nordion. The air transport portion of this alternative is similar (approximately the same distance) to the DuPont-Merck alternative and was not specifically evaluated. That is, the expected impacts would be similar to the impacts associated with delivery of the isotopes to Logan International.

Table B-2. Summary of Transportation Routing Information

Option/Material Transported			Shipment Description (km one-way)[a]		Population Densities (people/km²)				
Transportation Route		Shipments per year			Onsite		Offsite		
Origin	Destination		Onsite	Offsite	Rural	Suburban	Rural	Suburban	Urban
Target fabrication, irradiation, separations, and waste handling at LANL									
Unirradiated Targets									
CMR Facility	Omega West Reactor	52	6.5	0	5	360	Not Applicable		
Irradiated Targets									
Omega West Reactor	CMR Facility	52	6.5	0	5	360	Not Applicable		
Low-Level Waste									
CMR Facility	Technical Area 54[b]	90	8	0	5	360	Not Applicable		
Separated Medical Isotope									
CMR Facility	Albuquerque Int Airport	1520	18	135	5	360	9.2	385.1	2227.7
Albuquerque Int Airport	Boston, MA[c]	380		3200	See Table B-4				
Boston, MA	DuPont-Merck	380		56	Not Applicable		14.5	478.9	2563.5
Albuquerque Int Airport	Chicago, IL	380		1800	See Table B-4				
Chicago, IL	Amersham Mediphysics	380		13	Not Applicable		7.8	670.3	2829.0
Albuquerque Int Airport	St. Louis, MO	380		2200	See Table B-4				
St. Louis, MO	Mallinckrodt	380		8	Not Applicable		2.3	778.1	2611.2
Target fabrication at LANL or SNL, irradiation, and separations at SNL, and waste handling at the Nevada Test Site									
Unirradiated Targets									
LANL-CMR Facility	ACR Reactor	52	28	148	5	360	9.2	385.1	2227.7
SNL-Hot Cell Facility	ACR Reactor	52	0	0	5	360	Not Applicable		
Irradiated Targets									
ACR Reactor	Hot Cell Facility	52	0	0	5	360	Not Applicable		
Low-level Waste									
Hot Cell Facility	Nevada Test Site[b]	90	9	1099	5	360	3.3	475.9	2295.2
Separated Medical Isotope (Shipments from Albuquerque Int Airport to distributors as above)									
Hot Cell Facility	Albuquerque Int Airport	1520	9	8.5	5	360	28.0	546.3	2333.1

...le B-2. (contd)

Option/Material Transported		Shipments per year	Shipment Description (km one-way)[a]		Population Densities (people/km²)				
Transportation Route					Onsite		Offsite		
Origin	Destination		Onsite	Offsite	Rural	Suburban	Rural	Suburban	Urban
Target fabrication, irradiation, and separations at ORNL, and waste handling at Nevada Test Site									
Unirradiated Targets									
Radioisotope Development Lab	Reactor	52	0	0	5	360	Not Applicable		
Irradiated Targets									
Reactor	Radioisotope Development Lab	52	0	0	5	360	Not Applicable		
Low-level Waste									
Radioisotope Development Lab	Nevada Test Site[b]	90	11	3300	5	360	6.5	346.7	2214.7
Separated Medical Isotope (Shipments from Destination Airports to distributors as above)									
Radioisotope Development Lab	McGhee Tyson Airport	1520	11	29	5	360	6.6	412.1	1764.7
McGhee Tyson Airport	Boston, MA[c]	380	Not Applicable	1340	See Table B-4				
McGhee Tyson Airport	Chicago, IL	380	Not Applicable	750					
McGhee Tyson Airport	St. Louis, MO	380	Not Applicable	650					
Separated Medical Isotope (Shipments from Destination Airports to distributors as above)									
Target fabrication, irradiation, separations, and waste handling at INEL									
Unirradiated Targets									
Test Area North Facility	Power Burst Facility Reactor	52	53	0	5	360	Not Applicable		
Irradiated Targets									
Power Burst Facility Reactor	Test Area North Facility	52	53	0	5	360	Not Applicable		
Low-level Waste									
Test Area North Facility	ICPP[b]	90	44	0	5	360	Not Applicable		
Separated Medical Isotope (Shipments from Destination Airports to distributors as above)									
Test Area North Facility	Idaho Falls Airport	1520	80	40	5	360	1.1	522.1	1986.1
Idaho Falls Airport	Boston, MA	380	Not Applicable	3320	See Table B-4				
Idaho Falls Airport	Chicago, Il	380	Not Applicable	1990					
Idaho Falls Airport	St. Louis, Mo	380	Not Applicable	1890					
Separated Medical Isotope (Shipments from Destination Airports to distributors as above)									

(a) Zero onsite distance implies facilities are adjacent.
(b) Assuming 52-target shipments/yr, 24 targets/shipment, and waste from 14 targets/waste cask.
(c) Transportation impacts for shipments and the number of shipments to Nordion are similar or bounded by the analyses.

B.1.1.2 Shipping System Descriptions

Currently, four potential reactors and processing facilities are identified as potential alternatives for the production of the medical isotopes. Each of the reactor facilities would have specific requirements regarding the target design. Similarly each reactor or hot cell facility would also have specific cask handling capabilities. Therefore, a representative target design and shipping package configuration, based on LANL (1993e), was selected for evaluation.

The following sections provide descriptions of the representative shipping cask for unirradiated target shipments, irradiated target shipments, and both overland and air medical isotopes shipments. For all but one of the options (target fabrication at LANL and irradiation and separations at SNL), all target transportation would be onsite. However, all shipments would be made by truck and would comply with the appropriate DOT requirements contained in 10 CFR 71 (Type B container) and 49 CFR 173 (Type A container). All air shipments would comply with the requirements contained in 49 CFR 175.

Representative Target Truck Shipping Container and Cask. The target container and shipping cask described in LANL (1993e) would be used for transporting irradiated targets. This target transfer container is approximately 10 cm (4 in.) in diameter and 76 cm (30 in.) deep and surrounded by a 16 cm (6 in.) thick shield of stainless steel clad depleted uranium. A target transfer container can hold up to four irradiated targets, which would be shipped in Type B casks.

The number of unirradiated or irradiated targets to be shipped at one time would be a maximum of 24, that is, 6 target transfer containers packaged in a Type A container or 6 Type B casks containing 4 targets each or 2 casks containing 12 targets. Based on a common target design (up to 20 grams of 93% highly enriched uranium [HEU] per target) and cask capacity (24 targets per cask), the limits contained in Part 71.22 of 10 Code of Federal Regulations, General License: Type A package, Fissile Class III shipment (500 grams per shipment) would not be exceeded.

Representative Separated Medical Isotopes Truck and Air Shipping Cask. The separated medical isotopes would be transported in a Type B shipping cask by truck to the departure airport and from the destination airport to the medical isotope distributors, identified in B.1.1.1. It was assumed a representative Type B cask similar to CI-20WC-2 model would be used. The cask would be certified for air transport using commercial passenger or cargo flights. Based on the cask surface dose rates, additional shielding would be required for passenger flight shipments to meet regulatory requirements. This cask may contain up to 1000 Ci of Mo-99/Tc-99 in normal form as solids or liquid or up to 200 Ci of I-131.

Similar to the CI-20WC-2, the representative casks are depleted uranium shielded casks that are steel encased with wooden outer protective jackets and an inner steel containment vessel. The outer protective jacket (wood) is 24-1/4 x 22 x 28-3/4 in. and the depleted uranium shield is 2 in. thick with a 3.1 x 6 in. cylindrical cavity. The inner containment vessel, constructed of stainless steel, is a 2.73 in OD X 5.56 in. long. The gross weight of the package is about 400 lbs.

The CI-20WC-2 cask is not currently certified for international shipments. However, often cask designs suitable for transport of Mo-99 product are certified for international transport. The capacities and shielding of the internationally-certified casks are similar to those of the CI-20WC-2 cask and would not have a large effect on the number of shipments and their dose rates. Certification of the CI-20WC-2 cask for international transport is an option, if for some reason the internationally-certified casks are unavailable.

Representative Low-Level Waste Truck Shipping Cask. It is assumed that a B-3 Type B package would be used to transport waste packages on onsite and public roadways. This package is a steel cylindrical container with a lead shield (a minimum of 6 in.), a bottom drain assembly, and a gasketed and bolted lid. This package is suitable for transporting low-level solid wastes. The maximum weight of the loaded package is 30,000 lbs.

B.1.1.3 Transportation Route Information

The transportation route information used in this analysis is shown in Table B-2. The information shown in Table B-2 includes the shipping distances and population density data. These data were developed using the HIGHWAY (Joy and Johnson 1992) computer code for truck shipments, or estimated using site maps, and are used to calculate transportation impacts. The population density data for onsite shipments were developed using site maps and use suburban population densities to represent occupied facilities and rural population densities for all other areas adjacent to the transport route. These data are summarized in Table B-2 for each transport segment described in Section B.1.1.1.

B.1.1.4 Description of Methods Used to Estimate Consequences

This section describes the methods used to estimate consequences of normal and accidental exposure of individuals or populations to radioactive materials. The RADTRAN 4 (Neuhauser and Kanipe 1992) computer code was used to calculate the transportation impacts. The GENII software package (Napier et al. 1988) was used to estimate the radiological dose to maximally exposed individuals (MEI).

The output from computer codes, as total effective dose equivalent (TEDE) to the affected receptors, was then used to express the consequences in terms of potential latent cancer fatalities. Recommendations of the International Commission on Radiological Protection (ICRP 1991) for low dose rate radiological exposures were used to convert dose as total effective dose equivalent to latent cancer fatalities. The conversion factor applied to adult worker populations was 4×10^{-4} latent cancer fatalities/rem TEDE, and that for the general population was 5×10^{-4} latent cancer fatalities/rem TEDE. The general population was assumed to have a higher rate of cancer induction for a given radiation dose than the healthy adult worker population because of the presence of more sensitive individuals (such as, children) in the general population.

RADTRAN 4 Description. The RADTRAN 4 computer code (Neuhauser and Kanipe 1992) was used to perform the analyses of the radiological impacts of routine transport and the integrated population risks of accidents during transport. RADTRAN was developed by SNL/NM to calculate the risks associated with the transportation of radioactive materials. The original code was written by SNL/NM in 1977 in association with the preparation of NUREG-0170 (NRC 1977). The code has since been refined and expanded and is currently maintained by SNL/NM under contract from DOE. RADTRAN 4 is an update of the RADTRAN 3 (Madsen et al. 1986) and RADTRAN 2 (Taylor and Daniel 1982; Madsen et al. 1983) computer codes.

The RADTRAN 4 computer code is organized into the seven models listed as follows (Neuhauser and Kanipe 1992):

- material model
- transportation model
- population distribution model
- health effects model
- accident severity and package release model
- meteorological dispersion model
- economic model.

The code uses the first three models to calculate the potential population dose due to normal, incident-free transportation and the first six models to calculate the risk to the population from user-defined accident scenarios. The economic model is not used in this study. Population densities for each route were developed using Highway 5.0 (Joy and Johnson 1992) as inputs to RADTRAN 4. These data, which include the population densities and travel distances (or fractions of the route) in rural, urban, and suburban areas, are presented in Table B-3.

Material Model. The material model defines the source as either a point source or as a line source. For exposure distances less than twice the package dimension, the source was conservatively assumed to be a line source. For all other cases, the source was modeled as a point source that emits radiation equally in all directions.

The material model also contains a library of 59 isotopes, each of which has 11 defining parameters used in the calculation of dose. The user can add isotopes not in the RADTRAN library by creating a data table file consisting of 11 parameters in the input.

Transportation Model. The transportation model allows the user to input descriptions of the transportation route. A transportation route may be divided into links or segments of the journey with information for each link on population density, mode of travel (for example, trailer truck or ship), accident rate, vehicle speed, road type, vehicle density, and link length. Alternatively, the transportation route can also be described by aggregate route data for rural, urban, and suburban areas. For this analysis, the aggregate route method was used for each potential origin-destination combination. The origin-destination combinations addressed in this analysis are discussed in Section B.1.1.1.

Health Effects Model. The health effects model in RADTRAN 4 is replaced by hand calculations. The health effects are determined by multiplying the population dose (person-rem) calculated by RADTRAN 4 by a conversion factor. The conversion factors relate population dose to latent cancer fatalities and total detriment from cancer fatalities, cancer incidence, and genetic effects. Only cancer fatalities

Table B-3. RADTRAN Input Parameters for Truck Shipments

Parameter	Unirradiated Target	Irradiated Target	Separated Isotope	Low-Level Waste
Dose rate 1 m from Vehicle/Package (mrem/h)[a]	1.4	10	Mo-99 4.4 I-131 0.6 I-125 0.6 Xe-133 0.14	10
Length of Package (m)	1.0	1.0	0.8	
Velocity (Km/h)[b]	56.4	56.4	56.4	56.4
Percentage of Travel Distance in Rural Population Zone - Onsite	60	60	60	60
Percentage of Travel Distance in Rural Population Zone - Offsite[c]	1 - 0 2 - 84.7 3 - 0 4 - 0 5 - 0	1 - 0 2 - 0 3 - 0 4 - 0 5 - 0	1 - 84.7 2 - 2.5 3 - 2.5 4 - 38.7 5 - 96.9	1 - 0 2 - 90.8 3 - 90.8 4 - 68.0 5 - 0
Percentage of Travel Distance in Suburban Population Zone - Onsite	40	40	40	40
Percentage of Travel Distance in Suburban Population Zone - Offsite[c]	1 - 0 2 - 13.9 3 - 0 4 - 0 5 - 0	1 - 0 2 - 0 3 - 0 4 - 0 5 - 0	1 - 13.9 2 - 49.3 3 - 49.3 4 - 59.9 5 - 1.4	1 - 0 2 - 6.8 3 - 6.8 4 - 31.2 5 - 0
Percentage of Travel Distance in Urban Population Zone - Offsite[c]	1 - 0 2 - 1.4 3 - 0 4 - 0 5 - 0	1 - 0 2 - 0 3 - 0 4 - 0 5 - 0	1 - 1.4 2 - 48.2 3 - 48.2 4 - 1.3 5 - 1.2	1 - 0 2 - 6.8 3 - 6.8 4 - 0.8 5 - 0
Number of Truck Crewmen	2	2	2	2
Distance from Source to Crew (m)	10.0	10.0	10.0	10.0
Stop Time per km (h/km)[b]	0.011	0.011	0.011	0.011
Persons Exposed While Stopped[b]	50	50	50	50
Average Exposure Distance While Stopped (m)[b]	20.0	20.0	20	20.0
Number of People per Vehicle on Link[b]	2	2	2	2

(a) Taken from NUREG-0170 (NRC 1977).
(b) Default values from RADTRAN (Neuhauser and Kanipe 1992 and Madsen et al. 1983).
(c) 1 -,2 - ,3 - ,4 - , and 5 - refer to alternatives discussed in Section B.1.1.1.

were considered in this assessment. The conversion factors were taken from the ICRP Publication 60 (ICRP 1991) and amount to 4 x 10^{-4} latent cancer fatalities per person-rem for workers and 5 x 10^{-4} latent cancer fatalities/person-rem for the general public.

Accident Severity and Package Release. ModelAccident analysis in RADTRAN 4 is performed using the accident severity and package release model. The user can define up to 20 severity categories for three population densities (urban, suburban, and rural), each increasing in magnitude. NUREG-0170 (NRC 1977) defines eight severity categories for spent fuel containers that are related to fire, puncture, crush, and immersion environments. Various other studies have also been performed for small packages (Clarke et al. 1976) and large packages (Dennis et al. 1978), which can also be used to generate severity categories. The accident scenarios are further defined by allowing the user to input release fractions, and aerosol and respirable fractions for each severity category. These fractions are also a function of the physical-chemical properties of the materials being transported.

Meteorological Dispersion Model. RADTRAN 4 allows the user the choice of two different methods for the modeling of the atmospheric transport of radionuclides after a potential accident. The user can either input Pasquill atmospheric stability category data or averaged time-integrated concentrations. In this analysis, the dispersion of radionuclides after a potential accident is modeled by the use of time-integrated concentration values in downwind areas compiled from national averages by SNL/NM for use in RADTRAN4.

Incident-Free Transport. The models previously described are used by RADTRAN 4 to determine dose from incident-free transportation or risk from potential accidents. The public and worker doses calculated by RADTRAN 4 for incident-free transportation are dependent upon the type of material being transported and a corresponding transportation index for the package or packages of each material type. The transportation index is defined in 49 CFR 173.403(bb) as the highest package dose rate in millirem per hour at a distance of 1 m from the external surface of the package. Dose consequences are also dependent upon the size of the package, which as indicated in the material model description will determine whether the package is modeled as a point source or line source for close-proximity exposures.

Potential Accident Analysis. The potential accident analysis performed in RADTRAN 4 calculates population doses for each accident severity category using six exposure pathway models. They include inhalation, resuspension, groundshine, cloudshine, ingestion, and direct exposure. This RADTRAN 4 analysis assumes that any contaminated area is either mitigated or public access controlled so the dose via the ingestion pathway equals zero. The consequences calculated for each severity category are multiplied by the appropriate probabilities for accidents in each category and summed to give a total point estimate of risk for a radiological accident. The parameters used to calculate the frequencies and consequences of transportation accidents are presented in Section B.1.3.

RADTRAN 4 Input Parameters for Truck Shipments. RADTRAN 4 input parameters for calculating routine population doses include route information (shipping distances, population densities, and fractions of travel in rural, suburban, and urban areas), numbers of shipments, dose rate, material inventories, and parameters that define the population exposure characteristics. The route information and umbers of shipments are presented in Table B-2 and not repeated here. The remaining exposure parameters are described as follows.

RADTRAN 4 uses the dose rate at 1 m (referred to as the transportation index[(a)]) in calculating dose to the public and worker. All of the irradiated target and waste shipments in this analysis were assumed to be at the regulatory maximum dose rate, equating to a transportation index (TI) value of about 10 mrem/h. Because cask designs and shielding materials have not changed significantly since 1977, the TI used for the separated isotopes have been taken from NUREG-0170 (NRC 1977) and are as follows; highly enriched uranium 1.4 mrem/h, Mo-99 4.4 mrem/h, I-131 and I-125 0.6 mrem/h, and Xe-133 0.14 mrem/h. However, it is likely that many of these shipments would have significantly smaller TI values.

Tables B-3 and B-4 list the input parameters that are used by RADTRAN 4 in the calculation of population dose for incident-free transportation. Many of the parameters are default values in the RADTRAN 4 code. Those that are not default values are identified and their sources are provided in footnotes to the tables.

The potential receptors include workers and the general public. Worker doses include those received by the truck crew.

Public doses include doses to persons on the highway, doses to persons who reside near the highway and doses to nearby individuals at intermediate stops. For all truck shipping modes, the doses to passengers were assumed to be zero as no passengers would be traveling with the shipments. In addition, intermediate storage needs were assumed for the shipments, so the doses to in-transit storage personnel were set equal to zero.

Information needed to characterize the potential routes include the shipping distances, onsite and offsite population densities in rural, suburban, and urban areas along the routes, and fractions of total shipping distance that travel through rural, suburban, and urban areas. These data are presented in Tables B-2 and B-3.

RADTRAN 4 Routine Exposure Parameters for Air Shipments. Air transport of the casks from Albuquerque to the pharmaceutical suppliers is expected to be accomplished by commercial air-cargo transport. The shipping casks would be unloaded from their truck shipments at the origin airport (Albuquerque, New Mexico; Idaho Falls, Idaho; and Knoxville, Tennessee), loaded aboard the aircraft, and shipped to the destination airport (Chicago, Illinois; Boston, Massachusetts; and St. Louis, Missouri), where they would be picked up and transported by truck to the pharmaceutical suppliers. Each shipment

(a) Transport index: defined as the radiation dose rate in mrem/h at 1 m from package surface.

Table B-4. RADTRAN 4 Input Parameters for Passenger Air Shipments

Parameter	Value	Source
Population density, takeoff and landing	3861 people per km^2	NUREG-0170 (NRC 1977); represents high-density urban area
Population density, in-flight	719 people per km^2	NUREG-0170 (NRC 1977); represents medium-density suburban area
Velocity	692 kmph	NUREG-0170 (NRC 1977)
Crew/flight	3	NUREG-0170 (NRC 1977)
Crew exposure distance	15.2 m	NUREG-0170 (NRC 1977)
Passengers/flight	78	NUREG-0170 (NRC 1977)
Stop time	0.0008 h/km	PT-2370 (Neuhauser and Kanipe 1992)
Minimum stop time	2 h	SAND89-2370 (Neuhauser and Kanipe 1992)
Number of persons exposed at stops	1000	SAND89-2370 (Neuhauser and Kanipe 1992)
Exposure distance when stopped	50 m	SAND89-2370 (Neuhauser and Kanipe 1992)
Accident rate, takeoff/landing	2.8×10^{-6} per flight	Massey and Coats (1995)
Accident rate, in-flight	6.9×10^{-10}/km	Massey and Coats (1995)
Ci per package - molybdenum-99 - iodine-131 - xenon-133 - iodine-125	 820 220 620 7	Massey and Coats (1995)
Transport Index (dose rate at 1 m from side of package) - molybdenum-99 - iodine-131 - xenon-133 - iodine-125	 4.4 mrem/h[(a)] 0.6 mrem/h 0.14 mrem/h 0.6 mrem/h	NUREG-0170 (NRC 1977)

(a) Exceeds allowable (3.0 mrem/h) in 49 CRF 175 for passenger flights; therefore, may be required to be shipped by cargo air; use of passenger flights would bound public impacts.

was assumed to be transferred at the carrier's central distribution hub to a second flight to the final destination; thus, two loading and unloading procedures were included in the analysis of each air shipment. The sum of these two procedures was modeled in RADTRAN as one handling.

Airport handler exposures were modeled in two ways, depending on the size of the package. For small packages (maximum dimension less than 0.5 m [1.6 ft]) such as the D-133 gas bottle, the dose to workers is modeled as 2.5×10^{-4} rem/handling/TI (Madsen et al. 1986). Otherwise, the RADTRAN calculations were performed by multiplying the radiation dose rate, times the number of handlers, and length of exposure. In addition to the loading and unloading of aircraft, transit of the package through the airports was modeled as a stop that exposes 1000 persons at an average exposure distance of 50 m (164 ft).

Radiation exposures to air crews are calculated by RADTRAN using a simple model that uses an average exposure distance and number of exposed persons. The integrated crew exposure is calculated as the product of the dose rate at a specific distance from the source, the number of crew aboard the aircraft, and the transit time. The doses to aircraft passengers and flight attendants are calculated using an empirical value of 3×10^{-5} rem/h/TI (Madsen et al. 1986). The integrated exposures are the product of the number of shipments, TI value, number of exposed persons, the empirical TI-to-dose-rate conversion factor, and transit time.

The RADTRAN input parameters used in calculating the routine doses from the air transport legs of the isotope shipments are presented in Table B-4. The sources of the input data are also shown in the table.

Accident Impact Data. Potential accident environments are defined and their likelihood of occurrence are modeled using an approach that divides the entire spectrum of potential aircraft accident environments into six accident severity categories. The severity categories are based on event trees originally developed for spent fuel shipped by truck and rail (Wilmot 1981). The conditional probabilities of occurrence of each accident severity were developed from these data. The overall probability of an accident of a particular severity is calculated as the product of the base accident probability (accident rate) and the conditional probability. Accident rate data for aircraft accidents are shown in Table B-5. Accident rate data · air accidents are taken from Massey and Coats (1995)

The radionuclide release from which members of the public could receive a dose in the event of an accident depends on three factors in the event that a package fails and its protection is compromised. Release fractions define the fraction of the package inventory that would be released into the environment. Aerosol fraction defines the quantity of released material that would be lofted into the plume, and respirable fraction defines the quantity of aerosolized material that could be inhaled by human beings. These parameters are quantified for each type of radioactive material that would be shipped as part of the proposed action and are shown in Table B-6.

GENII Description. GENII (Napier et al. 1988), which is also referred to as the Hanford Environmental Dosimetry Software System, was developed to analyze radiological releases to the environment. GENII has been used to calculate the dose to MEIs (see Section B.1.3.1). GENII is composed of seven linked computer programs and their associated data libraries (Appendix C). This includes user interface programs, internal and external dose factor generators, and the environmental dosimetry programs.

Table B-5. RADTRAN Accident Impact Parameters for Air Shipments

Accident Rate - Air Takeoff/Landing - Air In-flight	**2.8 x 10⁻⁶/flight 6.9 x 10⁻¹⁰/km**			
Severity Category Parameters	**Probability[(a)]**	**Release Fraction[(b)]**	**Aerosol Fraction[(c)]**	**Respirable Fraction[(c)]**
Category 1	T; 0.208 I; 0.230	A; 0 B; 0	Xe; 0 Other; 0	Xe; 0 Other; 0
Category 2	T; 0.504 I; 0.130	A; 1 B; 0	Xe; 1 Other; 0	Xe; 1 Other; 0
Category 3	T; 0.050 I; 0.385	A; 1 B; 1	Xe; 1 Other; 0	Xe; 1 Other; 0
Category 4	T; 0.060 I; 0.014	A; 1 B; 1	Xe; 1 Other; 0	Xe; 1 Other; 0
Category 5	T; 0.128 I; 0.217	A; 1 B; 1	Xe; 1 Other; 1	Xe; 1 Other; 0.05
Category 6	T; 0.014 I; 0.024	A; 1 B; 1	Xe; 1 Other; 1	Xe; 1 Other; 0.05

(a) Conditional probability of encountering accident environment equivalent to Category 1 impact and thermal environments. Given for in-flight (I) and Takeoff/landing (T) portions of air trip.
(b) Release fractions are the fraction of the package inventory release from the package and are given for Type A (A; includes Xe-133 and I-125) and Type B (B; including Mo-99 and I-131) packages for each severity category.
(c) Aerosol and respirable fractions are the fractions of the released material that are in aerosol and respirable form, respectively, and are given separately for releases from Xe-133 and Other (Mo-99, I-125, and I-131) packages for each severity category.

GENII is capable of

- calculating doses resulting from acute or chronic releases, including options for annual dose, committed dose, and accumulated dose
- calculating doses from various exposure pathways evaluated, including those through direct exposure via water, soil, and air, as well as inhalation and ingestion pathways
- acute and chronic elevated and ground level releases to air
- acute and chronic releases to water

Table B-6. Radiological Inventories by Material Type Used in Analyses

Radionuclide	Curies per Radionuclide by Package Shipped[a]			
	Unirradiated Target	Irradiated Target[b][c]	Medical Isotopes[d]	Low-Level Waste[e][c]
Chromium-51		27.6		16.1
Iron-55		37.2		21.7
Iron-59		1.37		0.8
Krypton-85		6,670		
Strontium-89		2,330		87.2
Strontium-90		13.9		60.8
Yttrium-91		2,260		130
Zirconium-95		2,470		156
Niobium-95		164		278
Molybdenum-99		26,400	820	
Technetium-99		231,000		
Ruthenium-103		1,920		35.8
Ruthenium-106		26.9		8.8
Tellurium-127		422		
Tellurium-129		3,000		
Tellurium-129m		64.8		
Iodine-125			7.0	
Iodine-131		6,530	220	
Xenon-133		18,500	620	
Cesium-137		10.8		6.32
Cerium-141		4,150		41.3
Cerium-144		185		139
Promethium-147		41.0		23.9
Uranium-Total		19,500		
Uranium-235	0.0011			

(a) Only those default radionuclides defined in RADTRAN 4 are used to characterize the irradiated target and low-level waste. Other radionuclides are not expected to contribute significantly to the dose consequences. Curie quantities shown are for one shipping package.
(b) Taken from the LANL Environmental Assessment (LANL 1993e), October 1993, at 0 hours following irradiation - 24 irradiated targets per shipment.
(c) Curies per radionuclide have been adjusted to 20 kW 7-day irradiation.
(d) Each isotope is packaged and shipped separately.
(e) Waste generated from 14 targets stored for 180 days.

- initial contamination of soil or surfaces
- radionuclide decay.

The pathways considered in this analysis include inhalation, submersion, and external exposures due to ground contamination.

B.1.2 Routine or Incident-Free Transportation Impacts

The following sections describe expected radiological and nonradiological impacts during routine or incident-free transportation of unirradiated and irradiated targets, separated isotopes, and secondary waste products for each of the alternatives. The radiological inventories used in the analyses are shown in Table B-6.

B.1.2.1 Radiological Impacts From Transportation Activities

This section presents the analysis of the radiological impacts to the public and onsite individuals due to routine transportation. Members of the public or onsite individuals exposed to radiation include persons on onsite roads or offsite highways with the shipment, persons residing near these transport links, and persons at intermediate stops along the route (such as refueling stops). For air transport, it was assumed that all shipments would be made using commercial passenger flights; therefore, impacts to the public include airplane passengers and people in the airport terminals. This will result in conservative estimates, and will bound the air transport scenarios. The RADTRAN 4 computer code was used to perform these calculations. A description of RADTRAN 4 was presented in Section B.1.1.4. The following sections present the results of the incident-free exposure calculations.

The results of the public and onsite individual dose calculations, developed using the RADTRAN 4 computer code and the input parameters shown in Tables B-2, B-3, and B-4, are presented in Table B-7.

As shown in Table B-7, the radiological impacts to the combined truck and air transport crew range from 23 to 24 person-rem annually or 0.01 latent cancer fatalities (LCFs). The onsite and public radiological impacts range from 26 (ORNL) to 53 (INEL) person-rem annually or 0.01 to 0.03 LCFs. For shipments meeting 100% of the U.S. demand (i.e., 1035 shipments of Mo-99, xenon-133, and iodine-131 and 105 shipments of iodine-125 annually), the results are shown in Tables B-14 and B-16 for Nordion and the three U.S. distributors, respectively.

This action may require the transport of highly enriched uranium to the target fabrication facilities. Currently, all the sites except for SNL/NM have a sufficient supply of highly enriched uranium in storage to fabricate targets for 5 years or more. Consequently, no environmental impacts would be associated with transporting highly enriched uranium to these sites. For SNL/NM, approximately 25 kg of highly enriched uranium per year are estimated to be needed. The impacts of this were estimated based on information presented in the DOE report (1995q). Preliminary unit risk values (person-rem/km per kg of highly enriched uranium shipped) were derived from the data presented in the DOE report (1995q). Based on the results in DOE 1995q for the option in which highly enriched uranium would be shipped from the Y-12 Plant to Erwin, Tennessee, for blending, the unit risk values were calculated to be 5×10^{-8} person-rem/km-kg for the public and 1.3×10^{-7} person-rem/km-kg for the truck crews. These values were multiplied by the approximate distance from Y-12 to SNL/NM (2200 km) and the annual highly enriched uranium requirements (25 kg/yr) to calculate the annual radiological exposures for the highly enriched uranium shipments needed by SNL/NM to fabricate the required targets. The resulting radiological exposures for incident-free transport were 3×10^{-3} person-rem/yr to the public and 7×10^{-3} person-rem/yr to the truck crews. These exposures are insignificant relative to the annual exposures presented in Table B-7.

Table B-7. Radiological Impacts Due to Routine or Incident-Free Transportation

Alternative	Radiological Impacts (person-rem/yr)[(a)]		Health Effects (LCFs/yr)[(d)]	
	Crew[(b)]	Public[(c)]	Crew[(b)]	Public[(c)]
Los Alamos Target Fabrication, Irradiation, Separations, Onsite Waste Storage, and Shipments from Albuquerque International Airport	23 (1)	52 (0.08)	0.01	0.03
Los Alamos Target Fabrication and Irradiation and Separations at Sandia National Laboratories, Waste to Nevada Test Site, and Shipments from Albuquerque International Airport	24 (2)	52 (0.2)	0.01	0.03
Sandia National Laboratories Target Fabrication, Irradiation and Separations, Waste to Nevada Test Site, and Shipments from Albuquerque International Airport	24 (2)	52 (0.2)	0.01	0.03
Oak Ridge National Laboratory, Target Fabrication, Irradiation and Separations, Waste to Nevada Test Site, and Shipments from McGhee Tyson Airport	23 (2)	26 (0.2)	0.01	0.01
Idaho National Engineering Laboratory Target Fabrication, Irradiation, Separations, Onsite Waste Storage, and Shipments from Idaho Falls Airport	23 (1)	53 (0.05)	0.01	0.03

(a) Radiological impacts for truck transport are shown in parentheses.
(b) Truck and air transport crew, including handlers at airports.
(c) Includes public and onsite individuals where appropriate.
(d) Latent cancer fatalities calculated in accordance with ICRP Publication 60 (ICRP 1991).

Although not shown in Table B-7, the radiological impacts for air transport activities (assuming commercial passenger flights) account for more than 90% of the totals. This percentage is primarily due to the number of air shipments required annually, and the number of passengers exposed during the entire flight. However, the calculated dose to an individual passenger is approximately 0.7 mrem/shipment, which is negligible when compared to the dose received by the average U.S. citizen from both natural and artificial sources (approximately 360 mrem/yr). In addition, as reported in NCRP Report No. 93 (NCRP 1987), the average aircraft passenger, on flights not transporting radioactive materials, receives approximately 0.5 mrem/h, due to cosmic radiation. For comparison, it was assumed that, on the average, it would take approximately 4 h for the entire flight; therefore, passengers on the flight would receive approximately 2 mrem due to cosmic radiation. This dose is roughly two times that received due to transporting medical isotopes.

Assuming the medical isotopes are shipped air cargo and the cask dose rates remain the same, the crew impacts would remain approximately the same; however, impacts to the public (such as passengers and people in the airport terminal) would be significantly lower (less than 1 person-rem/yr). Also, increases in the cask dose rate (greater than 4.4 mrem/h) would increase crew impacts. However, this increase would not change the impacts to the public (that is, remain less than 1 person-rem/yr).

B.1.2.2 Nonradiological Impacts from Transportation Activities

Impacts to the public from nonradiological causes are also evaluated. These impacts include fatalities resulting from pollutants emitted from the vehicles during normal transportation. Based on the information contained in Rao et al. (1982), the types of pollutants that are present and can impact the public are sulfur oxides (SO_x), particulates, nitrogen oxides (NO_x), carbon monoxide (CO), hydrocarbons (HC), and photochemical oxidants (O_x). Of these pollutants, this report determined the majority of the health effects are due to SO_x and the particulates. Unit risk factors (fatalities per kilometer) for truck shipments were developed by Rao et al. (1982) for travel in urban population zones (1×10^{-7}/km for truck).

Table B-8 presents the results of the incident-free or routine nonradiological impacts. It also shows that impacts to the public (not including onsite individuals) are essentially the same or 0.008 to 0.009 fatalities. For shipments meeting 100% of the U.S. demand (i.e., 1035 shipments of Mo-99, xenon-133, and iodine-131 and 105 shipments of iodine-125 annually), the results are shown in Tables B-14 and B-16 for Nordion and the three U.S. distributors, respectively.

B.1.3 Transportation Accident Impacts

Radiological and nonradiological transportation accident impacts during transportation of unirradiated and irradiated targets, separated isotopes, and secondary waste products for each of the alternatives are discussed in the following sections.

B.1.3.1 Radiological Impacts Due to Transportation Accidents

Radiological impacts are calculated for the public, as well as the MEI. The impacts to the public are presented in this section as integrated population risks (that is, accident frequencies multiplied by consequences integrated over route-specific population, for a 1-year shipping campaign). The impacts to the public and MEI are based on the radiological inventories shown in Table B-6.

Table B-8. Nonradiological Impacts to the Public Due to Routine or Incident-free Transportation

Alternative	Fatalities/yr
Los Alamos Target Fabrication, Irradiation, Separations, Onsite Waste Storage, and Shipments from Albuquerque International Airport	0.008
Los Alamos Target Fabrication and Irradiation and Separations at Sandia National Laboratories, Waste to Nevada Test Site, and Shipments from Albuquerque International Airport	0.009
Sandia National Laboratories Target Fabrication, Irradiation and Separations, Waste to Nevada Test Site, and Shipments from Albuquerque International Airport	0.009
Oak Ridge National Laboratory, Target Fabrication, Irradiation and Separations, Waste to Nevada Test Site, and Shipments from McGhee Tyson Airport	0.009
Idaho National Engineering Laboratory Target Fabrication, Irradiation, Separations, Onsite Waste Storage, and Shipments from Idaho Falls Airport	0.008

Population risk calculations were performed using the RADTRAN 4 computer code (Neuhauser and Kanipe 1992) (see B.1.1.4). The MEI doses have been calculated using GENII (Napier 1988) (see also B.1.1.4).

Integrated Population Risk Assessment. For this analysis, risk is defined as the product of the frequency of occurrence of an accident involving a shipment and the consequences of an accident. Consequences are expressed in terms of the radiological dose and latent cancer fatalities from a release of dioactive material from the shipping cask or the exposure of persons to radiation that could result from .maged package shielding. The frequency of a transportation accident that involves radioactive materials is expressed in terms of the expected number of accidents per unit distance integrated over the total distance traveled. The response of the shipping cask to the accident environment and the probability of release or loss of shielding is related to the severity of the accident.

The frequencies of occurrence of transportation accidents that would release significant quantities of radioactive material are relatively small because the shipping casks are designed to withstand certain transportation accident conditions (that is, the shipping casks for all the materials shipped in this analysis were assumed to meet the Type B packaging requirements specified in 49 CFR 173 and 10 CFR 71). Accidents on the road are difficult to totally eliminate. However, because the shipping casks are capable of withstanding certain accident environments, including mechanical and thermal stress, only a relatively small fraction of accidents involve conditions that are severe enough to result in a release of radioactive materials.

Should an accident involving a shipment occur, a release of radioactive material could occur only if the cask were to fail. A failure would most likely be a small gap in a seal or small split in the containment vessel. For the radioactive material to reach the environment, it would have to pass through the split in the cask or through the failed seal. Materials released to the environment would be dispersed and diluted by weather action and a fraction would be deposited on the ground (drop out of the contaminated plume) in the surrounding region. Emergency response crews arriving on the scene would evacuate and secure the area to exclude bystanders from the accident scene. The released material would then be cleaned up using standard decontamination techniques, such as excavation and removal of contaminated soil. Monitoring of the area would be performed to locate contaminated areas and to guide cleanup crews in their choice of protective clothing and equipment (for example, fresh-air equipment, or filtered masks). Access to the area would be restricted by federal or state radiation control agencies until it had been decontaminated to safe levels.

The RADTRAN 4 computer code was used to calculate the radiological risk of transportation accidents involving radioactive material shipments. The RADTRAN 4 methodology was summarized previously. For further details, refer to the discussions presented in Madsen et al. (1986) and Neuhauser and Kanipe (1992).

The five major categories of input data needed to calculate potential accident transportation risk impacts using the RADTRAN 4 computer code are 1) accident frequency, 2) release quantities, 3) atmospheric dispersion parameters, 4) population distribution parameters, and 5) human uptake and dosimetry models. Accident frequency and release quantities are discussed as follows; the remaining parameters have been discussed in previous sections.

Accident Frequency. The frequency of a severe accident is calculated by multiplying an overall accident rate (accidents per truck-kilometer) by the conditional probability that an accident would involve mechanical or thermal conditions that are severe enough to result in container failure and subsequent release of radioactive material. Overall accident rates per kilometer of truck or rail travel were taken from Saricks and Kvitek (1994). State-specific accident rates were used in this study.

For this analysis, six shipment-specific severity categories were defined, with category 1 as the least severe and the higher categories (2-6) representing increasingly severe conditions. The conditional probabilities of encountering accident conditions in each severity category were taken from a U.S. Nuclear Regulatory Commission (NRC) document (Fischer et al. 1987), which were developed based on reviews of accident records and statistics compiled by various state and federal agencies. The conditional probability for a given severity category is defined as the fraction of accidents that would fall into that severity category if an accident were to occur. The conditional probabilities were determined using a binning process.

As discussed previously, severity category levels were defined to model the response of the various shipments to accidents. Severity category 1 was defined as encompassing all accidents that are within the Type B Package envelope, which would not be severe enough to result in failure of the shipping cask (such as, accidents with zero release). The higher categories (2-6) were defined to include more severe accidents and thus may lead to a release of radioactive material. The derivation of the severity category schemes and conditional probabilities of accidents in each severity category are discussed following for each shipping cask or container type. Table B-9 presents the conditional probabilities of the various severity categories used in this analysis.

Table B-9. Accident Severity Categories and Conditional Probabilities[(a)]

Mode/Truck	Conditional Probability by Severity Category					
	1	2	3	4	5	6
Rural	0.603	0.394	3 x 10^{-6}	3 x 10^{-6}	5 x 10^{-6}	7 x 10^{-6}
Suburban	0.602	0.394	0.004	4 x 10^{-6}	3 x 10^{-6}	2 x 10^{-6}
Urban	0.604	0.395	0.00038	3.8 x 10^{-7}	2.5 x 10^{-7}	1.3 x 10^{-7}

(a) Taken from Massey and Coats (1995).

Release Fractions. Release fractions are used to determine the quantity of radioactive material released to the environment as a result of an accident. The quantity of material released is a function of the severity of the accident (that is, the thermal and mechanical conditions produced in the accident), the response of the shipping container to these conditions, and the physical and chemical properties of the material being shipped. The basis for the release fractions used in this analysis are discussed following and summarized in Table B-10. The results of the integrated population risk assessment are presented in Table B-11.

Table B-10. Release Fractions Used for Assessment of Accident Impacts

Material	Release Fraction by Severity Category					
	1	2	3	4	5	6
Spent Fuel[(a)]						
Gases	0	0.0099	0.033	0.39	0.33	0.63
Cesium	0	1.1 x 10^{-7}	3.5 x 10^{-7}	6.0 x 10^{-6}	3.5 x 10^{-6}	6.0 x 10^{-5}
Ruthenium	0	4.1 x 10^{-9}	1.4 x 10^{-8}	2.4 x 10^{-7}	1.4 x 10^{-7}	2.4 x 10^{-6}
Particles	0	3.0 x 10^{-10}	1.0 x 10^{-9}	1.0 x 10^{-8}	1.0 x 10^{-8}	1.0 x 10^{-7}
Separated Isotopes[(b)] Mo-99, I-131	0	1	1	1	1	1
Xe-133, I-125	0	1	1	1	1	1
Secondary Waste[(b)]	0	0	0	1.0 x 10^{-8}	5.0 x 10^{-8}	5.0 x 10^{-8}

(a) These release fractions were applied to truck shipments of both unirradiated and irradiated targets (Massey and Coats 1995).
(b) Taken from Massey and Coats (1995).

The radiological impacts to the public (including onsite individuals) associated with truck transportation accidents range from 0.02 person-rem/yr (ORNL alternative) to 0.04 person-rem/yr (LANL and INEL alternative) (see Table B-11). The projected potential health effects range from 1 x 10^{-5} to 3 x 10^{-5} LCFs. For shipments to Nordion and the three U.S. distributors, the results shown in Tables B-15 and B-17, respectively, are for 100% of the annual U.S. demand.

Table B-11. Radiological Risk Due to Transportation Accidents, Including Truck and Air Transport

Alternative	Public[a]	
	Radiological Risk[b] (person-rem/yr)	**Health Effects (LCFs)[c]**
Los Alamos Target Fabrication, Irradiation, Separations, Onsite Waste Storage, and Shipments from Albuquerque International Airport	0.04 (5 x 10^{-4})	2 x 10^{-5}
Los Alamos Target Fabrication and Irradiation and Separations at Sandia National Laboratories, Waste to Nevada Test Site, and Shipments from Albuquerque International Airport	0.04 (2 x 10^{-3})	2 x 10^{-5}
Sandia National Laboratories Target Fabrication, Irradiation and Separations, Waste to Nevada Test Site, and Shipments from Albuquerque International Airport	0.04 (2 x 10^{-3})	2 x 10^{-5}
Oak Ridge National Laboratory, Target Fabrication, Irradiation and Separations, Waste to Nevada Test Site, and Shipments from McGhee Tyson Airport	0.02 (8 x 10^{-4})	1 x 10^{-5}
Idaho National Engineering Laboratory Target Fabrication, Irradiation, Separations, Onsite Waste Storage, and Shipments from Idaho Falls Airport	0.04 (5 x 10^{-4})	2 x 10^{-5}

(a) Includes public and onsite individuals where appropriate.
(b) Radiological risk for truck transport shown in parentheses.
(c) Latent cancer fatalities calculated in accordance with ICRP Publication 60 (ICRP 1991).

Results of Transportation Accident Impacts to a Maximally Exposed Individual. In addition to the radiological dose to the public, the doses to a MEI were calculated. It is assumed that a vehicle accident that would result in a release (catastrophic cask failure) would result in crew fatalities; therefore, radiological impacts to the crew were not calculated. The individual was assumed to be located 100 m (328 ft) from the accident.

Radiological accident impacts to the MEI are calculated using GENII (Napier 1988). To calculate the impacts to the receptor, it was assumed the release due to a catastrophic failure of the shipping cask was at ground level.

The radiological dose to the MEI located 100 m (328 ft) from a truck transportation accident, by material, is shown in Table B-12. As shown, the dose received due to an accident involving a shipment of iodine-131 is greater than all other calculated doses.

Table B-12. Accidental Releases and Dose to the Maximally Exposed Individual Located 100 m from Transport Accident

Isotope/ Material	Unirradiated Target	Irradiated Target	Mo-99	I-125	I-131	Xe-133	Waste
Qty. of Material[(a)]	0.0011	one shipment	41.0 Ci	0.35 Ci	11.0 Ci	31.0 Ci	one shipment
Dose (rem)	0.91	1.3	0.62	0.054	2.6	0.063	1.4×10^{-6}
(a) With the exception of the irradiated target and waste, the quantities shown are respirable.							

B.1.3.2 Non-Radiological Impacts from Transportation Accidents

This section describes the analyses performed to assess non-radiological impacts to the public. Nonradiological accident impacts are the fatalities resulting from potential vehicular accidents involving the shipments. It is assumed that a vehicle accident that would result in a release from a shipping cask could also result in crew fatalities; therefore, nonradiological vehicular accident impacts are calculated for the public and transport crew.

Manual calculations were performed using unit-risk factors (fatalities per km of travel) to derive estimates of the nonradiological impacts. The nonradiological impacts were calculated by multiplying the unit risk factors by the total shipping distances for all of the shipments in each shipping option. Nonradiological unit risk factors for vehicular accidents were taken from Saricks and Kvitek (1994) (public). These risk factors, in units of fatalities-per-km of travel in rural suburban, and urban population zones, were multiplied by the total distance traveled in each zone by all of the shipments and then summed to calculate the expected number of nonradiological accidental fatalities. The unit risk factor for travel in suburban zones was represented by the average of the rural and urban unit risk factors given by Saricks and Kvitek (1994).

The results of the nonradiological accident impact calculations for the five potential shipping scenarios are presented in Table B-13. The values reported in the table, 0.01 to 0.02 fatalities, represent the sum of the impacts from all of the shipments and include the impacts from shipments carrying cargo, as well as those from empty return shipments. For shipments to Nordion and the three U.S. distributors, the results shown in Tables B-15 and B-17, respectively, are for 100% of the annual U.S. demand.

Table B-13. Nonradiological Impacts Due to Truck Transportation Accidents

Alternative	Fatalities/yr
Los Alamos Target Fabrication, Irradiation, Separations, Onsite Waste Storage, and Shipments from Albuquerque International Airport	0.02
Los Alamos Target Fabrication and Irradiation and Separations at Sandia National Laboratories, Waste to Nevada Test Site, and Shipments from Albuquerque International Airport	0.01
Sandia National Laboratories Target Fabrication, Irradiation and Separations, Waste to Nevada Test Site, and Shipments from Albuquerque International Airport	0.01
Oak Ridge National Laboratory, Target Fabrication, Irradiation and Separations, Waste to Nevada Test Site, and Shipments from McGhee Tyson Airport	0.02
Idaho National Engineering Laboratory Target Fabrication, Irradiation, Separations, Onsite Waste Storage, and Shipments from Idaho Falls Airport	0.01

Table B-14. Routine Transportation Impacts for Shipments of 100% of the U.S. Demand to Nordion in Ottawa, Canada

Alternative	Radiological Impacts[a]				Non-Radiological Impacts[b]
	Radiological Impacts (person-rem/yr)[c]		Health Effects (LCFs)[d]		Fatalities/yr
	Crew	Public	Crew	Public	Public
Los Alamos Target Fabrication, Irradiation, Separations, Onsite Waste Storage, and Shipments from Albuquerque International Airport	23	69	0.01	0.04	0.008
Los Alamos Target Fabrication and Irradiation, Separations at Sandia National Laboratories, Waste to Nevada Test Site, and Shipments from Albuquerque International Airport	23	69	0.01	0.04	0.009
Sandia National Laboratories Target Fabrication, Irradiation, Separations, Waste to Nevada Test Site, and Shipments from Albuquerque International Airport	23	69	0.01	0.04	0.009
Oak Ridge National Laboratory Target Fabrication, Irradiation, Separations, Waste to Nevada Test Site, and Shipments from McGhee Tyson Airport	21	33	0.01	0.02	0.009
Idaho National Engineering Laboratory Target Fabrication, Irradiation, Separations, Onsite Waste Storage, and Shipments from Idaho Falls Airport	22	45	0.01	0.02	0.008

(a) Radiological Impacts calculated using the methodology described in Section B.1.2.1.
(b) Nonradiological Impacts calculated using the methodology described in Section B.1.2.2.
(c) Crew - includes truck and air crews and handlers at hubs; Public - includes public and onsite individuals where appropriate.
(d) Latent cancer fatalities (LCFs) calculated in accordance with ICRP Publication 60 (ICRP 1991).

Table B-15. Transportation Accident Impacts for Shipments of 100% of the U.S. Demand to Nordion in Ottawa, Canada

Alternative	Radiological Impacts to the Public[a]		Non-Radiological Impacts[b]
	Radiological Impacts (person-rem/yr)[c]	Health Effects (LCFs)[d]	Fatalities/yr
Los Alamos Target Fabrication, Irradiation, Separations, Onsite Waste Storage, and Shipments from Albuquerque International Airport	0.05	2×10^{-5}	0.02
Los Alamos Target Fabrication and Irradiation, Separations at Sandia National Laboratories, Waste to Nevada Test Site, and Shipments from Albuquerque International Airport	0.05	2×10^{-5}	0.01
Sandia National Laboratories Target Fabrication, Irradiation, Separations, Waste to Nevada Test Site, and Shipments from Albuquerque International Airport	0.05	2×10^{-5}	0.01
Oak Ridge National Laboratory Target Fabrication, Irradiation, Separations, Waste to Nevada Test Site, and Shipments from McGhee Tyson Airport	0.02	1×10^{-5}	0.02
Idaho National Engineering Laboratory Target Fabrication, Irradiation, Separations, Onsite Waste Storage, and Shipments from Idaho Falls Airport	0.03	2×10^{-5}	0.01

(a) Radiological Impacts calculated using the methodology described in Section B.1.3.1.
(b) Nonradiological Impacts calculated using the methodology described in Section B.1.3.2.
(c) Public - includes public and onsite individuals where appropriate.
(d) Latent cancer fatalities (LCFs) calculated in accordance with ICRP Publication 60 (ICRP 1991).

Table B-16. Routine Transportation Impacts for Shipments of 100% of the U.S. Demand to U.S. Distributors

Alternative	Destination	Radiological Impacts[a]				Non-Radiological Impacts[b]
		Radiological Impacts (person-rem/yr)[c]		Health Effects (LCFs)[d]		Fatalities/yr
		Crew	Public	Crew	Public	Public
Los Alamos Target Fabrication, Irradiation, Separations, Onsite Waste Storage, and Shipments from Albuquerque International Airport	Dupont-Merck	24	69	0.01	0.04	0.008
	Amersham Mediphysics	22	39	0.01	0.02	0.02
	Mallinckrodt Medical	23	48	0.01	0.02	0.004
Los Alamos Target Fabrication and Irradiation, Separations at Sandia National Laboratories, Waste to Nevada Test Site, and Shipments from Albuquerque International Airport	Dupont-Merck	24	69	0.01	0.04	0.009
	Amersham Mediphysics	22	39	0.01	0.02	0.01
	Mallinckrodt Medical	23	48	0.01	0.02	0.005
Sandia National Laboratories Target Fabrication, Irradiation, Separations, Waste to Nevada Test Site, and Shipments from Albuquerque International Airport	Dupont-Merck	24	69	0.01	0.04	0.009
	Amersham Mediphysics	22	39	0.01	0.02	0.01
	Mallinckrodt Medical	23	48	0.01	0.02	0.005
Oak Ridge National Laboratory Target Fabrication, Irradiation, Separations, Waste to Nevada Test Site, and Shipments from McGhee Tyson Airport	Dupont-Merck	23	33	0.01	0.02	0.009
	Amersham Mediphysics	23	24	0.01	0.01	0.01
	Mallinckrodt Medical	22	22	0.01	0.01	0.005
Idaho National Engineering Laboratory Target Fabrication, Irradiation, Separations, Onsite Waste Storage, and Shipments from Idaho Falls Airport	Dupont-Merck	24	72	0.01	0.04	0.008
	Amersham Mediphysics	23	45	0.01	0.02	0.01
	Mallinckrodt Medical	22	42	0.01	0.02	0.004

(a) Radiological Impacts calculated using the methodology described in Section B.1.2.1
(b) Nonradiological Impacts calculated using the methodology described in Section B.1.2.2
(c) Crew - includes truck and air crews and handlers at hubs; Public - includes public and onsite individuals where appropriate
(d) Latent cancer fatalities (LCFs) calculated in accordance with ICRP60 (ICRP 19).

Table B-17. Transportation Accident Impacts for Shipments of 100% of the U.S. Demand to U.S. Distributors

Alternative	Destination	Radiological Impacts to the Public[c]		Non-Radiological Impacts[b]
		Radiological Impacts (person-rem/yr)[a]	Health Effects (LCFs)[d]	Fatalities/yr
Los Alamos Target Fabrication, Irradiation, Separations, Onsite Waste Storage, and Shipments from Albuquerque International Airport	Dupont-Merck	0.05	2×10^{-5}	0.02
	Amersham Mediphysics	0.03	1×10^{-5}	0.02
	Mallinckrodt Medical	0.03	2×10^{-5}	0.01
Los Alamos Target Fabrication and Irradiation, Separations at Sandia National Laboratories, Waste to Nevada Test Site, and Shipments from Albuquerque International Airport	Dupont-Merck	0.05	3×10^{-5}	0.01
	Amersham Mediphysics	0.03	2×10^{-5}	0.02
	Mallinckrodt Medical	0.04	2×10^{-5}	0.009
Sandia National Laboratories Target Fabrication, Irradiation, Separations, Waste to Nevada Test Site, and Shipments from Albuquerque International Airport	Dupont-Merck	0.05	3×10^{-5}	0.01
	Amersham Mediphysics	0.03	2×10^{-5}	0.01
	Mallinckrodt Medical	0.04	2×10^{-5}	0.008
Oak Ridge National Laboratory Target Fabrication, Irradiation, Separations, Waste to Nevada Test Site, and Shipments from McGhee Tyson Airport	Dupont-Merck	0.02	1×10^{-5}	0.02
	Amersham Mediphysics	0.02	1×10^{-5}	0.02
	Mallinckrodt Medical	0.02	1×10^{-5}	0.02
Idaho National Engineering Laboratory Target Fabrication, Irradiation, Separations, Onsite Waste Storage, and Shipments from Idaho Falls Airport	Dupont-Merck	0.05	3×10^{-5}	0.01
	Amersham Mediphysics	0.03	2×10^{-5}	0.01
	Mallinckrodt Medical	0.03	2×10^{-5}	0.007

(a) Radiological Impacts calculated using the methodology described in Section B.1.3.1
(b) Nonradiological Impacts calculated using the methodology described in Section B.1.3.2
(c) Public - includes public and onsite individuals where appropriate
(d) Latent cancer fatalities (LCFs) calculated in accordance with ICRP60 (ICRP 19).

Appendix C

Input to GENII Calculations for all Alternatives

Appendix C

Input to GENII Calculations for all Alternatives

Where appropriate, site-specific parameters were used in the analyses for radiological impacts. The complete set of site-specific parameters is shown in Table C-1. This table lists the site, and the facility for each process. Associated with that site is a population file, and a joint frequency distribution file of meteorological conditions averaged over time, as well as food production data where known. Printouts of these files containing the data follow Table C-1. Where input data went directly into the calculations (for example, distance and direction to the maximally exposed individual [MEI] or release height), the data are listed in Table C-1.

The tables in this appendix contain the values used in running GENII for this document. The three sets of tables include population distributions by directions and distance; wind by direction, wind speed, and wind stability; and food production by direction and distance. In all of the tables, the compass is divided into 16 sectors starting with the south and continuing clockwise to SSE. In each of the sections, the sites are listed in the same order: Sandia National Laboratories/New Mexico (SNL/NM); Los Alamos National Laboratory (LANL) TA-2; LANL TA-3; Oak Ridge National Laboratory (ORNL); and Idaho National Engineering Laboratory (INEL).

Table C-1. Site-Specific Parameters Used in Radiologic Calculations

Site	Operation/Scenario	Facility	Population File	Joint Frequency Distribution	Normal Operations: Onsite MEI	Accidents: Onsite MEI	Offsite MI	Nearest Public Access	Accidents:Pop Wted Sector	Stack Height (m)	Inner Radius (m)	Flow Rate (m^3/s)
SNL/NM	Fabrication	Hot Cells	acrrpop.90	jfsnl15.5yr	1.6 km NW	300 m N	5400 m N	5400 m N	North n=133,266	38.1	0.9	22.1
	Irradiation: Normal Operation/Fuel Element Rupture/Target Rupture	ACRR	acrrpop.90	jfsnl15.5yr	1.6 km NW	300 m N	5400 m N	5400 m N	North n=133,266	16.5	0.1	0.35
	Transfer: Mo-99 Target Rupture	ACRR to Hot Cells	acrrpop.90	jfsnl15.5yr	1.6 km NW	300 m N	5400 m N	5400 m N	North n=133,266	Ground Level		
	Processing: Normal Operation/Operator Error for Mo-99, I-125 Targets	Hot Cells	acrrpop.90	jfsnl15.5yr	1.6 km NW	300 m N	5400 m N	5400 m N	North n=133,266	38.1	0.9	22.1
LANL	Fabrication	Hot Cells/ CMR	ta3pop.93	jfta6-10.5yr	200 m E	200 m NNW	990 m E	200 m E	ENE n=26760	16.6	2.6	52.9
	Irradiation: Normal Operation/Fuel Element Melt/Target Rupture	Omega West	ta2pop.93	jfta6-10.5yr	650 m W	200 m NNW	580 m NNW	300 m N	NW n=4743	45.7	0.1	0.38
	Transfer to Casks: Target Rupture	Omega West	ta2pop.93	jfta4110.1yr	N/A	200 m NNW	1300 m N	300 m N	NW n=4743	Ground Level		
	Processing: Normal Operation/Operator Error for Mo-99, I-125 Targets	Hot Cells/ CMR	ta3pop.93	jfta6-10.5yr	200 m E	100 m W	990 m N	100 m W	ENE n=26760	16.6	2.6	52.9
ORNL	Fabrication	Hot Cells X-3047	ornlpop.92	jfx10-10.10yr	4.1 km SSW	300 m W	5450 m E	400 m NE	East n=241,081	76.2	2.85	66.4
	Irradiation: Normal Operation/Fuel Element Melt/Target Rupture	ORNL X-3039	ornlpop.92	jfx10-10.10yr	4.1 km SSW	300 m W	5450 m E	400 m NE	East n=241,081	76.2	2.85	66.4
	Transfer: Mo-99 Target Rupture	BSR X-3039	ornlpop.92	jfx10-10.10yr	N/A	300 m W	5450 m E	400 m NE	East n=241,081	76.2	2.85	66.4
	Processing: Normal Operation/Operator Error for Mo-99, I-125 Targets	Hot Cells X-3047	ornlpop.92	jfx10-10.10yr	4.1 km SSW	300 m W	5450 m E	400 m NE	East n=241,081	76.2	2.85	66.4

Table C-1. (contd)

Site	Operation/Scenario	Facility	Population File	Joint Frequency Distribution	Normal Operations: Onsite MEI	Accidents: Onsite MEI	Offsite MI	Nearest Public Access	Accidents:Pop Wted Sector E/Q	Stack Height (m)	Inner Radius (m)	Flow Rate (m³/s)
INEL	Fabrication	Hot Cell Facility	pbfpop.93	jfpbf10.5yr	1600 m ESE	200 m S	12.4 km SE	1000 m SSE	East n=70,150	10 m assumed		
	Irradiation: Normal Operation/Fuel Element Melt/Target Rupture	Power Burst Facility	pbfpop.93	jfpbf10.5yr	1600 m ESE	200 m S	12.4 km SE	1000 m SSE	East n=70,150	24.4	0.45	2.8
	Transfer: Mo-99 Target Rupture	Power Burst Facility	pbfpop.93	jfpbf10.5yr	1600 m ESE	200 m S	12.4 km SE	1000 m SSE	East n=70,150	Ground Level		
	Processing: Normal Operation/Operator Error for Mo-99, I-125 Targets	Hot Cell Facility	pbfpop.93	jfpbf10.5yr	1600 m ESE	200 m S	12.4 km SE	1000 m SSE	East n=70,150	10 m assumed		
Dismissed:												
U of MO		Fabrication at Gulf Atomics										
		MURR	murrpop.90	STAR data in hand								
		Processing at AECL										
		Processing at a US hot cell										
		HFIR @ORNL Bldg 7911	ornlpop.92	jfx10-10.10yr		4540 m ENE	5160 m WSW			30 m MT4		

C.1 Population Distribution Tables

Tables C-2 to C-6 show the number of people living near the site by compass direction (rows) from the site and by distance from the site (columns). Each distribution is centered on or near the facility specified in the file table. The most recent data available are reported. All SNL/NM facilities used the same population files.

The Omega West Reactor and Chemistry and Metallurgy Research Facility at LANL are separated, thus they have slightly different population distributions. As shown in Table C-1, the Chemistry and Metallurgy Research Facility used the population distribution for TA-3, while Omega West Reactor's population distribution centered on TA-2.

The population distribution was the same for both Oak Ridge Research Reactor and the hot cell facilities because the two are so close to each other.

Because the exact location of the INEL hot cells were unknown at the time of this writing, it was assumed the hot cells would be constructed in the vicinity of the Power Burst Facility (PBF), thus, the PBF population file was used to represent the hot cells, as well as the reactor.

Table C-2. Sandia National Laboratories/New Mexico Population Grid Based on 1990 Census Data
Total = 606718

(created [9-14-95] lhs;
distance in miles from site)

Miles/ Sector	1	2	3	4	5	10	20	30	40	50	Total
S	0	0	0	159	5	105	1493	38	173	436	2409
SSW	0	0	0	147	28	97	6688	15339	2559	580	25438
SW	0	0	82	55	65	97	16770	3375	74	77	20595
WSW	0	0	41	55	71	2345	1273	376	18	3	4182
W	0	0	39	55	71	9118	5407	259	129	0	15078
WNW	0	0	92	76	409	22551	26093	283	572	6	50082
NW	0	0	123	397	1526	48374	55127	811	14	19	106391
NNW	0	0	123	264	4598	72184	65639	11440	568	1658	156474
N	393	1159	1227	359	2148	79235	36726	8702	1844	1473	133266
NNE	0	0	0	963	4832	37896	5384	1384	2297	4966	57722
NE	0	0	0	216	852	2382	4157	820	700	3860	12987
ENE	0	0	0	859	139	452	3459	1809	333	296	7347
E	0	0	0	0	81	445	2131	3505	743	160	7065
ESE	0	0	0	0	135	344	1155	969	1150	290	4043
SE	0	0	0	0	213	123	178	412	662	199	1787
SSE	0	0	0	0	59	95	247	224	1096	131	1852

Table C-3. Los Alamos National Laboratory TA-2 Omega West Reactor 1993 Projection Based on 1990 Data Total = 236825

(distances in kilometers)

km/ Sector	1	2	4	8	15	20	30	40	60	80	Total
S	4	15	0	0	45	1	584	1200	3684	3348	8881
SSW	4	15	0	2	1	1	116	145	3001	54157	57442
SW	4	15	0	1	5	0	0	30	3478	4	3537
WSW	67	141	5	0	2	2	276	598	452	5	1548
W	28	54	127	0	1	17	62	218	44	129	680
WNW	57	399	1962	56	0	1	33	25	200	2234	4967
NW	247	357	2242	834	0	4	28	66	494	471	4743
NNW	314	380	515	1	0	7	0	148	150	248	1763
N	124	408	348	0	0	15	82	811	542	551	2881
NNE	39	326	461	50	0	14	741	477	879	332	3319
NE	43	312	517	236	1	3	9539	2527	2104	1063	16345
ENE	7	53	319	83	22	422	11486	3868	1815	2346	20421
E	8	24	120	2	179	1371	4631	505	28	239	7107
ESE	1	0	21	3	868	2	307	11351	2871	2657	18081
SE	0	14	25	0	5117	0	116	60384	11565	765	77986
SSE	4	17	2	0	52	0	4	3262	3560	223	7124

Table C-4. Los Alamos National Laboratory TA-3 Chemistry and Metallurgy Research Facility Total = 250889

(Building B3-29 Area Population from 1990 Census Estimated for 1993;
Created 05/26/95, Radian Corporation;
distances in kilometers)

km/ Sector	1	2	4	8	15	20	30	40	60	80	Total
S	0	0	0	3	1	1	1054	2390	2445	5853	11747
SSW	0	0	0	3	1	0	17	0	2889	65919	68829
SW	0	0	0	2	3	0	0	277	3294	3	3579
WSW	0	0	0	0	0	6	284	629	353	20	1292
W	0	0	0	0	9	21	183	70	62	322	667
WNW	0	0	0	0	0	9	42	22	969	1412	2454
NW	0	22	0	0	0	2	21	98	569	384	1096
NNW	0	348	94	0	0	9	7	111	152	171	892
N	1	738	2296	5	0	7	56	677	301	624	4705
NNE	3	437	1524	91	0	8	140	906	1112	380	4601
NE	5	409	1191	883	0	2	4703	3666	2431	497	13787
ENE	4	78	1180	1635	5	162	13952	5168	1665	2913	26762
E	1	194	62	174	2	485	4108	2274	78	126	7504
ESE	1	13	42	32	5451	0	92	16144	14043	3136	38954
SE	0	0	0	0	581	0	2	34818	23979	472	59852
SSE	0	0	0	0	52	0	13	1261	2571	271	4168

Table C-5. Oak Ridge National Laboratory 1992 Projected Population Based on 1990 Census Data Total = 905740

(ORNL Population ORNL 1992 Annual Rpt. LHS [8/10/95] distances in meters from site)

Meters/ Sector	100	200	300	2400	6400	12000	24000	40000	56000	72000	Total
S	0	0	0	0	100	2525	11108	8028	9295	4107	35163
SSW	0	0	0	0	67	1027	3429	10559	23037	15157	53276
SW	0	0	0	0	5	1148	3022	3882	6718	11785	26560
WSW	0	0	0	0	0	1566	12243	9186	5749	5162	33906
W	0	0	0	0	34	1591	9701	2099	15321	13190	41936
WNW	0	0	0	3	419	923	3501	1589	2576	4948	13959
NW	0	0	0	34	563	2163	4450	2240	2935	8642	21027
NNW	0	0	0	1442	1056	1904	977	1033	9509	5399	21320
N	0	0	0	289	2297	2570	752	2360	2695	8164	19127
NNE	0	0	0	18	4185	5279	5881	14059	16255	7466	53143
NE	0	0	0	0	1775	13940	16275	8906	5534	7014	53444
ENE	0	0	0	0	0	2374	31245	56253	16797	18605	125274
E	0	0	0	0	7	3415	85356	105705	23801	22797	241081
ESE	0	0	0	0	172	8215	32223	37569	9125	12574	99878
SE	0	0	0	0	240	4522	9745	30233	1242	824	46806
SSE	0	0	0	0	1	3009	8518	5115	1841	1356	19840

Table C-6. Idaho National Engineering Laboratory Power Burst Facility Population Grid Based on 1993 Annual Report Total = 121455

(80 km [created 18 August 1995 LHS] distances in meters)

Meters/ Sector	800	2400	4000	5600	7200	12000	24000	40000	56000	72000	Total
S	0	0	0	0	0	0	0	0	0	2960	2960
SSW	0	0	0	0	0	0	0	0	0	160	160
SW	0	0	0	0	0	0	0	0	0	0	0
WSW	0	0	0	0	0	0	0	0	0	120	120
W	0	0	0	0	0	0	0	0	0	0	0
WNW	0	0	0	0	0	0	0	2600	0	1200	3800
NW	0	0	0	0	0	0	0	0	0	10	10
NNW	0	0	0	0	0	0	352	0	0	15	340
N	0	0	0	0	0	0	0	0	0	0	0
NNE	0	0	0	0	0	0	0	0	0	90	90
NE	0	0	0	0	0	0	0	0	0	2400	2400
ENE	0	0	0	0	0	0	0	0	0	11530	11530
E	0	0	0	0	0	0	0	0	1750	68400	70150
ESE	0	0	0	0	0	0	0	0	0	3050	3050
SE	0	0	0	0	0	25	0	0	8150	12450	20625
SSE	0	0	0	0	0	2300	0	0	0	3920	6220

C.2 Wind Speed/Wind Stability Tables

Tables C-7 through C-11 give the meteorologic data representing the frequency the wind blows in each direction and pasquill stability class. The tables are organized in terms of the compass direction the wind is blowing, starting in the south and moving clockwise in 16 sectors, and a scale is included that combines wind speed and pasquill wind stability category. The wind speed categories are from 1 through 6 (7 for INEL) and the stability categories are A through F (G for ORNL).

Meteorological data are represented in the joint frequency distribution tables. These tables show the percent of the time the wind blows in a given direction, within a given range of wind speeds, and during a given atmospheric stability class (A-F or G). These data are frequently averaged over several years. The midpoint of a wind speed is chosen to represent each wind speed range.

Joint frequency distributions are specific to each location and even release height; however, data are limited to collection points. The nearest collection point was used as the best available data. For SNL/NM, this meant joint frequency data from the Albuquerque International Airport were used for all the SNL/NM facilities. Los Alamos collection points were TA-6 and TA-41. TA-6 is on the mesa and is close to the Chemistry and Metallurgy Research Facility. TA-6 was also used to represent the meteorologic conditions from the Omega West Reactor stack, which is 45 m above the mesa top. Ground-level releases from the Omega West Reactor were modeled using meteorologic data from TA-41, which is in the same canyon as the reactor. Limitations on TA-41 data exist because data were collected only for 1.5 years. Because the topography dominates over seasonal differences, the fraction of year is not a serious complication. Of course, the longer data are averaged, the more representative they would be of any average year.

Oak Ridge Research Reactor and its hot cells are represented by meteorologic data collected at the X-10 met tower, while the data for the Power Burst Facility were collected nearby.

See Table C-7

Sandia National Laboratories/New Mexico 15 m Albuquerque International Airport Pasquill A-F
(1960-1964 Average)
(Created 16-Aug-95 LHS)

dir; wind towards this direction
SP:ST; wind speed: wind stability
wind speed categories:
1: 1.03 m/sec
2: 2.83 m/sec
3: 4.63 m/sec
4: 6.95 m/sec
5: 9.78 m/sec
6: 12.10 m/sec

Table C-7. Sandia National Laboratories/New Mexico 15 m Albuquerque International Airport (1960-1964 average)

DIR/ SP:ST	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
1 : A	0.10	0.02	0.07	0.04	0.03	0.06	0.08	0.04	0.10	0.08	0.11	0.10	0.13	0.10	0.08	0.04
1 : B	0.64	0.27	0.30	0.17	0.16	0.23	0.35	0.27	0.58	0.29	0.55	0.38	0.45	0.48	0.51	0.42
1 : C	0.17	0.08	0.06	0.05	0.04	0.08	0.15	0.10	0.19	0.08	0.11	0.07	0.10	0.08	0.11	0.10
1 : D	0.15	0.06	0.06	0.05	0.05	0.06	0.10	0.07	0.12	0.02	0.09	0.05	0.04	0.07	0.09	0.07
1 : E	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1 : F	1.36	0.77	0.99	0.64	0.72	1.35	1.78	0.99	1.17	0.38	0.53	0.42	0.42	0.53	0.57	0.66
2 : A	0.10	0.03	0.03	0.02	0.02	0.04	0.04	0.05	0.14	0.09	0.16	0.00	0.13	0.13	0.11	0.06
2 : B	0.38	0.20	0.14	0.09	0.07	0.08	0.18	0.20	0.52	0.46	0.60	0.53	0.49	0.46	0.39	0.37
2 : C	0.66	0.25	0.13	0.06	0.05	0.14	0.28	0.27	0.62	0.36	0.43	0.31	0.31	0.31	0.39	0.50
2 : D	0.50	0.19	0.19	0.06	0.12	0.21	0.30	0.23	0.37	0.18	0.25	0.17	0.17	0.16	0.22	0.27
2 : E	0.59	0.33	0.25	0.17	0.19	0.55	0.88	0.49	0.51	0.26	0.27	0.23	0.21	0.22	0.20	0.31
2 : F	2.07	1.00	0.93	0.44	0.56	1.53	2.27	1.23	0.96	0.33	0.37	0.35	0.31	0.42	0.56	0.95
3 : A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3 : B	0.13	0.06	0.03	0.03	0.01	0.03	0.07	0.08	0.30	0.26	0.38	0.30	0.21	0.18	0.14	0.07
3 : C	0.68	0.15	0.11	0.05	0.09	0.09	0.15	0.21	0.62	0.54	0.59	0.42	0.30	0.30	0.29	0.40
3 : D	1.37	0.35	0.28	0.21	0.35	0.57	0.51	0.45	0.91	0.54	0.57	0.55	0.37	0.34	0.32	0.55
3 : E	2.18	0.82	0.30	0.18	0.26	0.54	0.59	0.39	0.55	0.32	0.30	0.24	0.19	0.25	0.36	0.62
3 : F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4 : A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4 : B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4 : C	0.03	0.01	0.00	0.01	0.02	0.04	0.03	0.04	0.13	0.13	0.17	0.11	0.09	0.06	0.04	0.04

Table C-7. (contd)

DIR/ SP:ST	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
4 : D	1.54	0.22	0.12	0.36	1.31	1.40	0.41	0.27	0.86	0.82	0.67	0.67	0.55	0.74	0.81	0.84
4 : E	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4 : F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5 : A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5 : B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5 : C	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.03	0.03	0.02	0.01	0.02	0.02	0.02	0.01
5 : D	0.20	0.01	0.01	0.09	0.83	0.81	0.16	0.04	0.31	0.24	0.21	0.20	0.26	0.32	0.32	0.14
5 : E	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5 : F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6 : A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6 : B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6 : C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00
6 : D	0.02	0.00	0.00	0.02	0.40	0.26	0.03	0.01	0.11	0.03	0.05	0.08	0.07	0.10	0.07	0.02
6 : E	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6 : F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	12.87	4.82	4.00	2.74	5.28	8.08	8.36	5.43	9.11	5.45	6.44	5.20	4.83	5.27	5.60	6.44

See Table C-8
TA 6 Joint frequency Pasquill (1990-1994 Average)
Created 16 Aug 1995 LHS
Applied to Chemistry and Metallurgy Research Facility and Omega West Reactor Stack Releases
dir; wind towards this direction
SP:ST; wind speed: wind stability
wind speed categories:
1: 0.88 m/sec
2: 2.50 m/sec
3: 4.40 m/sec
4: 7.00 m/sec
5: 10.00 m/sec
6: 20.00 m/sec

Table C-8. Chemistry and Metallu,, ..esearch Facility and Omega West Reactor Stack Releases

DIR/ SP:ST	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
1 : A	0.14	0.22	0.50	0.88	0.97	0.82	0.86	0.69	0.40	0.19	0.11	0.07	0.08	0.07	0.09	0.07
1 : B	0.04	0.09	0.19	0.28	0.29	0.20	0.18	0.19	0.16	0.09	0.05	0.02	0.02	0.02	0.02	0.02
1 : C	0.08	0.15	0.23	0.31	0.37	0.21	0.17	0.20	0.26	0.15	0.09	0.04	0.04	0.03	0.05	0.05
1 : D	0.96	0.75	0.62	0.43	0.52	0.44	0.38	0.57	0.95	0.97	0.85	0.65	0.61	0.59	0.83	0.78
1 : E	0.55	0.28	0.16	0.08	0.09	0.08	0.10	0.15	0.26	0.49	0.66	0.50	0.40	0.38	0.64	0.63
1 : F	0.54	0.29	0.18	0.05	0.07	0.08	0.09	0.10	0.18	0.30	0.56	0.76	1.01	1.00	1.06	0.75
2 : A	0.05	0.07	0.20	0.24	0.30	0.51	0.82	0.81	0.44	0.14	0.07	0.05	0.05	0.04	0.06	0.06
2 : B	0.04	0.13	0.33	0.32	0.33	0.44	0.55	0.88	0.72	0.29	0.13	0.08	0.07	0.06	0.08	0.06
2 : C	0.13	0.37	0.52	0.29	0.44	0.47	0.27	0.88	1.42	0.75	0.40	0.21	0.13	0.13	0.17	0.09
2 : D	0.81	0.75	0.37	0.09	0.19	0.23	0.11	0.43	1.31	2.23	2.09	1.24	0.95	0.95	1.31	0.70
2 : E	0.24	0.09	0.03	0.00	0.01	0.01	0.02	0.04	0.11	0.34	0.78	1.60	0.98	1.03	2.37	0.66
2 : F	0.10	0.04	0.01	0.00	0.00	0.00	0.01	0.01	0.02	0.03	0.11	0.69	3.03	3.07	1.34	0.28
3 : A	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.05	0.01	0.01	0.00	0.00	0.00	0.01	0.01
3 : B	0.01	0.02	0.03	0.01	0.00	0.01	0.06	0.26	0.43	0.21	0.11	0.05	0.03	0.01	0.04	0.03
3 : C	0.05	0.18	0.19	0.02	0.01	0.03	0.06	0.75	1.59	0.87	0.51	0.47	0.27	0.20	0.29	0.06
3 : D	0.11	0.28	0.06	0.01	0.01	0.02	0.00	0.23	0.42	0.98	0.83	0.91	1.51	1.53	0.91	0.11
3 : E	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.06	0.28	0.54	0.09	0.00
3 : F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.32	0.00	0.00
4 : A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4 : B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table C-8. (contd)

DIR/ SP:ST	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
4 : C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4 : D	0.02	0.08	0.01	0.00	0.00	0.00	0.00	0.03	0.13	0.27	0.19	0.37	0.88	1.01	0.27	0.02
4 : E	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.04	0.00	0.00
4 : F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5 : A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5 : B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5 : C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5 : D	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.10	0.17	0.02	0.00
5 : E	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5 : F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6 : A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6 : B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6 : C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6 : D	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.10	0.00	0.00
6 : E	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6 : F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	3.87	3.79	3.63	3.01	3.60	3.55	3.69	6.24	8.85	8.32	7.57	7.78	10.71	11.29	9.65	4.38

See Table C-9
LANL TA41 (TA 2) - 10.5 m - Pasquill A-F (Nov 93 to Jul 95) - approx 95% recoverability
Translated to GENII format (sfs - 8/95).
Applied to Omega West Reactor ground level releases
dir; wind towards this direction
SP:ST; wind speed: wind stability
wind speed categories:
1: 0.90 m/sec
2: 2.50 m/sec
3: 4.38 m/sec
4: 7.00 m/sec
5: 10.00 m/sec
6: 15.00 m/sec

Table C-9. Omega West Reactor Ground Level Releases

DIR/ SP:ST	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
1 : A	1.16	1.26	1.83	1.58	2.04	1.85	1.20	0.59	0.30	0.19	0.26	0.29	0.45	0.31	0.34	0.88
1 : B	0.12	0.08	0.08	0.13	0.45	0.48	0.34	0.13	0.02	0.01	0.03	0.04	0.06	0.07	0.12	0.26
1 : C	0.10	0.06	0.06	0.14	0.43	0.71	0.51	0.14	0.03	0.02	0.03	0.08	0.24	0.11	0.14	0.36
1 : D	0.27	0.17	0.20	0.31	1.24	2.31	1.66	0.55	0.22	0.17	0.26	0.87	6.33	1.39	0.69	0.73
1 : E	0.01	0.02	0.01	0.02	0.18	0.34	0.12	0.08	0.03	0.03	0.08	0.28	5.35	0.51	0.07	0.08
1 : F	0.01	0.03	0.02	0.05	0.45	0.73	0.22	0.09	0.04	0.07	0.12	0.40	8.77	0.33	0.07	0.08
2 : A	0.47	0.31	0.35	0.36	0.64	0.60	0.37	0.14	0.03	0.04	0.10	0.29	0.35	0.12	0.13	0.62
2 : B	0.10	0.03	0.02	0.06	0.41	0.26	0.10	0.04	0.00	0.00	0.00	0.06	0.25	0.12	0.17	0.44
2 : C	0.04	0.01	0.01	0.02	0.36	0.26	0.03	0.01	0.00	0.00	0.00	0.01	0.51	0.37	0.41	0.42
2 : D	0.01	0.00	0.00	0.00	0.11	0.16	0.01	0.01	0.00	0.01	0.01	0.06	3.35	0.87	0.80	0.16
2 : E	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.61	0.12	0.05	0.00
2 : F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	17.30	0.07	0.01	0.00
3 : A	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.15	0.01	0.00	0.01
3 : B	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.04	0.04	0.03
3 : C	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.62	0.54	0.31	0.05
3 : D	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	1.12	0.98	0.36	0.00
3 : E	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00
3 : F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.48	0.00	0.00	0.00
4 : A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4 : B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table C-9. (contd)

DIR/ SP:ST	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
4 : C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4 : D	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.26	0.23	0.05	0.00
4 : E	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4 : F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5 : A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5 : B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5 : C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5 : D	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00
5 : E	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5 : F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6 : A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6 : B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6 : C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6 : D	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6 : E	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6 : F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	2.29	1.97	2.58	2.67	6.34	7.71	4.56	1.78	0.67	0.54	0.89	2.45	51.49	6.19	3.76	4.12

See Table C-10
Oak Ridge Research Reactor - X10 Facility - 10 m Pasquill A-G (1983 to 1992 - 10 yr avg)
Translated to GENII format (sfs - 8/95).

dir; wind towards this direction
SP:ST; wind speed: wind stability
wind speed categories:
1: 1.79 m/sec
2: 2.46 m/sec
3: 4.47 m/sec
4: 6.93 m/sec
5: 9.61 m/sec
6: 13.00 m/sec

Table C-10. Oak Ridge Research Reactor - X10 Facility

DIR/ SP:ST	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
1 : A	0.18	0.18	0.21	0.29	0.33	0.43	0.35	0.31	0.36	0.41	0.34	0.26	0.23	0.16	0.14	0.13
1 : B	0.10	0.11	0.14	0.17	0.14	0.14	0.07	0.07	0.08	0.16	0.18	0.15	0.11	0.10	0.05	0.08
1 : C	0.13	0.18	0.26	0.32	0.13	0.12	0.09	0.09	0.12	0.21	0.29	0.27	0.18	0.13	0.10	0.10
1 : D	1.62	1.69	2.36	1.85	0.47	0.32	0.24	0.21	0.29	0.60	1.61	2.46	2.18	1.60	1.57	1.47
1 : E	2.13	2.40	2.84	1.70	0.24	0.11	0.08	0.08	0.12	0.20	0.91	2.55	2.78	2.43	2.26	2.11
1 : F	0.56	0.56	0.64	0.54	0.15	0.06	0.04	0.06	0.06	0.11	0.25	0.74	0.85	0.75	0.60	0.50
1 : G	0.01	0.02	0.03	0.05	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.03	0.02	0.01	0.01
2 : A	0.20	0.21	0.24	0.40	0.70	0.53	0.38	0.40	0.58	0.92	1.12	0.74	0.52	0.35	0.19	0.20
2 : B	0.13	0.12	0.15	0.39	0.59	0.16	0.08	0.05	0.17	0.58	0.86	0.63	0.50	0.30	0.11	0.10
2 : C	0.10	0.12	0.32	1.12	0.90	0.12	0.03	0.02	0.08	0.41	1.07	0.81	0.58	0.27	0.05	0.05
2 : D	0.13	0.26	0.42	2.02	0.74	0.16	0.09	0.07	0.12	0.36	1.87	2.31	1.38	0.42	0.08	0.10
2 : E	0.06	0.13	0.26	0.66	0.07	0.03	0.01	0.01	0.03	0.11	0.39	1.10	0.58	0.26	0.09	0.09
2 : F	0.04	0.03	0.03	0.06	0.03	0.02	0.02	0.02	0.03	0.05	0.07	0.20	0.18	0.16	0.06	0.04
2 : G	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
3 : A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3 : B	0.01	0.00	0.00	0.03	0.04	0.01	0.01	0.01	0.01	0.08	0.17	0.11	0.18	0.22	0.05	0.01
3 : C	0.02	0.04	0.02	0.17	0.15	0.01	0.00	0.01	0.04	0.29	1.01	0.49	0.56	0.33	0.01	0.02
3 : D	0.02	0.03	0.00	0.13	0.16	0.00	0.00	0.00	0.02	0.10	0.74	0.47	0.52	0.23	0.01	0.01
3 : E	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
3 : F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3 : G	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4 : A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4 : B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4 : C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.06	0.02	0.02	0.01	0.00	0.00
4 : D	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.10	0.04	0.03	0.01	0.00	0.00
4 : E	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table C-10. (contd)

DIR/ SP:ST	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
4 : F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4 : G	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5 : A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5 : B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5 : C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5 : D	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5 : E	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5 : F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5 : G	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6 : A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6 : B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6 : C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6 : D	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6 : E	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6 : F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6 : G	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	5.44	6.09	7.92	9.90	4.85	2.22	1.49	1.41	2.11	4.62	11.04	13.38	11.42	7.75	5.38	5.02

See Table C-11

INEL-near PBF - 10 m Pasquill A-F (1987 to 1991 - 5 yr avg)

Translated to GENII format (sfs-8/95) - 90.2% of hrs recovered

dir; wind towards this direction

SP:ST; wind speed: wind stability

wind speed categories:

1: 1.00 m/sec

2: 2.50 m/sec

3: 4.50 m/sec

4: 6.93 m/sec

5: 13.20 m/sec

6: 19.00 m/sec

Table C-11. Idaho National Engineering Laboratory, Near the Power Burst Facility

DIR/ SP:ST	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
1 : A	0.42	0.47	0.42	0.38	0.27	0.24	0.21	0.22	0.28	0.37	0.37	0.31	0.30	0.30	0.32	0.43
1 : B	0.10	0.12	0.05	0.04	0.01	0.00	0.01	0.02	0.04	0.05	0.04	0.02	0.02	0.02	0.03	0.08
1 : C	0.11	0.19	0.12	0.01	0.01	0.01	0.01	0.01	0.04	0.03	0.03	0.01	0.02	0.02	0.04	0.06
1 : D	0.29	0.56	0.40	0.22	0.06	0.04	0.04	0.08	0.15	0.16	0.10	0.05	0.04	0.04	0.06	0.13
1 : E	0.26	0.34	0.44	0.31	0.11	0.05	0.04	0.15	0.18	0.18	0.13	0.06	0.05	0.06	0.06	0.12
1 : F	1.30	1.79	1.70	1.31	0.91	0.84	0.97	1.28	1.33	1.33	1.06	0.90	0.76	0.83	0.82	1.06
2 : A	0.26	0.38	0.41	0.37	0.19	0.16	0.19	0.33	0.49	0.67	0.60	0.46	0.37	0.24	0.26	0.21
2 : B	0.09	0.20	0.21	0.11	0.04	0.03	0.02	0.10	0.23	0.31	0.28	0.17	0.10	0.04	0.03	0.06
2 : C	0.15	0.41	0.40	0.09	0.01	0.01	0.03	0.08	0.16	0.23	0.19	0.11	0.04	0.02	0.02	0.03
2 : D	0.63	2.98	2.22	1.06	0.33	0.14	0.15	0.55	0.73	0.81	0.52	0.34	0.18	0.07	0.05	0.14
2 : E	0.29	0.88	1.15	1.02	0.34	0.11	0.17	0.46	0.57	0.50	0.34	0.19	0.09	0.06	0.05	0.09
2 : F	0.43	0.79	0.86	0.70	0.35	0.30	0.27	0.43	0.61	0.59	0.45	0.34	0.28	0.24	0.24	0.24
3 : A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3 : B	0.04	0.04	0.04	0.02	0.01	0.01	0.02	0.05	0.13	0.19	0.17	0.14	0.06	0.03	0.04	0.04
3 : C	0.08	0.11	0.17	0.08	0.02	0.04	0.03	0.16	0.30	0.49	0.79	0.46	0.15	0.08	0.07	0.09
3 : D	0.43	1.62	1.36	0.45	0.08	0.05	0.23	0.73	0.94	1.34	1.78	1.17	0.33	0.11	0.07	0.16
3 : E	0.17	0.46	0.66	0.35	0.08	0.04	0.34	0.63	0.32	0.38	0.50	0.35	0.05	0.03	0.02	0.04
3 : F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4 : A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4 : B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4 : C	0.01	0.01	0.00	0.00	0.00	0.01	0.00	0.01	0.04	0.05	0.08	0.07	0.02	0.01	0.01	0.01
4 : D	0.70	0.71	0.51	0.16	0.01	0.01	0.08	0.32	0.74	1.29	3.46	2.03	0.30	0.08	0.08	0.25

Table C-11. (contd)

DIR/ SP:ST	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
4 : E	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4 : F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5 : A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5 : B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5 : C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5 : D	0.21	0.16	0.07	0.00	0.00	0.00	0.01	0.05	0.19	0.41	2.01	1.40	0.12	0.03	0.05	0.11
5 : E	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5 : F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6 : A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6 : B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6 : C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6 : D	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.03	0.04	0.62	0.37	0.03	0.01	0.00	0.02
6 : E	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6 : F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7 : A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7 : B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7 : C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7 : D	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00
7 : E	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7 : F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	5.98	12.23	11.20	6.68	2.83	2.09	2.82	5.66	7.50	9.42	13.53	8.96	3.31	2.32	2.32	3.37

C.3 Food Production Distribution Tables

Tables C-12 through C-17 give food production distributions for beef cattle and dairy cattle, by compass direction from the site and distance from the site. No tables are included for ORNL. The production figures are given in terms of head of cattle, except for INEL, where they are listed by kg/yr of meat and L/yr of milk.

These data were used outside of GENII. All the food produced in the sector being evaluated was assumed to be consumed. Spreadsheet calculations took into account the distance, direction, and total production when calculating the potential population dose.

Table C-12. Food Production Grid for SNL/NM, TA V (Annular Core Research Reactor)

Beef Cattle Total = 32355 head
distance in miles

Miles/ Sector	0-10	10-20	20-30	30-40	40-50	Total
S	173	209	332	465	563	1742
SSW	173	227	332	457	560	1749
SW	173	397	341	465	584	1960
WSW	173	522	338	465	597	2095
W	45	507	869	668	597	2686
WNW	0	387	807	699	560	2453
NW	0	87	276	371	477	1211
NNW	0	158	265	371	477	1271
N	99	232	265	371	477	1444
NNE	99	242	265	758	1137	2501
NE	99	408	367	611	788	2273
ENE	144	470	438	614	789	2455
E	173	408	404	560	713	2258
ESE	173	478	495	495	636	2277
SE	173	424	362	495	636	2090
SSE	173	233	353	495	636	1890

Table C-13. Food Production Grid for SNL/NM, TA V (Annular Core Research Reactor)

Dairy Cattle Total = 7288 head
distance in miles

Miles/ Sector	0-10	10-20	20-30	30-40	40-50	Total
S	89	45	64	82	56	336
SSW	89	58	64	76	51	338
SW	89	179	70	89	92	519
WSW	89	267	65	89	115	625
W	23	259	444	233	115	1074
WNW	198	403	278	95	0	974
NW	0	35	52	63	81	231
NNW	0	42	45	63	81	231
N	50	75	45	63	81	314
NNE	50	82	45	331	367	875
NE	50	191	23	11	14	289
ENE	73	214	8	11	14	320
E	89	161	6	8	8	272
ESE	89	229	124	4	5	451
SE	89	184	11	4	5	293
SSE	89	42	4	4	7	146

Table C-14. Food Production Grid for LANL, Centered on TA-53

Beef Cattle Total = 28900 head
distance in kilometers

km/ Sector	0-1	1-2	2-4	4-8	8-15	15-20	20-30	30-40	40-60	60-80	Total
S	0	0	0	0	21	73	290	391	414	533	1722
SSW	0	0	0	0	0	9	258	258	295	639	1459
SW	0	0	0	0	21	68	78	209	391	113	880
WSW	0	0	0	0	16	73	197	253	652	448	1639
W	0	0	0	0	34	97	289	294	594	781	2089
WNW	0	0	0	0	17	103	290	289	786	2392	3877
NW	0	0	10	0	6	57	167	179	511	895	1825
NNW	0	0	10	0	12	50	193	62	610	1255	2192
N	0	0	0	0	14	46	121	206	772	1020	2179
NNE	0	0	0	0	13	5	32	256	701	878	1885
NE	0	0	0	1	10	19	5	129	234	1350	1748
ENE	0	0	0	6	36	30	146	53	614	1348	2233
E	0	0	0	7	31	30	149	70	251	466	1004
ESE	0	0	0	0	0	0	134	14	146	465	759
SE	0	0	0	0	55	51	33	0	467	826	1432
SSE	0	0	0	0	47	79	132	233	613	873	1977

Table C-15. Food Production Grid for LANL, Centered on TA-53

Dairy Cattle Total = 1963 head
distance in kilometers

km/ Sector	0-1	1-2	2-4	4-8	8-15	15-20	20-30	30-40	40-60	60-80	Total
S	0	0	0	0	0	0	0	0	0	0	0
SSW	0	0	0	0	0	0	0	0	0	1800	1800
SW	0	0	0	0	0	0	0	0	0	0	0
WSW	0	0	0	0	0	0	0	0	0	0	0
W	0	0	0	0	0	0	0	0	0	0	0
WNW	0	0	0	0	0	0	0	0	0	0	0
NW	0	0	0	0	0	0	0	0	0	0	0
NNW	0	0	0	0	0	0	0	0	0	0	0
N	0	0	0	0	0	0	0	0	0	0	0
NNE	0	0	0	0	0	0	0	0	0	0	0
NE	0	0	0	0	0	0	0	0	0	0	0
ENE	0	0	0	0	0	9	24	0	0	0	33
E	0	0	0	0	0	21	109	0	0	0	130
ESE	0	0	0	0	0	0	0	0	0	0	0
SE	0	0	0	0	0	0	0	0	0	0	0
SSE	0	0	0	0	0	0	0	0	0	0	0

Table C-16. INEL PBF Food Production Grid (from FOODPROD.ID provided by INEL for NPR EIS)

INEL GENII Food Production Grid (meat, milk)
Updated 15-May-90 PRL, Data taken from file COWVEG1.DAT

Beef Cattle Production - kg/y meat   Total = 26748000
distance in meters

Meters/ Sector	800	2400	4000	5600	7200	8000	24000	40000	56000	72000	Total
S	0	0	0	0	0	0	0	0	0	1710000	1710000
SSW	0	0	0	0	0	0	0	0	0	0	0
SW	0	0	0	0	0	0	0	0	0	0	0
WSW	0	0	0	0	0	0	0	0	0	0	0
W	0	0	0	0	0	0	533000	533000	0	0	1066000
WNW	0	0	0	0	0	0	341000	793000	1100000	0	2234000
NW	0	0	0	0	0	0	0	394000	2160000	541000	3095000
NNW	0	0	0	0	0	0	0	252000	252000	63800	567800
N	0	0	0	0	0	0	755000	0	139000	0	894000
NNE	0	0	0	0	0	0	0	0	411000	1470000	1881000
NE	0	0	0	0	0	0	0	164000	1470000	749000	2383000
ENE	0	0	0	0	0	0	0	0	519000	1210000	1729000
E	0	0	0	0	0	0	0	83200	1200000	2410000	3693200
ESE	0	0	0	0	0	0	0	0	0	1970000	1970000
SE	0	0	0	0	0	0	0	0	2830000	705000	3535000
SSE	0	0	0	0	0	0	0	0	1530000	460000	1990000

Table C-17. INEL PBF Food Production Grid (from FOODPROD.ID provided by INEL for NPR EIS)

INEL GENII Food Production Grid (meat, milk)
Updated 15-May-90 PRL, Data taken from file COWVEG1.DAT

Dairy Cattle Production -L/y milk
distance in meters

Meters/ Sector	800	2400	4000	5600	7200	8000	24000	40000	56000	72000	Total
S	0	0	0	0	0	0	0	0	0	5700000	5700000
SSW	0	0	0	0	0	0	0	0	0	0	0
SW	0	0	0	0	0	0	0	0	0	0	0
WSW	0	0	0	0	0	0	0	0	0	0	0
W	0	0	0	0	0	0	562000	562000	0	0	1124000
WNW	0	0	0	0	0	0	361000	843000	0	0	1204000
NW	0	0	0	0	0	0	0	402000	0	0	402000
NNW	0	0	0	0	0	0	803000	0	0	0	803000
N	0	0	0	0	0	0	803000	0	0	0	803000
NNE	0	0	0	0	0	0	0	0	1120000	0	1120000
NE	0	0	0	0	0	0	0	482000	4140000	0	4622000
ENE	0	0	0	0	0	0	0	0	1490000	3410000	4900000
E	0	0	0	0	0	0	0	0	3730000	6990000	10720000
ESE	0	0	0	0	0	0	0	0	0	69900000	69900000
SE	0	0	0	0	0	0	0	0	10200000	2570000	12770000
SSE	0	0	0	0	0	0	0	0	5540000	1570000	7110000

Appendix D

Climate and Meteorology

Appendix D

Climate and Meteorology

D.1 Sandia National Laboratories/New Mexico

The Sandia National Laboratories/New Mexico (SNL/NM) is located near the boundary between a mid-latitude semiarid and a tropical semiarid climate (Critchfield 1974). Meteorological data are available from measurements at the Albuquerque International Airport and at the adjacent Kirtland Air Force Base. Climatic averages for a number of meteorological parameters are provided in Table D-1. On an average, the maximum daily temperature exceeds 32°C (90°F) on 64 days per year and is below 0°C (32°F) on 5 days per year; the minimum daily temperature is below 0°C (32°F) on 120 days per year and is below -18°C (0°F) about once every two years (DOC 1987a). July is the warmest month, with daily maximum and minimum temperatures averaging 34°C (93°F) and 18°C (65°F), respectively. January is the coolest month, with daily maximum and minimum temperatures averaging 8°C (47°F) and -5°C (22°F), respectively (DOC 1987a).

Annual precipitation is on the order of 21 cm (8 in.) with about 55% falling from July through October. Precipitation is about double in the Manzano Mountains to the east (McCord et al. 1993). Measurable precipitation (defined as 0.025 cm [0.01 in.] or greater) is recorded on an average of 60 days per year and the area experiences an average of 42 thunderstorm days per year. The average annual snowfall is 28 cm (11 in.) and daily snowfall accumulations of 2.5 cm (1 in.) or greater occur an average of 4 days per year (DOC 1987a).

Winds across the SNL/NM are modified by the Manzano Mountains and other terrain features. The prevailing wind direction at the Albuquerque International Airport is from the southeast. Wind speeds average about 4 m/s (9 mph) at about 7 m (23 ft) above ground level. Average wind speeds are highest in April (5 m/s [11 mph]) and lowest in December (3.5 m/s [8 mph]) (DOC 1987a). Figure D-1 provides the average distribution of the direction from which the wind blows and wind speeds at the proposed project location.

D.2 Los Alamos National Laboratory

The Los Alamos National Laboratory (LANL) has a semiarid, temperate mountain climate (Bowen 1990). Meteorological data are available from onsite measurements, with the main monitoring site located in the TA-59 area (on a mesa). Climatic averages for a number of meteorological parameters are provided.

Table D-1. Sandia National Laboratories/New Mexico (SNL/NM) Average Local Climatology[(a)]

Station Name: Albuquerque International Airport
Elevation: 1619 m

Monthly Averages							
Month	Temp. (°F)	Precip. (Inches)	Wind Speed (MPH)	Cloud Cover (10ths)	Precip. Days (#)	Daily Relative Humidity Max (%)	Daily Relative Humidity Min (%)
Jan	35	0.4	8.0	4.8	3.9	71	40
Feb	39	0.4	8.8	4.9	4.1	65	32
Mar	46	0.5	10.1	5.1	4.6	56	24
Apr	55	0.4	11.0	4.6	3.3	49	18
May	64	0.5	10.5	4.2	4.3	48	18
Jun	75	0.5	10.0	3.3	3.8	46	17
Jul	79	1.3	9.1	4.5	8.9	60	27
Aug	76	1.5	8.2	4.3	9.2	66	30
Sep	69	0.9	8.6	3.6	5.7	62	31
Oct	57	0.9	8.3	3.5	4.9	62	30
Nov	44	0.4	7.9	4.0	3.5	66	36
Dec	36	0.5	7.7	4.6	4.1	71	43

Annual Mean Air Temp:	56.2°F
Anemometer Height:	7.0 m
Mean Annual Wind Speed:	9 mph
Annual Precipitation:	8.1 in.
Precipitation Days:	60 yr^{-1}
Thunderstorms Freq:	42 yr^{-1}

(a) Meteorological parameters are presented using the units with which they are routinely measured (for example, temperature: °F; wind speed: mph). Data are from measurements made at Albuquerque International Airport (DOC 1987a).

in Table D-2. On average, the maximum daily temperature exceeds 32°C (90°F) on 2 days per year and is below 0°C (32°F) on 19 days per year; the minimum daily temperature is below 0°C (32°F) on 154 days per year and is below -18°C (0°F) on 2 days per year (Bowen 1990). July is the warmest month, with daily maximum and minimum temperatures averaging 27°C (81°F) and 13°C (55°F), respectively. January is the coolest month, with daily maximum and minimum temperatures averaging 4°C (40°F) and -8°C (17°F), respectively (Bowen 1990). Significant temperature differences will frequently occur between the mesa tops and canyons within LANL, with cooler temperatures in the canyons.

Annual precipitation is on the order of 46 cm (18 in.) with about 40% falling in July and August. Measurable precipitation (defined as 0.025 cm [0.01 in.] or greater) is recorded on an average of 89 days

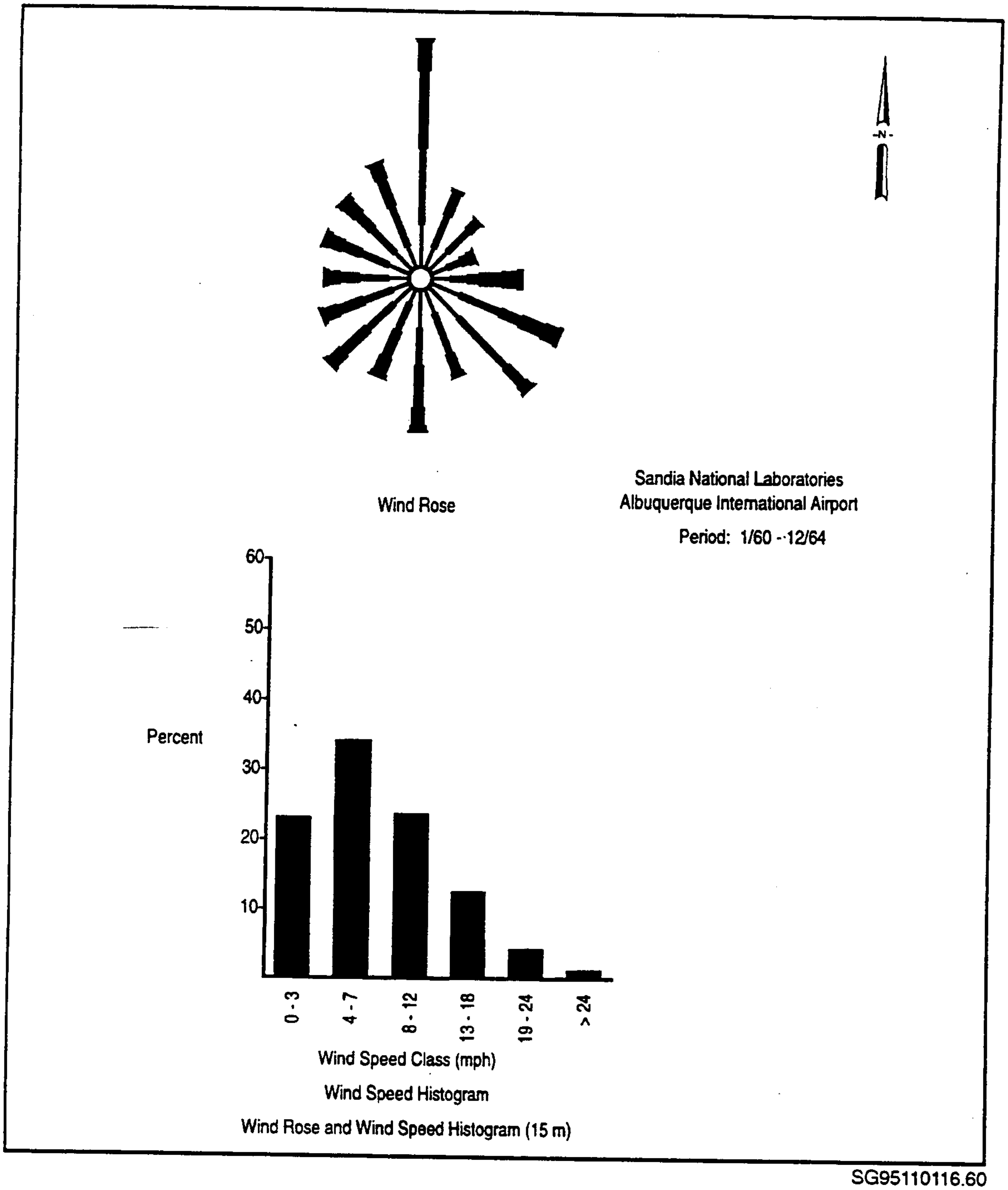

Figure D-1. Average Distribution of Wind Directions and Wind Speeds at Albuquerque International Airport

Table D-2. Los Alamos National Laboratory (LANL) Average Local Climatology[(a)]

Station Name: Los Alamos National Laboratory
Elevation: 2260 m

Monthly Averages							
Month	Temp. (°F)	Precip. (Inches)	Wind Speed (MPH)	Cloud Cover (10ths)	Precip. Days (#)	Daily RH Max (%)	Daily RH Min (%)
Feb	32	0.7	5.5	4.9	6.0	75	37
Mar	38	1.0	7.1	5.1	7.0	70	34
Apr	46	0.9	8.0	4.6	5.5	60	26
May	55	1.1	7.8	4.2	6.9	62	24
Jun	65	1.1	7.3	3.3	6.0	58	22
Jul	68	3.2	6.0	4.5	14.4	69	30
Aug	66	3.9	5.7	4.3	14.5	77	35
Sep	60	1.6	6.3	3.6	7.9	72	32
Oct	50	1.5	6.2	3.5	5.5	70	34
Nov	38	1.0	5.9	4.0	4.3	70	36
Dec	31	1.0	5.0	4.6	5.1	72	40

Annual Mean Air Temp: 48.1°F
Anemometer Height: 12.0 m
Mean Annual Wind Speed: 6 mph
Annual Precipitation: 17.8 in
Precipitation Days: 89 yr^{-1}
Thunderstorms Freq: 58 yr^{-1}

(a) Meteorological parameters are presented using the units with which they are routinely measured (e.g., temperature: °F, wind speed: mph). Data are from measurements made onsite (Bowen et al. 1990). Cloud cover data are from Albuquerque, New Mexico (DOC 1987b).

per year and the area experiences an average of 58 thunderstorm days per year. The average annual snowfall is 130 cm (52 in.) and daily snowfall accumulations of 2.5 cm (1 in.) or greater occur an average of 14 days per year (Bowen 1990).

Throughout the year, surface winds are strongly influenced by local and regional complex terrain. Mountain-valley circulation patterns often produce significant diurnal variations in the winds. As a result, wind directions and speeds may vary significantly from location to location on the Pajarito Plateau (Bowen 1990). The prevailing wind direction in the western portion of LANL is from the west-northwest; while in the eastern portion of the installation, it is from the southwest. Over the course of a year, wind speeds average about 3 m/s (6 mph) at about 12 m (39 ft) above ground level. Average wind speeds are highest in March (3.6 m/s [8 mph]) and lowest in January and December (2.2 m/s [5 mph]) (Bowen 1990). Figures D-2 and D-3 provide the average distribution of the direction from which the wind blows and wind speeds at the proposed project location.

D.3 Oak Ridge National Laboratory

The Oak Ridge National Laboratory (ORNL) is located near the boundary between a humid subtropic and a humid continental warm summer climate (Critchfield 1974). Meteorological data are available from onsite measurements and from measurements in the city of Oak Ridge, Tennessee. Climatic averages for a number of meteorological parameters are provided in Table D-3. On an average, the maximum daily temperature exceeds 32°C (90°F) on 30 days per year and is below 0°C (32°F) on 6 days per year; the minimum daily temperature is below 0°C (32°F) on 87 days per year and is below -18°C (0°F) about once every two years (DOC 1987a). July is the warmest month, with daily maximum and minimum temperatures averaging 31°C (87°F) and 19°C (66°F), respectively. January is the coolest month, with daily maximum and minimum temperatures averaging 8°C (46°F) and -2°C (28°F), respectively (DOC 1987a).

Annual precipitation is on the order of 140 cm (55 in.). Measurable precipitation (defined as 0.025 cm [0.01 in.] or greater) is recorded on an average of 128 days per year and the area experiences an average of 51 thunderstorm days per year. The average annual snowfall is 33 cm (13 in.) and daily snowfall accumulations of 2.5 cm (1 in.) or greater occur an average of four days per year (DOC 1987a).

Winds on the ORNL are influenced by the local topography. Mountain ridges and valleys tend to channel winds and mountain valley circulation often produces significant diurnal variations in the winds. As a result, wind directions and speeds may vary significantly from location to location across the ORNL. The prevailing wind direction in the ORNL's northeast-trending valleys and in the city of Oak Ridge is from the southwest. A high incidence of winds is also experienced from neighboring sectors and in the opposite direction. Wind speeds in the city of Oak Ridge average about 2 m/s (4 mph) at about 9 m (30 ft) above ground level (DOC 1987a). Average wind speeds are highest in April (2.5 m/s [6 mph]) and lowest in October (1.5 m/s [3.5 mph]) (DOC 1987a). Figure D-4 provides the average distribution of the direction from which the wind blows and wind speeds at the proposed project location.

D.4 Idaho National Engineering Laboratory

The Idaho National Engineering Laboratory (INEL) has a mid-latitude semiarid climate (Clawson et al. 1989). Meteorological data are available from onsite measurements at the Central Facilities Area Meteorology Station and other onsite monitoring locations (Clawson et al. 1989). Climatic averages for a number of meteorological parameters are provided in Table D-4. On an average, the maximum daily temperature exceeds 32°C (90°F) on 25 days per year and is below 0°C (32°F) on 60 days per year; the

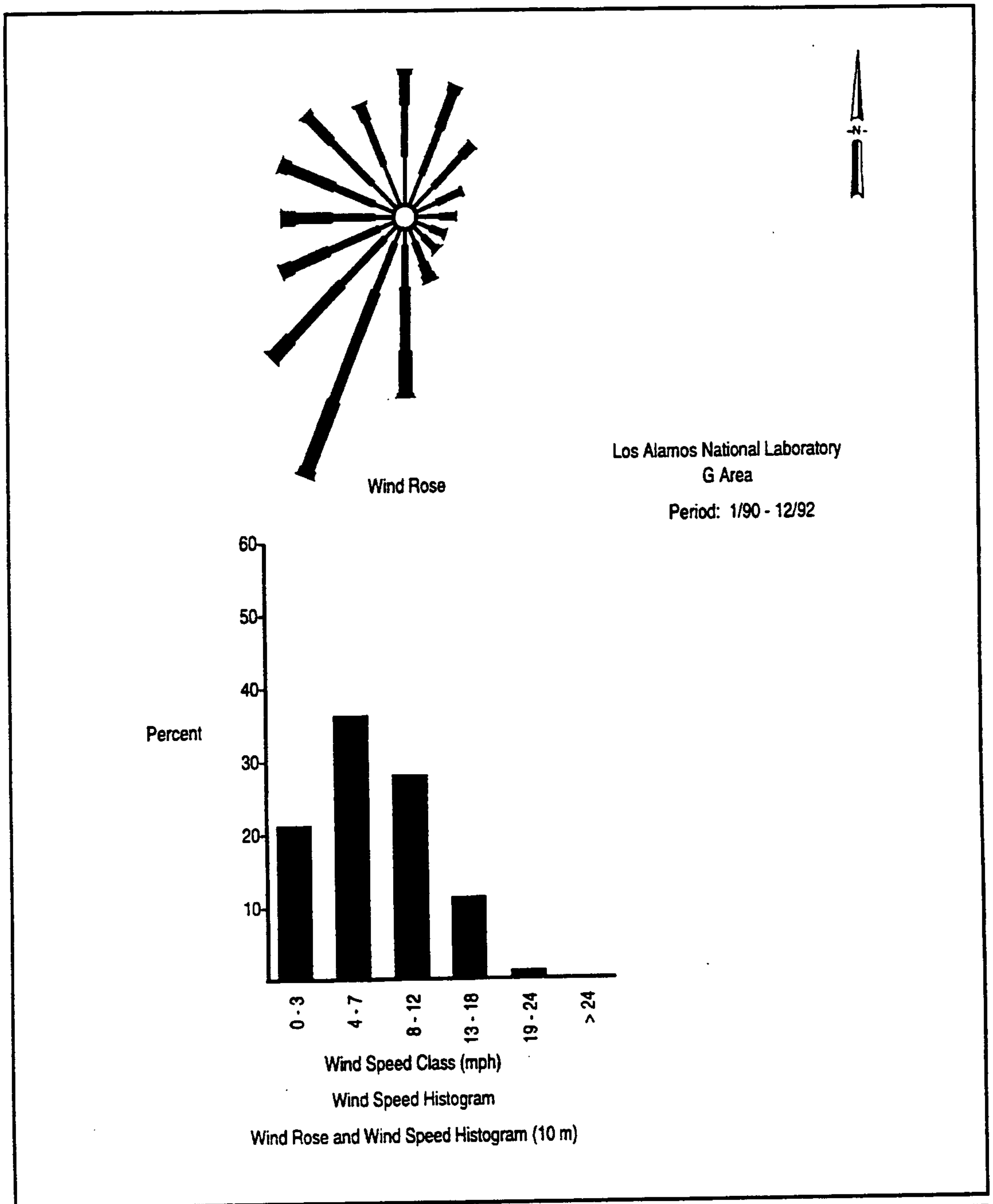

Figure D-2. Average Distribution of Wind Directions and Wind Speeds at Los Alamos National Laboratory (G Area)

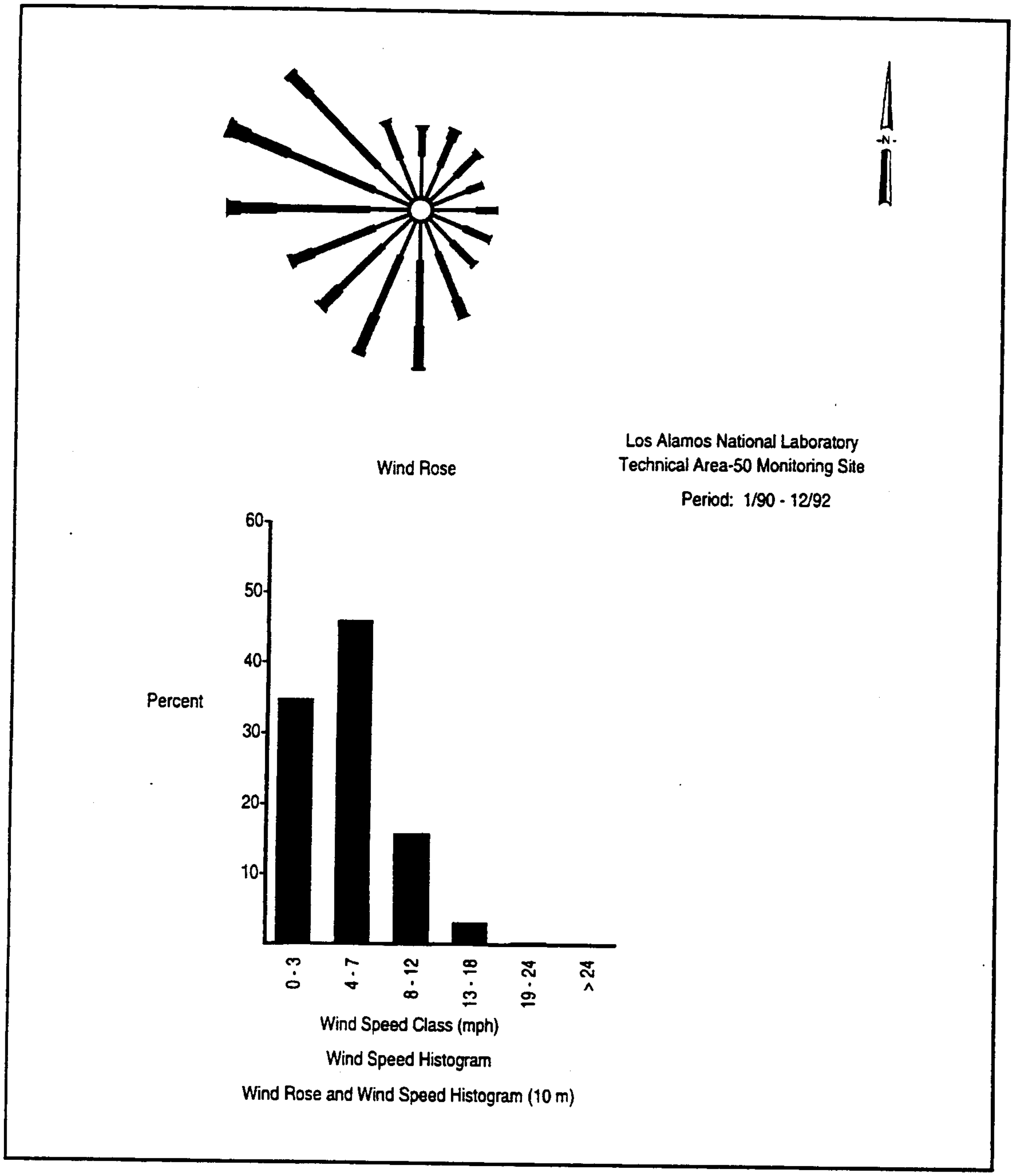

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Figure D-3. Average Distribution of Wind Directions and Wind Speeds at Los Alamos National Laboratory (Technical Area-50 monitoring site)

Table D-3. Oak Ridge National Laboratory (ORNL) Average Local Climatology[a]

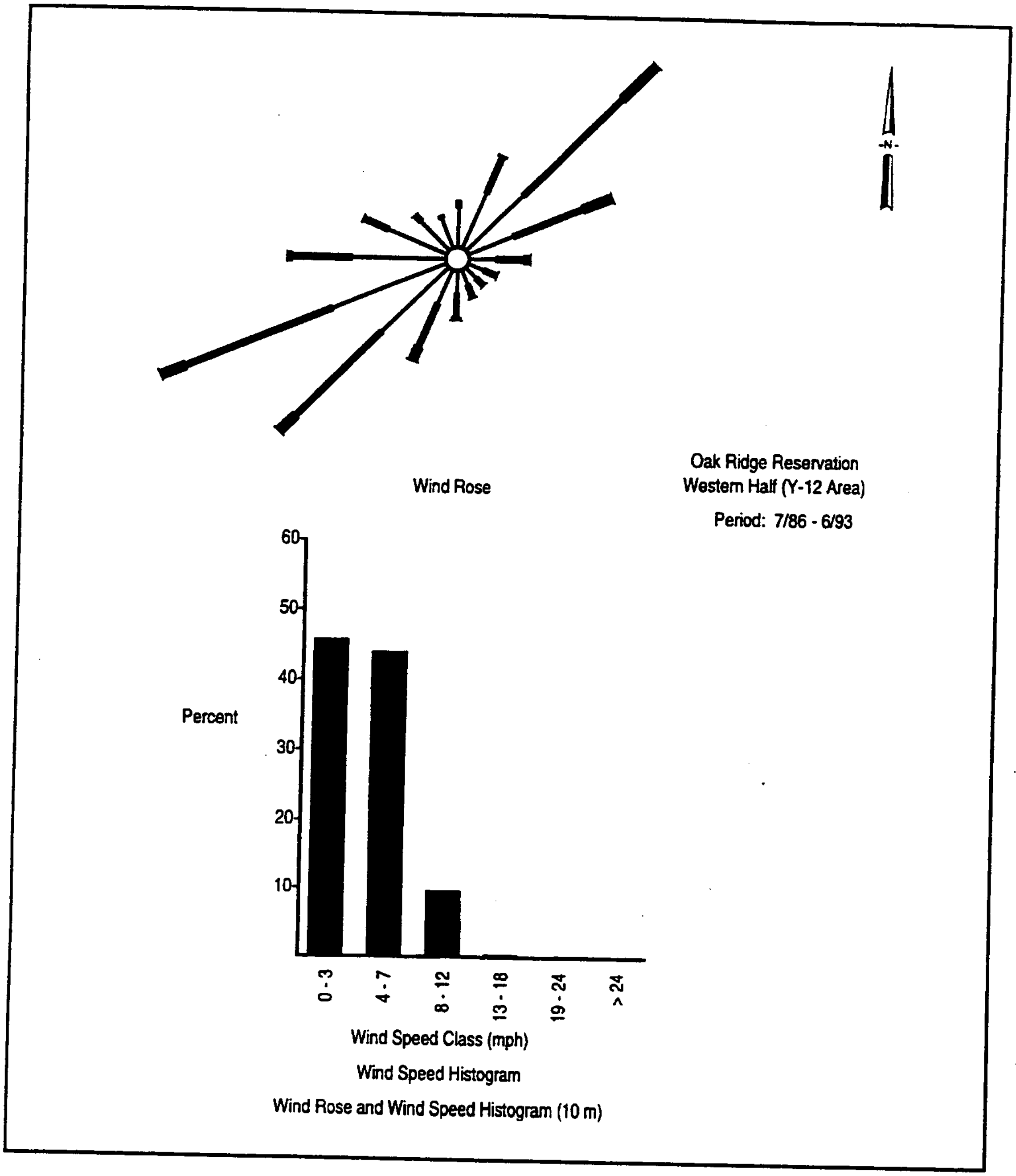
Station Name: Oak Ridge, Tennessee
Elevation: 268 m

MT2 Monitoring Site at X-10 facility
Elevation: 289 m

Monthly Averages							
						Daily RH	
Month	Temp. (°F)	Precip. (Inches)	Wind Speed (MPH)	Cloud Cover (10ths)	Precip. Days (#)	Max (%)	Min (%)
Feb	42	4.6	4.0	6.5	11.4	73	48
Mar	50	6.2	4.3	6.5	12.6	68	47
Apr	58	4.4	4.3	5.9	10.8	72	47
May	65	4.2	3.8	5.9	10.7	76	52
Jun	73	4.3	3.3	5.5	10.3	77	53
Jul	77	5.2	3.1	5.8	11.9	74	50
Aug	75	3.8	2.9	5.5	10.4	81	55
Sep	69	3.8	2.9	5.6	8.3	77	56
Oct	57	2.9	3.0	5.0	7.9	71	47
Nov	48	4.5	3.4	6.1	10.1	71	48
Dec	39	5.7	3.5	6.5	10.9	72	55

Annual Mean Air Temp:	57.4°F (Oak Ridge)
Anemometer Height:	10.0 m (MT2/X-10)
Mean Annual Wind Speed:	4 mph (MT2/X-10)
Annual Precipitation:	54.8 in (Oak Ridge)
Precipitation Days:	128 yr^{-1} (Oak Ridge)
Thunderstorms Freq:	51 yr^{-1} (Oak Ridge)

(a) Meteorological parameters are presented using the units with which they are routinely measured (e.g., temperature: °F, wind speed: mph). Data are from measurements made at the X-10 meteorological tower and in the city of Oak Ridge, Tennessee. Temperature, wind speed, and humidity data are from the MT2/X-10 monitoring location (data were provided by meteorologist Ron Sharp [ORNL Office of Environmental Compliance and Documentation] using Oak Ridge Meteorological Data Analysis Program. The program reads archived hourly meteorological data and generates tables of climatological averages, input files for atmospheric dispersion models, and other meteorological support products). Other meteorological data are from monitoring in the city of Oak Ridge (DOC 1987a).



SG95110116.59

Figure D-4. Average Distribution of Wind Directions and Wind Speeds at Oak Ridge National Laboratory

Table D-4. Idaho National Engineering Laboratory (INEL) Average Local Climatology[(a)]

Station Name: INEL - Central Facilities Area
Elevation: 1530 m

Monthly Averages							
Month	Temp. (°F)	Precip. (Inches)	Wind Speed (MPH)	Cloud Cover (10ths)	Precip. Days (#)	Daily RH	
						Max (%)	Min (%)
Feb	22	0.6	6.9	7.6	5.9	89	42
Mar	31	0.6	8.7	7.1	6.2	84	34
Apr	42	0.7	9.3	6.7	6.0	81	23
May	51	1.2	9.3	6.2	7.8	83	22
Jun	60	1.2	8.9	5.0	6.9	73	16
Jul	68	0.5	8.0	3.4	3.7	59	16
Aug	66	0.6	7.7	3.8	3.7	65	15
Sep	56	0.6	7.2	4.0	3.6	74	18
Oct	44	0.5	6.8	5.1	3.7	82	24
Nov	30	0.7	6.4	7.2	5.7	86	30
Dec	19	0.8	5.1	7.9	7.1	89	40

Annual Mean Air Temp:	42.0°F
Anemometer Height:	6.1 m
Mean Annual Wind Speed:	8 mph
Annual Precipitation:	8.7 in
Precipitation Days:	69 yr^{-1}
Thunderstorms Freq:	23 yr^{-1}

(a) Meteorological parameters are presented using the units with which they are routinely measured (e.g., temperature: °F, wind speed: mph). Data are from measurements made onsite at the Central Facilities Area (Clawson et al. 1989). Cloud cover data are from Pocatello, Idaho (DOC 1987c).

minimum daily temperature is below 0°C (32°F) on 214 days per year and is below -18°C (0°F) on 34 days per year (Clawson et al. 1989). July is the warmest month, with daily maximum and minimum temperatures averaging 31°C (87°F) and 9°C (49°F), respectively. January is the coolest month, with daily maximum and minimum temperatures averaging -3°C (27°F) and -15°C (5°F), respectively (Clawson et al. 1989).

Annual precipitation is on the order of 22 cm (9 in.) with about 27% falling in May and June. Measurable precipitation (defined as 0.01 in. or greater) is recorded on an average of 69 days per year and the ea experiences an average of 23 thunderstorm days per year. Daily snowfall accumulations of 2.5 cm in.) or greater occur an average of 10 days per year; the average annual snowfall is 70 cm (28 in.) (Clawson et al. 1989).

Winds at the INEL are strongly influenced by the orientation of the bordering mountain ranges and the general orientation of the Eastern Snake River Plain. Local mountain-valley circulations, both nighttime drainage winds and upslope flows, are commonly observed across the installation. As a result of such local influences, significant variations in wind direction and speed are often observed across the installation. The prevailing wind direction in the Central Facilities Area (in the southwestern portion of the installation) is from the west-southwest. In the Technical Area North (in the northern portion of the installation), the prevailing wind direction is from the north. Wind speeds at the Central Facilities Area and Technical Area North average 3.4 m/s (7.5 mph) and 3.1 m/s (7.1 mph), respectively, at 6 m (20 ft) above ground level (Clawson et al. 1989). Average wind speeds at both monitoring locations are highest in April (4 m/s [9 mph]) and lowest in December (2 m/s [5 mph]) (Clawson et al. 1989). Figures D-5 and D-6 provide the average distribution of the direction from which the wind blows and wind speeds at the proposed project location.

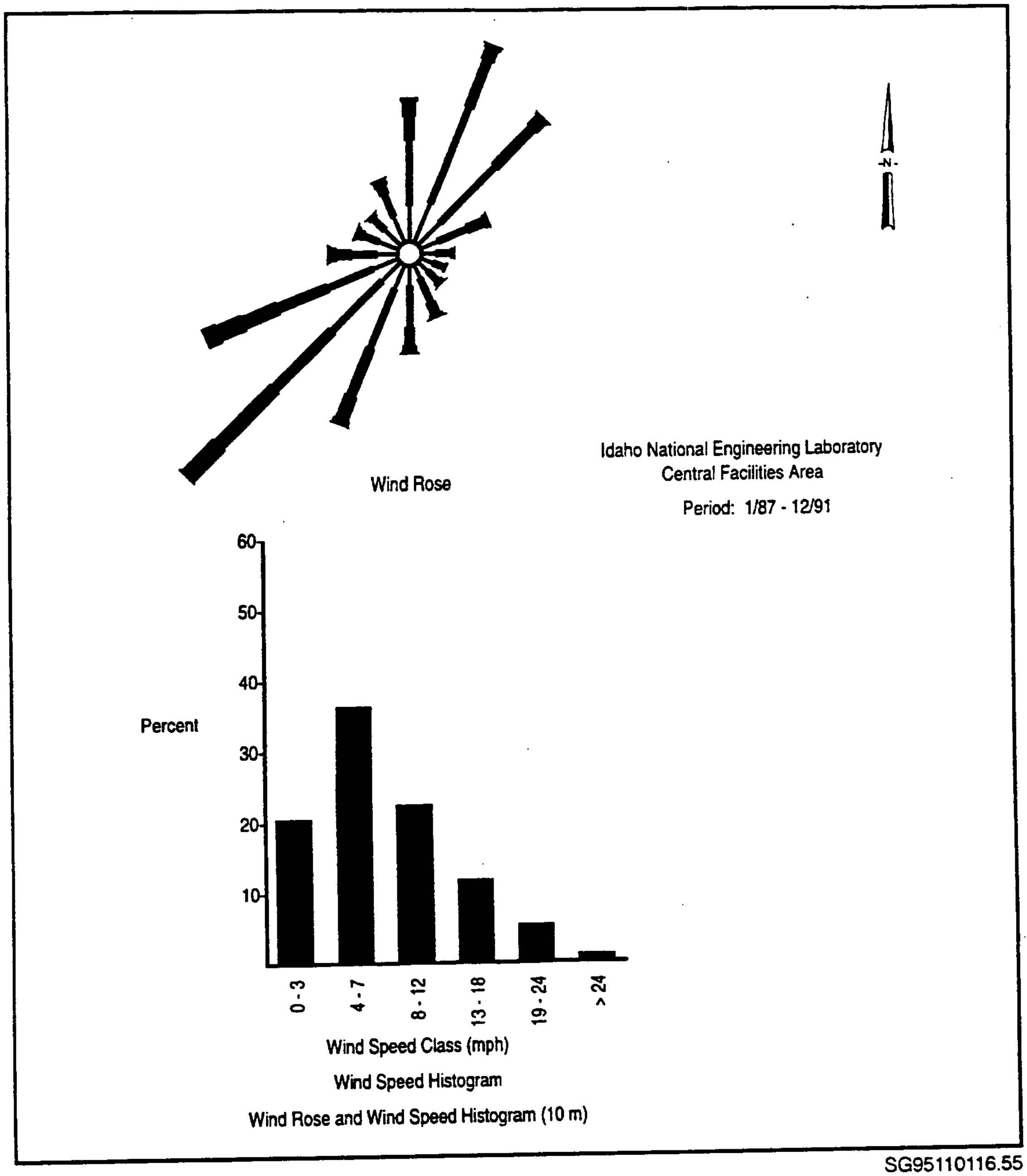


Figure D-5. Average Distribution of Wind Directions and Wind Speeds at Idaho National Engineering Laboratory (Central Facilities Area)

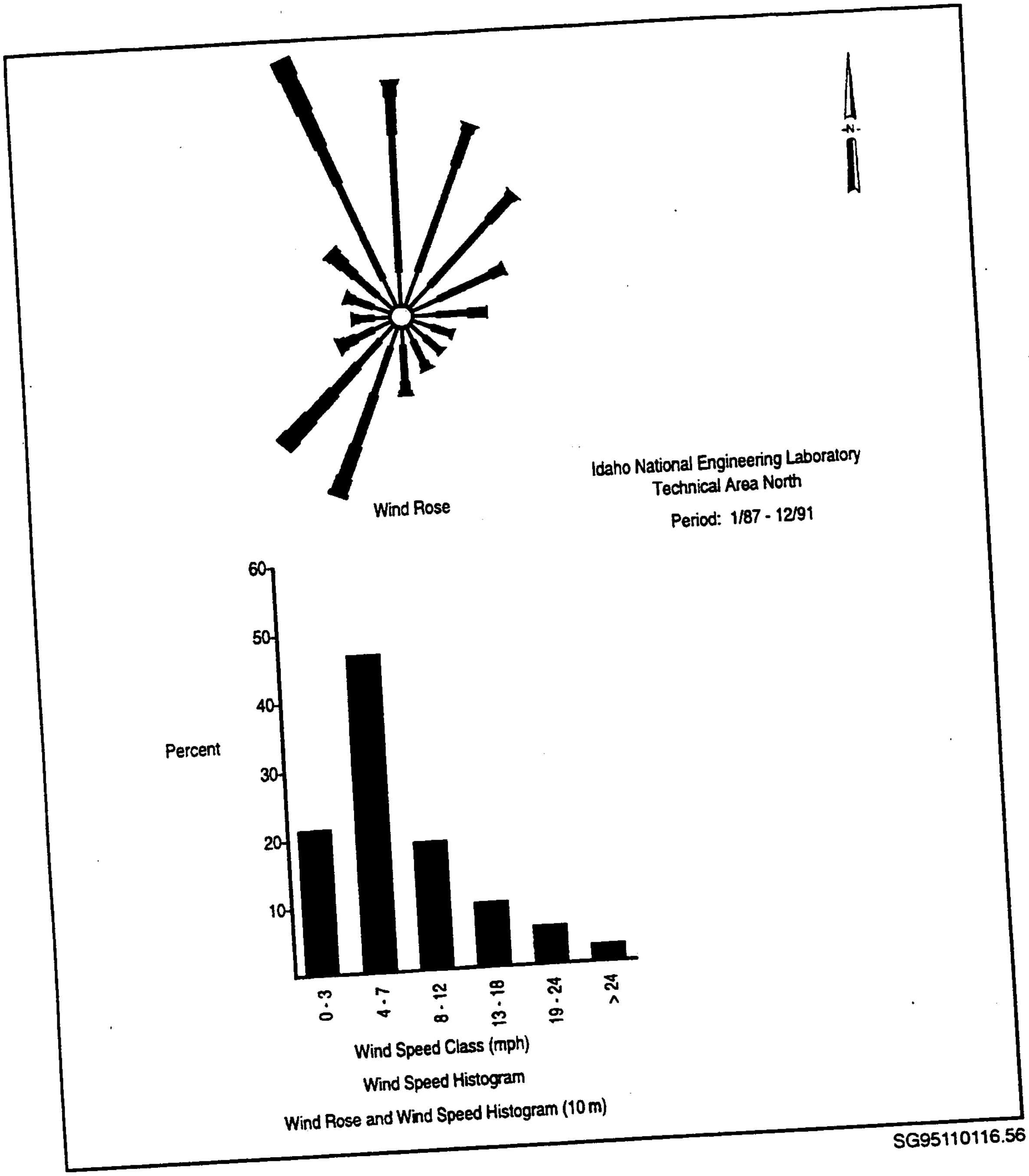
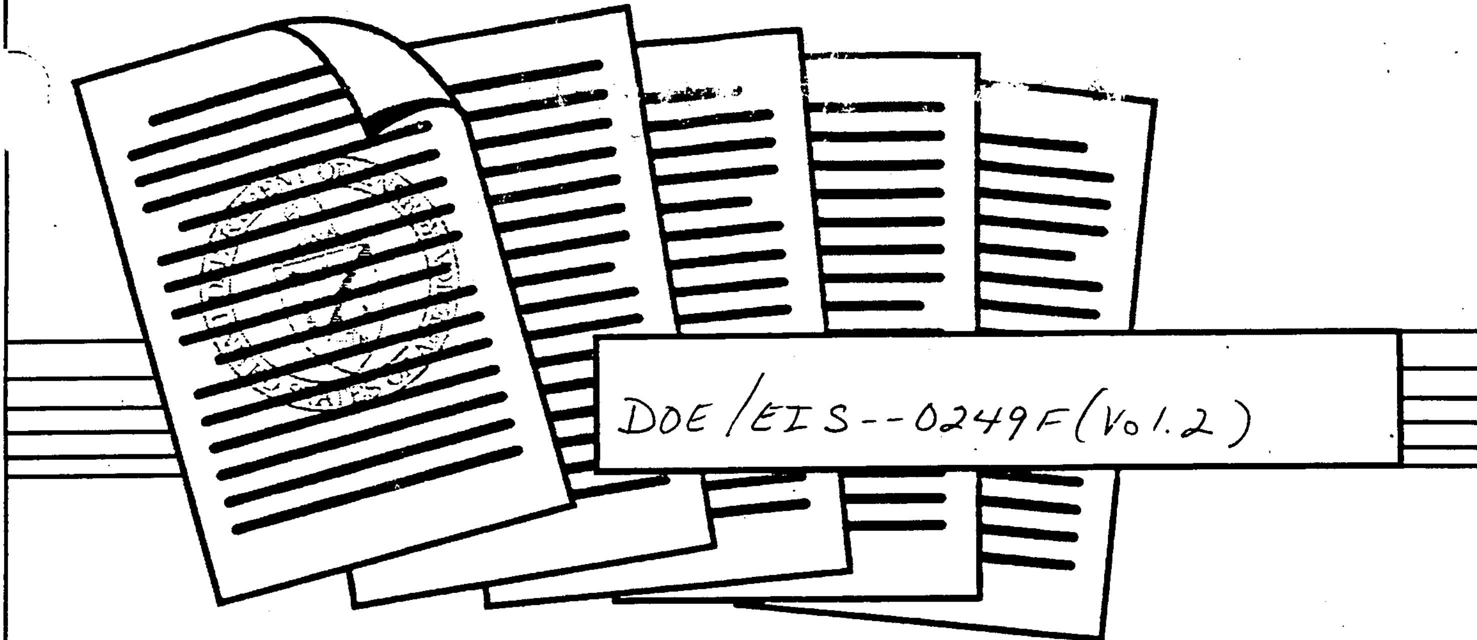


Figure D-6. Average Distribution of Wind Directions and Wind Speeds at Idaho National Engineering Laboratory (Technical Area North)



DOE/EIS--0249F(Vol.2)

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DOE/EIS-0249-F

Medical Isotopes Production Project: Molybdenum-99 and Related Isotopes

Environmental Impact Statement

Volume II
Comment Response Document

U.S. Department of Energy
Office of Nuclear Energy, Science and Technology
Washington, D.C.

April 1996

COVER SHEET

RESPONSIBLE AGENCY:
U.S. Department of Energy

TITLE:
Medical Isotopes Production Project: Molybdenum-99 and Related Isotopes: Environmental Impact Statement

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ABSTRACT:

This Environmental Impact Statement (EIS) provides environmental and technical information concerning the U.S. Department of Energy's (DOE) proposal to establish a domestic source to produce molybdenum-99 (Mo-99) and related isotopes (iodine-131, xenon-133, and iodine-125). Mo-99, a radioactive isotope of the element molybdenum, decays to form metastable technetium-99 (Tc-99m), a radioactive isotope used thousands of times daily in medical diagnostic procedures in the U.S. Currently, all Mo-99 used in the U.S. is obtained from a single Canadian source. DOE is pursuing the Medical Isotopes Production Project in order to ensure that a reliable supply of Mo-99 is available to the U.S. medical community as soon as practicable. Under DOE's preferred alternative, the Chemistry and Metallurgy Research Facility at the Los Alamos National Laboratory (LANL) and the Annular Core Research Reactor and Hot Cell Facility at Sandia National Laboratories/New Mexico (SNL/NM) would be used for production of the medical isotopes.

In addition to the preferred alternative, three other reasonable alternatives and a No Action alternative are analyzed in detail. The sites for these three reasonable alternatives are LANL, Oak Ridge National Laboratory (ORNL), and Idaho National Engineering Laboratory (INEL). The analyses in this EIS indicate no significant difference in the potential environmental impacts among the alternatives. Each of the alternatives would use essentially the same technology for the production of the medical isotopes. Minor differences in environmental impacts among alternatives relate to the extent of activity necessary to modify and restart (as necessary) existing reactors and hot cell facilities at each of the sites, the quantities of low-level radioactive waste generated, how such waste would be managed, and the length of time needed for initial and full production capacity.

DOE issued a Draft EIS on December 22, 1995, and held a formal public comment period on the draft through February 9, 1996. Two public hearings were held at or near each of the four alternative locations during the comment period. Comments received and DOE's responses to those comments are found in the second volume of this EIS. The Final EIS contains change bars in the left-hand margin, reflecting DOE's consideration of the public comments.

Contents

Volume II

Section 1.0: Introduction

1.0 Introduction

In December 1995, the U.S. Department of Energy published the *Medical Isotopes Production Project: Molybdenum-99 and Related Isotopes Draft Environmental Impact Statement* (DOE/EIS-0249D). DOE announced the availability of the Draft EIS for public review and comment in the *Federal Register* on December 22, 1995 (60 FR 66542); this announcement initiated a 49-day public comment period. DOE held eight hearings to receive oral and written comments and to exchange information with the public on the Draft EIS. Two hearings were held at each of the following locations: Idaho Falls, Idaho, on January 17, 1996; Oak Ridge, Tennessee, on January 25, 1996; Albuquerque, New Mexico, on January 30, 1996; and Los Alamos, New Mexico, on February 1, 1996. The public comment period ended on February 9, 1996. Comments provided by the public were considered in preparing this Final EIS.

This Final EIS has been made available for review at DOE Reading Rooms in Washington, D.C.; Idaho Falls, Idaho; Albuquerque, New Mexico; Los Alamos, New Mexico; and Oak Ridge, Tennessee. In addition, DOE has provided it to libraries at the Georgia Institute of Technology, the Massachusetts Institute of Technology, the University of Missouri - Columbia, and the Rhode Island Nuclear Science Center. Finally, DOE has distributed this document to individuals; organizations; and Federal, state, and local officials who commented on the Draft EIS or who are known to have an interest in the proposed project.

During the comment period, 61 persons offered formal comments at the 8 public hearings: 16 persons at the first Idaho Falls hearing; 25 at the second Idaho Falls hearing; 2 at the first Oak Ridge hearing; 2 at the second Oak Ridge hearing; 4 at the first Albuquerque hearing; 7 at the second Albuquerque hearing; 1 at the first Los Alamos hearing; and 4 at the second Los Alamos hearing.

Several of the people who offered oral comments at the hearings also provided written copies of their comments. Counting the written comments provided at the hearings, DOE received 101 letters and written statements (including one electronic mail message) related to the Draft EIS. Of the letters and written statements, 8 were from government agencies, 10 were from elected officials, 26 were from organizations, and 57 were from individuals. Tables 1-1, 1-2, 1-3, and 1-4 list the government agencies, elected officials, organizations, and individuals, respectively, who provided comments on the Draft EIS.

In the tables and in this document, letters and written statements are identified by a "C" followed by a 3-digit identification number (e.g., C027). Oral comment transcripts are identified by a 2-letter abbreviation for the hearing location, the hearing time ("A" for afternoon and "B" for evening), and a 2-digit identification number. For example, the comments made by the third commentor at the Idaho Falls evening hearing would be denoted as "IDB03."

Section 2.0 includes copies of all letters and written statements received by DOE and oral comments made at the public hearings. It also presents the DOE responses to the comments, reproduced on the page(s) following the copy of the letter, written statement, or oral comment transcript.

In cases where a person offered oral comments at a hearing and also provided a written copy of those same comments, both the transcript of the oral comments and the written copy of the comments are reproduced in this section. This is indicated in the following tables by a comment letter number, followed by a "/", followed by a hearing transcript number (e.g., C014/IDA03). The responses to those comments are provided on the page following the written copy of the comments.

In cases where a person offered different sets of comments, either orally or in writing, responses are provided following the copy of each individual oral comment transcript, letter, or written statement. This is indicated in the following tables by a comment letter number followed by an "&", followed by a hearing transcript designation and number (e.g., C013 & IDA11). The identification number for each oral and written set of comments offered by an individual is presented by that individual's name in the following tables.

A revision to the text of Volume I of the EIS is indicated by a change bar beside the affected text. For EIS changes resulting from public comments, the section of the EIS that was changed is identified in the response to the comment.

For additional reference material on acronyms, units of measure, bibliography listings, and glossary terminology, the reader is referred to Volume I of the EIS.

Table 1-1. Government Agencies Commenting on the Draft EIS

Comment	Agency	Representative
C060	U.S. Nuclear Regulatory Commission	Donald A. Cool
C066	State of Tennessee, Department of Environment and Conservation	Don Dills
C075	New Mexico Energy, Minerals & Natural Resources Department	Jennifer A. Salisbury
C086	State of Idaho INEL Oversight Program	Robert N. Ferguson
C091	U.S. Environmental Protection Agency, Region 6	Michael P. Jansky
C096	U.S. Department of the Interior, Fish and Wildlife Service	Jennifer Fowler-Propst
C097	State of New Mexico, Environment Department	Gedi Cibas
C098	Department of Health & Human Services, Food and Drug Administration	Peter Paras

Table 1-2. Elected Officials Commenting on the Draft EIS

Comment	Official	Office
C012	Pete T. Cenarrusa	Secretary of State, State of Idaho
C014/IDA03	Dirk Kempthorne	U.S. Senator, Idaho
C015/IDA02	Larry E. Craig	U.S. Senator, Idaho
C016/IDA04	Michael D. Crapo	U.S. Representative, Idaho
C017/IDA01	Philip E. Batt	Governor, State of Idaho
C030	Peter J. Angstadt	Mayor, City of Pocatello, Idaho
C037/IDB02	Jerry T. Twiggs[(a)]	President Pro Tem, Idaho State Senate
C071	Ginger Welch	Los Alamos County Council
C085	Alvino Lucero	Governor, Pueblo of Isleta
C095/IDB01	Linda Milam	Mayor, City of Idaho Falls
LAA01	Lawry Mann	Chairman, Los Alamos County Council
LAB03	Morris Pongratz	Los Alamos County Councilor

(a) The letter from Senator Twiggs was co-signed by 25 other Idaho State Senators

Table 1-3. Organizations Commenting on the Draft EIS

Comment	Organization	Representative
C005	American Nuclear Society	John Graham
C010/IDA05	Idaho Falls Symphony	Norma Jean Housley
C011	IEEE Nuclear Medical Sciences Technical Committee	Edward J. Hoffman
C013 & IDA11	Brady's	C.A. Brady II
C018	Voigt Davis Realtors	Don Davis
C023	Idaho Academy of Science	Philip A. Anderson
C031	ECSI Executone	Ted A. Kasper
C032/ALB07	Sierra Club - Albuquerque Group	Jay B. Sorenson Richard Barish Susan Gorman
C033/IDA10	American Nuclear Society, Idaho Section	John Commander
C036	San Jose Community Awareness Council	Dolores S. Herrera
C039	Four Hills Village Homeowners Association	Robert H. Multhaup
C045	Water Information Network	Susan Diane
C047	Health Physics Society	William A. Mills
C051	Bueno Los Alamos Surveillance Team	Bonnie Bonneau Ditto Nowakoski
C057	Thermo Technology Ventures	Richard F. Testa
C058 & IDB03	Idaho Brain Tumor Center	Francis Paul William J. Sewell
C065	Ruidoso Upper Canyon Association	Hazel C. Haynsworth
C067 & ORB01	Oak Ridge Local Oversight Committee	Amy S. Fitzgerald
C068	Nordion International	Dr. Iain Trevena
C074	Land and Water Fund of the Rockies	Everett DeLano
C074 & ALA04	Southwest Organizing Project	Michael Guerrero
C079 & IDA06	Greater Idaho Falls Chamber of Commerce	Con Mahoney C. Hugh White, Jr.
C082	Idaho Falls Medical Society	George Groberg
C093 & IDB06	Beauty for All Seasons	John V. Galazin
C094	Eastern Idaho Economic Development Council	Daniel Cudaback
C099	Council on Radioisotopes and Radiopharmaceuticals	Carl W. Seidel
C101	Nuclear Energy Institute	Felix M. Killar, Jr.
ALA01	Southwest Research and Information Center	William Paul Robinson
ALA03	New Mexico Physicians for Social Responsibility	Janna Rolland
ALB01	Greater Albuquerque Chamber of Commerce	Ron Motz

Table 1-4. Individuals Commenting on the Draft EIS

Comment	Name[a]
IDB12	Dave Anderson
C003 & C100	Robert L. Anderson
IDA13	David Austin
IDA16	Cory Barnard
C002	Andy Baumer
ALB06	Bill Becker
C028	Clarence F. Bellem
IDB16	Barbara Berlin
IDB18	Bob Berlin
C001 & C038	William J. Berry
LAB04	Frances Berting
IDB21	Ellen Bingham
IDB24	Michael Breen
C064 & IDB13	Kent L. Brinker
ORB02	Al Brooks
C083	Brent J. Buescher
C007	Merle E. Bunker
C050	Debbie S. Christensen
C027	Robert B. Clark
IDB17	Ron Clawson
C019 & IDB22	Thomas M. Crawford
C020, C089 & IDA08	G. Ross Darnell
C061	Glen Darnell
C022	Steven A. Davies
C063, C078/LAB02	Michael & Ian Dempsey
C046	Kenneth D. Dobbin
IDA07	Bill Downs
C026	Sheryl Doyle
C072	David M. Ericson, Jr.
IDA12	Frank Fogarty
C009	David A. Freiwald
C073	George A. Freund
C043	Uri Gat
IDB15	Bill George
C055	Greg Gerber
C029	David A. Griffiths
ALB04	William Hadley
C004	Michael F. Hartshorne
C062	Bentley J. Harwood
C049	J. Stephen Herring
C084 & IDB19	John R. Horan

(a) Some of the letters have been signed by more than one individual. Only a single signator's name is used here.

Comment	Name
C008	John B. Hudson
C042	Paul Kasten
IDA14	Andrea Kennedy
IDB14	Joanne Long
ALB05	Peter Lundman
C041	Don & Elaine Mangum
C025	Kathryn A. McBride
C054	M. Ilene McKnight
C077 & LAB01	Eric McNamara
IDA15	Herbert Moore
ALA02	Karen Neuhauser
C076	Suzanne Noga
IDB11 & IDB26	Jon Ochi
IDB08	Linda Owens
C090	James N. Paglieri
ORA01	Bob Peelle
IDB10	Tom Piper
IDB07	Bill Pitchford
C088	Donivan Porterfield
C035	L. Rand Ricks
C040	Leslie Romriell
IDB25	Thomas J. Setter
C044	Robin Seydel
C021	Kathy Sica
C080	Robert L. Skinner
IDB04	Helen Stanton
C034	Ben Stutzman
C069	Brad L. Swanson
C092	Richard L. Taylor
C070 & IDB05	Roderic W. Thomas
IDB20	James H. Thorsen
C053	David Tracy
C059 & ALB03	Priscilla Tracy
IDB09	Linda Tucker
C056	Robert D. Ulrich
C052 & ORA02	Barbara A. Walton
C081 & ALB02	Ruth F. Weiner
IDA09	Linda Weiss
C087	Steve Yanicak
IDB23	Mark Young
C006 & C024	Steven K. Zohner
C048	Anonymous

Section 2.0: Comment Documents and Responses

William J. Berry
2660 St. Charles Ave.
Idaho Falls, ID 83404
208-523-4183.

Mr. Wade Carroll, MIPP-EIS Document Manager
U. S. Department of Energy
Office of Isotope Production and Distribution, NE-70
19901 Germantown Road
Germantown, MD 20874

Dear Mr. Carroll,

Use of the Annular Core Research Reactor at Sandia National Laboratories and the Chemistry and
1 Metallurgy Research Facility at Los Alamos National Laboratory may be the Department of Energy
preferred alternative, but this alternative does not appear to be the best possible option on the basis of
2 cost and mission. Furthermore, this preferred alternative requires transportation of Highly Enriched
Uranium (HEU) targets on public roads.

3 Use of the Power Burst Facility at the Idaho National Engineering Laboratory seems to be the most
favorable alternative from the standpoint of mission and cost. Transportation of HEU targets would
not require the use of public roads. At present, the only potential mission for the Power Burst Facility
is also a medical application which could be conducted concurrently with isotope production. As
4 stated in the Draft Environmental Impact Statement, privatization of Mo-99 production could also be
incorporated early in the process.

Please consider these comments in preparation of the Final Environmental Impact Statement.

Sincerely,

William J. Berry

Responses to Comment Letter C001

1 The Annular Core Research Reactor/Hot Cell Facility combination at SNL/NM is the preferred alternative for target irradiation and processing for the reasons stated in Section 3.3.1.1.

2 The comment correctly observes that, under the preferred alternative, targets containing unirradiated uranium-235 would be transported over public roads from LANL to SNL/NM. This operation would be carried out in accordance with applicable DOE and DOT regulations and would not measurably increase the risk associated with this alternative. The quantities of material transported, their chemical and physical form, and the packaging used during transport would combine to result in minimal risk to security or public health. (See Section 5.11 and Appendix B for a discussion of transportation impacts.)

It should be noted that one option for the SNL/NM alternative (identified in Section 3.3.1.3) is to fabricate the targets at the SNL/NM site, resulting in no transport of unirradiated targets over public roads. In addition, each of the other alternatives would require transport of radioactive materials (irradiated targets, low-level radioactive waste, or separated isotopes) over public roads. However, in no case would the necessity to use public roads substantially increase the risks of implementing the project at these sites.

3 The Department recognizes that the estimated cost of the INEL alternative is lower than that of the preferred alternative; however, the uncertainties associated with the estimated cost of the INEL alternative are higher than for the preferred alternative. If the Department decides to proceed with the proposed action, the information presented in the EIS (including the cost data), the operational readiness of facilities, and other programmatic factors will be considered in the final selection of facilities for Mo-99 production. For any of the alternative reactors, if chosen, the reactor's primary mission would be designated as medical isotope production.

4 Private U.S. production of Mo-99 could be accomplished by privatization of a DOE operation or by a separate initiative by the private sector. The process of privatization is not part of this proposed action. The Department published a Notice for Expression of Interest in the *Federal Register* in December 1995 to solicit concepts from private industry for privatization of DOE isotope activities. Businesses interested in pursuing Mo-99 production have been invited to respond to this solicitation. If the Department decides to implement the action proposed in this EIS and if concepts on privatization of Mo-99 production received from the private sector are promising, DOE would proceed with a request for proposals to facilitate privatization on a competitive basis.

January 17, 1996

Mr. Wade Carroll, MIPP-EIS Document Manager
U.S. Department of Energy, NE-70
19901 Germantown Road
Germantown, MD 20874

Dear Mr. Carroll:

1 I believe the DOE should reconsider the preferred alternative in the MIPP-EIS. For the following reasons, I believe the proposed PBF facility at the INEL site is a better alternative:

- 2 "The DOE's position is that, in the long-term, the domestic production of Mo-99 should be undertaken by the private sector." The IBTC currently holds a lease on PBF for potential use as a Boron Neutron Capture Therapy treatment center. If PBF is chosen for the MIPP, IBTC would coordinate its reactor conversion plans with DOE, reducing costs and accelerating the schedule. The INEL alternative is the only one which clearly leads to privatization.
- 3 The MIPP is not within the mission of the ACRR, therefore DOE "would retain the right for the ACRR to be available to support defense missions in times of national emergency..." This raises the possibility that isotope production could be suspended in time of emergency, creating a potential shortage the MIPP is intended to prevent. Isotope production for medical applications has been a part of the INEL's mission since 1980, allowing dedication of the PBF facility to the MIPP.
- 4 The ACRR was identified as the preferred alternative "because it is a currently operating reactor, which reduces both cost and schedule uncertainties associated with producing Mo-99..." While the uncertainty of costs and schedules may be higher at PBF, both the ACRR and PBF are estimated to be 28 months to full production, while facility preparation costs at PBF are $2M less and annual operating costs are 45% lower ($8.4M vs. $12.2M) at PBF.
- 5 All operations can be conducted on the INEL with little, if any, transportation on public highways. The preferred alternative requires shipping the targets from LANL to SNL, and wastes from SNL to NTS, on public highways.

In summary, I feel there are specific technical reasons why the PBF facility at the INEL is a better alternative than the preferred alternative at the ACRR for the MIPP.

Sincerely,

Andy Baumer
648 Adell Ave.
Idaho Falls, ID 83402

Responses to Comment Letter C002

1 Comment noted.

2 The Idaho Brain Tumor Center (IBTC) has informed DOE of its interest in coordinating its efforts with those of DOE. The Department is aware of this potential for the INEL alternative. Although the potential for privatization of the proposed action in this EIS is important, the process for privatization is not part of this proposed action. Each of the production alternatives has potential for privatization. DOE has solicited expressions of interest from the industrial community for the privatization of any isotope production activity conducted by DOE, including the proposed Medical Isotopes Production Project. If promising concepts are received, the Department would seek privatization proposals on a competitive basis.

3 If the Annular Core Research Reactor (ACRR) is selected for the Mo-99 production project, its mission would be changed from defense testing to medical isotope production. It is possible that the ACRR could be diverted to support defense missions in case of a national emergency. However, the Department has determined that the probability of needing the ACRR for defense purposes is sufficiently low to preclude disqualifying the reactor from consideration.

4 The Department recognizes that the estimated cost of the INEL alternative is lower than that of the preferred alternative; however, the uncertainties associated with the estimated cost of the INEL alternative are higher than for the preferred alternative. If the Department decides to proceed with the proposed action, the information presented in the EIS (including the cost data), the operational readiness of facilities, and other programmatic factors will be considered in the final selection of facilities for Mo-99 production.

5 The comment correctly observes that, under the preferred alternative, targets containing unirradiated uranium-235 would be transported over public roads from LANL to SNL/NM, and low-level radioactive waste would be transported from SNL/NM to the Nevada Test Site (NTS) for disposal. These operations would be carried out in accordance with applicable DOE and DOT regulations and would not measurably increase the risks associated with this alternative. The quantities of material transported, their chemical and physical form, and the packaging used during transport would combine to result in minimal risk to security or public health. (See Section 5.11 and Appendix B for a discussion of transportation impacts.)

It should be noted that one option for the SNL/NM alternative (identified in Section 3.3.1.3) is to fabricate the targets at the SNL/NM site, resulting in no transport of unirradiated materials over public roads. In addition, each of the other alternatives would require transport of radioactive materials (irradiated targets, low-level radioactive waste, or separated isotopes) over public roads. However, in no case would the necessity to use public roads substantially increase the risks of implementing the project at these sites.

Jan. 1, 1996
115 Columbia SE
Albuquerque, New Mexico 87106
505-255-5462

Mr. Wade Carroll, NEPA Document Manager
Office of Isotope Production and Distribution, NE-70
U. S. Department of Energy
19901 Germantown Road,
Germantown, Maryland 20874-1290 REF: DOE/EIS-0249D

Dear Mr. Carroll:

I would like to make a comment on the health and safety of the general public of the
Albuquerque area, as related to the Molly 99 reactor project.
At the first presentation on the isotope reactor, December 1994, your spokesman
included a statement the reactor will " add, unfortunately", (my emphasis) to the background
level of radiation in our environment here. The Environmental Assessment also confirms this,
1 and states there are already 8 other hazardous sources of radionuclide pollutants at the Kirtland
AFB/Sandia National Lab complex. The draft statement does not reflect consideration of this
complex of pollutants, and unknown future DOE projects, which may create a serious public
health problem. You surely know of the DOE and DOD talk to place a large supply of war head
plutonium, and other waste categories here in the city.
My point is that we are told repeatedly that this area already has a high level of
1 radioactivity from past above ground nuclear weapons tests, accidental nuclear reactor leaks,
undocumented accidents with lab plutonium, and the high altitude radiation. Therefore it goes
against common sense to place the isotope production here, another source of pollutants in our
environment. The Molly 99 medial isotopes are a truly good medical tool. I have been the
beneficiary in recent years of their benefits. But the waste produced by the reactor process is
not good for humans.
If you will notice the site for the reactor is within eyesight of a metropolitan area of
nearly 600,000 people, and within a stone's throw is the Veterans Administration Hospital and
the Lovelace Hospital in which are several thousand people who are usually in weakened states of
health, a time of being most vulnerable to contaminations. Several public schools and a major
airport terminal with hundreds of thousands of people passing through each year are within the
same visual range of the isotope reactor site.
In my opinion, it is foolhardy, dangerous, and disregardful of public health to place
another radioactive emitter source such as the medical isotope reactor in this area. I would
1 like to see the EIS address the above mentioned factors and conditions in relation to public heath
problems with the reactor. Your overall program of activities treats New Mexico as a vacant
desert state and the city of Albuquerque likewise. This is not true.
2 And, the economic structure of this project amounts to a public subsidy to a private
sector company, something we are suppose to be moving away from. Your letter presents the
3 problem as one of a foreign supplier versus a domestic source. This is in violation of the spirit
of the NAFTA accords in which we trade and work as friends in one common market.

Sincerely,
R. Anderson
Robert L. Anderson

Responses to Comment Letter C003

1 The EIS is required to consider the cumulative impacts of the proposed action with other ongoing or anticipated actions at the candidate sites, and it does so in Section 5.16. With respect to radiological air quality, the proposed action plus the other activities at SNL/NM would result in a dose of 0.17 mrem to the most exposed individual. This is less than 2% of the EPA standard for radionuclide emissions from DOE facilities (10 mrem/year).

If the proposed action were implemented, the collective dose to the population within 50 miles of SNL/NM would increase by less than 0.01% compared to that from background radiation. This small increase from normal operation of the isotope production facilities, or from any reasonably foreseeable accidents, would not be expected to measurably increase the risk of cancer fatality experienced by the 610,000 residents living in the vicinity of the laboratory.

2 The Department has proposed the Medical Isotopes Production Project to ensure that a reliable supply of Mo-99 is available to the U.S. medical community. If the Department decides to pursue this project, the Mo-99 would be sold at prevailing world market rates. DOE does not intend to artificially lower the cost paid by pharmaceutical companies for Mo-99 and would thus not artificially increase the profits realized by these companies on sales of Mo-99. Therefore, DOE believes that it would be incorrect to label isotope production by the Department as a subsidy to private industry or "corporate welfare."

If the decision is made to pursue this project, the Department would act as a backup to the existing Canadian supplier. The Department would operate its facilities to produce only as much Mo-99 as is necessary to maintain the capabilities of the facility and staff to produce 100% of U.S. demand in response to an interruption of the existing supply. In essence, the project would act as an "insurance policy" for the U.S. against a Mo-99 supply shortage. The goal of the proposed project is to ensure that a supply of Mo-99 is readily available to the U.S. medical community.

As stated in the EIS, DOE supports the production of Mo-99 by private industry. If a private company begins reliably producing Mo-99 in the U.S., DOE could phase out its production of Mo-99.

3 The problem with the Mo-99 supply situation is not that the supply is from a foreign country. The problem is that the entire U.S. supply comes from a single source. It should also be noted that this single source accounts for about 85% of the world supply of Mo-99. If this source were to become unavailable, production facilities in other countries would most likely focus on meeting their own needs first and, in any case, would not be able to meet even half of U.S. demand for Mo-99. Given this supply situation, the Department has proposed establishing a domestic production source to ensure that a reliable supply of Mo-99 is available to the U.S. medical community.

1568 Eagle Ridge Court NE
Albuquerque, N.M. 87122
January 3rd, 1996

Mr. Wade Carroll, EIS Project Manager
Office of Nuclear Energy, Science and Technology (NE-70)
U.S. Department of Energy
19901 Germantown, Maryland 20874-1290

Dear Mr. Carroll,

1 I am responding to the proposed Medical Isotopes Production Project and the draft of the related Environmental Impact Statement (EIS). Thank you for providing me a copy. As a citizen I am embarrassed that the Department of Energy has been forced to proceed with an EIS when I believe that the Environmental Assessment already prepared should have been completely adequate.

I wonder if those small groups opposed to all things nuclear have chosen to fight this battle as part of a general campaign of opposing anything that the Department of Energy does. This is a tactical error on their part. Their efforts are much needed elsewhere. I believe that there are terrible environmental tragedies throughout the globe that would profit from measures much more stringent than an EIS. The biologically unbelievable overpopulation of the earth will apparently soon take us past the carrying capacity of the earth even if the biologic diversity our last wild sanctuaries are destroyed in favor of gaining a few marginal resources. With gifts of antibiotics and some food (but no birth control) the human breeding population has temporarily exploded pending nature's inevitable, brutal checks on overpopulation. Our children suffer the consequences. Let the anti-medical isotopes production forces direct their efforts to the real problems of our world.

I am a physician boarded by the American Board of Radiology and the American Board of Nuclear Medicine. I believe strongly in the benefits of medical isotopes that I use daily for the care of patients with a wide spectrum of disease and injury. The NAFTA agreement and stories about Canada's willingness to build a new facility for Mo-99 production does not persuade me that the DOE project should stop. There is great wisdom in maintaining a back-up source of Mo-99. As an American taxpayer I want to see this project completed with a minimum of artificial expense. Committed as your are to finishing the EIS process, I hope that responsible administrators will rise above the political turmoil and proceed promptly with the medical isotopes project.

Sincerely,

Michael F. Hartshorne M.D.

Response to Comment Letter C004

1 The Department prepared a environmental assessment on the *Proposed Production of Mo-99 and Related Medical Isotopes at Sandia National Laboratories/New Mexico and Los Alamos National Laboratory*. This environmental assessment was distributed for public comment during the pre-approved review period on February 7, 1995. Based on the environmental assessment and on public comments received, the Department decided that it would be appropriate to prepare an environmental impact statement.

AMERICAN NUCLEAR SOCIETY

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La Grange Park, Illinois
60526 USA

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Mr. Wade Carroll
NEPA Document Manager
Office of Isotope Production and Distribution, NE-70
U.S. Department of Energy
Germantown, MD 20874

December 20, 1995

Medical Isotope Production EIS

Dear Mr. Carroll,

1 The American Nuclear Society endorses and supports the establishment of the reliable domestic supply of Mo-99 proposed in the U.S. Department of Energy's Draft Environmental Impact Statement for Medical Isotope Production and urges that the work necessary to effect that source of supply be accomplished on the most expeditious schedule.

The United States of America has been a world leader in, and a large user of, radioisotopes for medical and research applications. The corresponding national need for reliable supplies of isotopes to support these important activities was documented in the recent National Academy of Sciences- Institute of Medicine report. It is particularly urgent that the U.S. Government establish a reliable uninterrupted supply of Mo-99 as the source of Tc-99m, the main radioisotope used in diagnostic nuclear medicine, which now amount to more that 35,000 procedures daily.

In view of the established public need for these radioisotopes, the uncertainty in the current supply, and the current lack of backup capacity, the Society strongly endorses DOE's proposed action for establishment of a reliable domestic source of these materials and urges that the steps required to implement that action be accomplished as rapidly as possible.

Yours sincerely

John Graham
President

Leaders in the development, dissemination and application of nuclear science and technology to benefit humanity.

JOHN GRAHAM, PRESIDENT

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Response to Comment Letter C005

1 Comment noted.

Steven K. Zohner
1042 Grizzly Ave.
Idaho Falls, ID 83402
Ph. 208-524-4176
Work Ph 208-526-3669
January 17, 1996

Mr. Wade Carroll
EIS Project Manager
Office of Nuclear Energy, Science and Technology (NE-70)
U.S. Department of Energy
19901 Germantown Road
Germantown, Maryland 20874-1290

Subject: Comments on DOE'S draft medical isotope production project: molybdenum-99 and related isotopes environmental impact statement (DOE/EIS-0249D)

Dear Mr. Carroll:

1 I believe that the draft EIS shows that the INEL has significant advantages over DOE's preferred site. Here is a listing of some of those advantages.

Security

2 Unirradiated U-235 creates significant security requirements. Facilities at the INEL using or storing purified U-235 are kept under strict security. The INEL has a long history of working with and protecting the unirradiated U-235. Currently, the INEL has in place adequate security procedures and trained personnel to meet DOE's security requirements.

Shared cost

The INEL "PBF lease agreement in place Idaho Brain Tumor Center for Boron Neutron Capture Therapy. Idaho Brain Tumor Center interested in shared cost venture."

Privatization

"Mo-99 production feasibility studies addressed the possibility of conducting all processes in stand alone cells purchased from a viable supplier. Such as arrangement would be of great financial advantage, if these cells could be located in an existing facility close to the Power Burst Facility and possibly even be considered a single facility with the Power Burst Facility"

"The Power Burst Facility could be used to produce Mo-99 and concurrently as a Boron Neutron Capture Therapy treatment center. This approach could incorporate privatization of Mo-99 production early in the process."

Mr. Wade Carroll
January 17, 1996
Page 2

Site modifications
"However, it may be feasible to erect an additional annex to the Power Burst Facility structure, shielded from the main reactor building, and connected to existing Power Burst Facility effluent ventilation and radiation monitoring systems. Such a facility would provide great advantage to the use of stand-alone manufactured cells and eliminate transportation time and liability."

Table 3-2, shows that the hot "cells at the INEL are adequate but would require minor modifications." while DOE's preferred site would require "New hot cells required for full production."

The greatest modifications are necessary at the preferred site. "The planned facility modifications at SNL/NM are the most extensive required at any site."

3

Reduced radiation exposures.
Table 3-1, shows the dose to the population within 80 km of the INEL project would be over 10 times lower than DOE's preferred site in New Mexico.

Table 3-1, shows the radiological dose to transportation crews and to the public is lower at the INEL than DOE's preferred site.

Table 3-1, shows that the dose to the maximally exposed individual near the INEL would receive nearly 10 times less dose than the maximally exposed individual at DOE's preferred site from an accident during target processing.

Table 3-1, shows that the dose to the population within 80 km of the INEL due to a target processing accident is 10 times lower than DOE's preferred site.

Table 5-3, and Table 5-8,
The dose to off site resident at the preferred site are 10 times higher than for the INEL option.

The dose to on site workers are 10 times higher for the preferred site than for the INEL option.

The off site population dose is 2 times higher than the INEL option.

The off site population dose from hot cell operation at the preferred site is 10 times higher than the INEL option.

Mr. Wade Carroll
January 17, 1996
Page 3

Accident Impact Reduction

4 Table 3-1, target processing at the INEL is shown to be 10 times less likely to have a accident per year than any other option. Other types of accidents are about the same for each site. This 10 fold reduction at the INEL is impressive in preventing potential harm.

Cost Savings

Table 3-1, shows that the INEL site will be $ 2,000,000 less expensive to construct than DOE's preferred site. The yearly operating costs at the INEL will be nearly $ 4,000,000 less than DOE's preferred site.

The INEL option is less expensive than DOE's preferred site. The total savings of the INEL option over DOE's preferred site is 25 million dollars. This includes facility and labor costs for 1996 through 1999.

Schedule from ROD

The schedule from the record of decision to full operation is the same for the INEL and DOE's preferred site.

Isotope production experience

The INEL has 35 years of isotope production experience. DOE's preferred site has no isotope production experience.

Air quality

"Neither INEL nor any of the surrounding counties is designated as a nonattainment area (40 CFR 81.313) for the National Ambient Air Quality Standards (40 CFR 50)."

5 "Of the sites under consideration in this EIS, the only site that is located in an area that has nonattainment status for a criteria pollutant is SNL/NM, which is in an area that is nonattainment for carbon monoxide."

Waste management

"Low level radioactive waste would be shipped from SNL/NM to the Nevada Test Site for disposal." The state of Nevada is currently fighting this site in court.

6 Waste disposal at the INEL option. "In this alternative, all three steps (fabrication, irradiation, and processing) would be carried out on site at INEL." "INEL is a cradle to grave waste management operation.."

"Cradle to grave waste management. No shipping, all waste disposed at INEL facilities. Liquid low level waste treated and stored on site."

Mr. Wade Carroll
January 17, 1996
Page 4

Spent nuclear fuel

"Adequate wet and dry spent fuel storage exists on site."
This is referring to the INEL option.

DOE's preferred option will result in having to ship the spent fuel to the INEL. The state of Idaho may not be willing to accept this waste.

Nuclear waste issues

7 The governor of Idaho and DOE signed an agreement in October 1995 that allows spent nuclear fuel shipments to the INEL only under specific circumstances. The pact prohibits any shipments of spent fuel to Idaho after April 30, 1999, until shipments of transuranic waste from the INEL to the Waste Isolation Pilot Project in New Mexico or another facility are proceeding at a specified rate.

The INEL option for the production of medical isotopes has the ability to store the spent fuel at the INEL.

These advantages of the INEL site are rather impressive. It is my belief that because of these advantages the INEL would be a better choice than DOE's preferred site.

Sincerely,

Steven K Zohner

Steven K. Zohner

Responses to Comment Letter C006

1 Comment noted. This letter discusses several important factors regarding the proposed project. Discussions of many of these factors (security, reduced radiation exposures, accident impact reduction, air quality, waste management, spent nuclear fuel, and nuclear waste issues) are provided below.

The other factors discussed in the letter (shared cost, potential privatization of the production operations, modifications required, cost and schedule, and isotope production experience on site) are also important. These factors will be considered as the Department formulates its decision on the project.

2 This is true, but this is also true of the other sites. Each has a long history of handling and storing strategic special nuclear materials. Physical security requirements for materials are delineated in 10 CFR 73. All facilities, federal or commercial, are subject to those requirements. On all sites, security requirements for special nuclear materials are part of the special nuclear materials control program. Handling and storage of unirradiated targets is specified to be under the special nuclear materials control program at each site. This is stated for SNL/NM in Section 3.3.1.3. The physical protection requirements for shipment of unirradiated targets are discussed in the same section and reference the requirements delineated in 10 CFR 73.67(e).

3 The results in Table 3-1, and the corresponding results reported in Section 5 of the EIS, indicate that while the dose to the population within 80 km of INEL is lower, the doses to individual offsite residents and onsite workers from facility operation are similar or higher for the INEL alternative compared to the preferred alternative at SNL/NM. However, the dose to the maximally exposed offsite individual for either alternative is less than 2% of the EPA standard for radionuclide air emissions at DOE facilities (10 mrem/year).

The lower population within 50 miles of INEL results in a smaller collective dose from air emissions at that site, whereas the collective doses to the public and crew from transportation are similar for the two alternatives. The risk of latent fatal cancer in the offsite population as a result of normal operation or accidents is much lower than 1 for both alternatives, such that no health consequences would be expected for any reasonable duration of the project.

4 Two types of target processing accidents were evaluated at all sites: one for processing Mo-99 targets and one for processing iodine-125 targets. Both accidents were evaluated at INEL (see Table 5-44 and Table 5-45); however, only the accident resulting in the highest potential offsite consequences was reported in the summary (Table 3-1). At INEL, the iodine-125 target processing accident would result in the highest potential offsite consequences. For the other alternatives, the Mo-99 target processing accident was reported in the summary because the potential consequences were greater than for the iodine-125 target processing accident at those sites.

The expected frequency of the Mo-99 target processing accident was assumed to be 1.0/year at all sites because the nature and scope of the process would be similar under all alternatives. The expected frequency of the iodine-125 target processing accident is lower at all sites (0.1/year) because fewer targets of this type would be processed under any alternative. In all cases, the risk of latent fatal cancer from accidents during target processing is much lower than 1, and the differences in risk between the alternatives are not likely to be a major consideration in siting the project.

5 The nonattainment status for carbon monoxide in the Albuquerque area would not affect the ability to site or operate the Medical Isotopes Production Project at SNL/NM. The isotope production mission would not result in a measurable increase in emissions of criteria pollutants and therefore would not contribute to the degradation of air quality in the region.

6 The Department recognizes that "cradle-to-grave" waste management is a benefit of the INEL and LANL alternatives and will consider this factor in making its decision on the proposed project.

Regarding the issue of shipping low-level radioactive waste to the Nevada Test Site (NTS) under the preferred and ORNL alternatives, the NTS is preparing a site-wide environmental impact statement and has included waste generated from the Mo-99 mission in the quantities and description of materials proposed to be stored on the site. The Department believes that any uncertainty surrounding NTS's ability to accept the waste from the Mo-99 mission is sufficiently small that there will not be an impact on a proposed Mo-99 program. The ultimate disposition of waste generated under the proposed project may change based on future decisions resulting from the DOE Waste Management Programmatic Environmental Impact Statement (DOE 1995a).

7 Each facility has at least 5 years worth of spent fuel storage capability at full production levels. Final disposition of all spent fuel generated in the DOE complex, including the disposition of spent fuel from the INEL option, will be in accordance with the DOE Spent Nuclear Fuel Programmatic EIS (SNF PEIS) (DOE 1995b) Record of Decision.

2218 46th St.
Los Alamos, NM
87544
January 13, 1996

Mr. Wade Carroll
EIS Project Manager
Office of Nuclear Energy Science
and Technology
U.S. Department of Energy
19901 Germantown Road
Germantown, Maryland 20874-1290

Dear Mr. Carroll:

1 I strongly believe that the Omega West Reactor is the best choice in the United States for producing Molybdenum-99 for the U.S. medical community. It is certainly the least expensive choice, and I am
2 convinced that it could go into production much sooner than any of the other possibilities.

Unfortunately, I am going to be out of the country for the next 30 days and cannot, at this time, give you all the reasons that back up my above views. I will get in touch with you again in mid-February.

Sincerely yours,

Merle E. Bunker

Merle E. Bunker

Responses to Comment Letter C007

1 Comment noted.

2 According to the cost and schedule estimates contained in Section 5.22 of the EIS, the LANL alternative along with the SNL/NM alternative involves the second highest estimated cost, both in terms of preparation costs and operating costs; however, the uncertainties associated with the LANL estimates are less than for the ORNL and INEL estimates. The revised cost estimates in Section 5.22 of the Final EIS show that the LANL alternative preparation costs are equivalent to the SNL/NM alternative and are lower than the ORNL estimate, but higher than the INEL estimate. The estimated time to full production in both the Draft EIS and Final EIS is shorter for the LANL alternative than any of the other alternatives.

Subject: <NULL>
Author: flyreel@dns.ida.net_at_Internet at X400PO
Date: 1/18/96 8:46 PM

X-Sender: flyreel@mail.ida.net
Mime-Version: 1.0
Content-Type: text/plain; charset="us-ascii"

Please send this note to:
Mr. Wade Carroll, MIPP EIS Document
Manager, Office of Nuclear Energy, Science and Technology (NE-70), U.S.
Department of Energy, 19901 Germantown Road, Germantown, Maryland 20874.

Thanks

Mr. Carroll;

>The INEL's Power Burst Facility is being considered for producing medical
>isotopes for cancer and heart disease, screening and therapy. A preliminary
>Environmental Impact Statement by the DOE lists it as one of four
reasonable
>options among 17 considered for producing a widely used medical isotope,

>molybdenum-99.

1 I would like to see the facility activated and used. We have already paid
for the reactor and it is ideal for the BNCT treatment. We have the
technical personnel here at the INEL to operate the plant. I see no reason
2 to build an new plant, that will have to be cleaned up eventually.
Unneeded expense.

Some object that Idaho is so remote. Yeah, remote, 5 hours by air from
anywhere in the US.

Thank you.

John B. Hudson
235 Clary Ave
Idaho Falls, Id 83401

jnh@inel.gov, work

NO FEAR, Sit Down, Buckle Up, LogOn!

Responses to Comment Letter C008

1 Comment noted.

2 None of the options involve the construction of a new plant. The SNL/NM option, however, does involve the construction of a new hot cell within an existing building. Also, the INEL option may involve the construction of hot cell facilities adjacent to the PBF facility.

21 Jan 1996

Wade Carroll, MIPP-EIS
Document Management
US DOE, NE-70
19901 Germantown Rd.
Germantown, MD 20874

Re: Draft EIS for Medical Isotopes Project, Mo-99, et al

Dear Mr. Carroll:

Background:

1) I am a member of DOE/EM's SNL/ITRI SSAB, representing the Four Hills Homeowners Association. But this letter presents my own questions, and not yet officially those of the HoA or the SSAB.

2) I have studied the Summary and Sections 1-2 of the DEIS, and have skimmed the remainder. The document refers to the vulnerbaility of interruption of supply of Mo-99 to the U.S. A DOE official here have referred to it as a 'foreign' [vs U.S.] source.

Questions:

1 Question 1: Do you have official written notice from the Canadians stating that they may not be a relaible supplier of Mo-99 in the future, and that the U.S. should consider developing alternate sources, and if so, may I have a copy of that correspondence?

2 Question 2: Regarding references to it as a 'foreign' sourcem as if that were 'bad,' I note that Canada has, for a LONG time, been a good U.S. trading and defense partner. And the recently signed NAFTA and GATT only emphasizes things. So is there now something strategically or politically 'bad' about having Canada as a Mo-99 supplier?

Sincerely,

David A. Freiwald, Ph.D.
1708 Soplo Rd., SE
Albuquerque, NM 87123-4485

Responses to Comment Letter C009

1 The Department has not received, nor does it expect to receive, written notice from Nordion International or the Canadian government stating that they may not be a reliable supplier of Mo-99 in the future. (See letter from Nordion International-C068.)

2 The problem with the Mo-99 supply situation is not that the supply is from Canada (or from any other foreign country, for that matter). The problem is that the entire U.S. supply comes from a single source. It should also be noted that this single source accounts for about 85% of the world supply of Mo-99. If this source were to become unavailable, production facilities in other countries would most likely focus on meeting their own needs first and, in any case, would not be able to meet even half of U.S. demand for Mo-99. Given this supply situation, the Department has proposed establishing a domestic production source to ensure that a reliable supply of Mo-99 is available to the U.S. medical community.

The Idaho Falls Symphony

John LoPiccolo, Music Director & Conductor

Wade Carroll
MIPP-EIS Document Manager
US Department of Energy
Office of Isotope Production and Distribution, NE-70
19901 Germantown Rd.
Germantown, MD 20874
(301) 903-7731
fax (301) 903-5434

January 16, 1996

The Board of Directors and administrative staff of the Idaho Falls Symphony is in support
1 of the production of medical isotopes for cancer and heart disease screening and therapy at
the Idaho National Engineering Laboratory.
We believe the Power Burst Facility is technically the superior facility for the project. In
2 addition, the location would eliminate the need for shipment of low-level waste across
state lines.
We also believe the Idaho Falls community would provide the necessary infrastructure,
3 including medical, educational, and cultural facilities, to support the project and its
personnel.
The Idaho Falls Symphony is an important cultural resource for Idaho Falls and the surrounding area. This helps attract a high caliber of educated professionals and skilled personnel to the area with their families, to support continued progress at the INEL.
In turn, the overall economic health of our area is crucial to maintaining the fiscal integrity or our community's cultural base, including the Symphony.
In light of the importance of this project for its lifesaving mission, and the mutual benefit to the community of locating the project here, we hope your decision will be to locate this project at this site.

Sincerely,

The undersigned members of the Board of Directors and Staff of the Idaho Falls Symphony.

William [illegible], Executive Director

Norma Jean [illegible], Pres.

David L. [illegible] Jr., Member

[illegible] Member

[illegible]

Tamar Jorgensen, Past President

[illegible] President

John Piccolo, Conductor

Bradford A. [illegible]

Marcy Mason

[illegible]

Maria S Anderson

Responses to Comment Letter C010

1 Comment noted.

2 Each of the reasonable alternatives analyzed in the EIS is capable of meeting the selection criteria for a Mo-99 production facility and thus is capable of satisfying the purpose of and need for the proposed project.

The Department recognizes that "cradle-to-grave" waste management is a benefit of the INEL and LANL alternatives and will consider this factor in making its decision on the proposed project.

3 The INEL and the other alternative sites have the necessary infrastructure to support the proposed project.

IEEE Nuclear Medical Sciences Technical Committee

IEEE

CHAIR: *Edward J. Hoffman*
(310) 825-8851
FAX *(310) 825-4517*
EMail: *ieee_ejh@mail.nuc.ucla.edu*

January 5, 1996

Mr. Wade Carroll
NEPA Document Manager
Office of Isotope Production and Distribution, NE-70
United States Department of Energy
Germantown, MD 20874

Attn: Medical Isotope Production EIS

Dear Mr. Carroll:

The IEEE Nuclear and Plasma Sciences Society endorses and supports the establishment of the reliable domestic supply of Mo-99 proposed in the U.S. Department of Energy's Draft of an Environmental Impact Statement for Medical Isotope Production and urges that the work necessary to effect that source of supply be accomplished on the most expeditious possible schedule.

The United States of America has been a world leader in and the largest user of radioisotopes for medical and research applications. The corresponding national need for reliable supplies of isotopes to support these important activities was documented in the recent National Academy of Sciences-Institute of Medicine report

It is clearly in the best interest of the citizens of the United States to assure an uninterruptable source of radioisotopes for research and biomedical applications, and it is particularly urgent that the U.S. Government establish a reliable uninterrupted supply of Mo-99 as the source of Tc-99m, the main radioactive isotope used in diagnostic nuclear medicine.

In view of the established public need for these radioisotopes, the uncertainty in the current supply, and
the current lack of backup capacity the IEEE Nuclear and Plasma Sciences Society strongly endorses
1 DOE's proposed action for establishment of a reliable domestic source of these materials and urges that
steps required to implement that action be accomplished on the most aggressive possible schedule

Yours Very Truly.

Edward J. Hoffman, Ph.D.
Professor of Pharmacology and Radiological Sciences
UCLA School of Medicine
Chairman, IEEE NPSS Nuclear Medical and Imaging Science Technical Committee

THE INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC.

Response to Comment Letter C011

1 Comment noted.

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SECRETARY OF STATE

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Fiscal Division
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Computer Services
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January 16, 1996

Honorable Hazel O'Leary
Secretary of Energy
1000 Independence Ave., S.W.
Washington DC 20585

Dear Secretary O'Leary:

1 The Idaho National Engineering Laboratory's (INEL) Power Burst Facility (PBF) reactor has recently been listed as the potential site of the United States sole source of Molybdenum-99 (Mo-99) isotope production. I believe that the PBF represents the most technologically compatible, economically efficient and environmentally sound facility for domestic Mo-99 production and urge its designation as such.

2 Idaho is proud that the PBF will soon focus the world's attention on the implementation of Boron Neutron Capture Therapy (BNCT) at the Idaho Brain Tumor Center (IBTC). The technological partnership between DOE and IBTC is a credit to Idaho and the nation. It is my hope the victims whose maladies will be treated here, whether from Idaho, the United States or around the world, will come to understand, as you and I do, the broad advantages to our lives this government/private sector relationship creates.

3 The production of medical isotopes and the practice of BNCT are technologically compatible projects which can be carried out more efficiently and more cost effectively at the INEL's PBF reactor than at her facilities currently under evaluation by DOE. Both technologies require a constant supply of neutrons and a high flux of neutrons. The PBF produces the ideal neutron flux for BNCT and for medical isotope production.

4 Initial engineering studies show that the Idaho PBF facility can be readied for medical isotope production in 6-12 months less time and for $5 million less that any of the other three finalists being considered for the project.

5 High product quality and consistancy of supply are the two most important ingredients when considering a facility for the production of medical isotopes. The Advanced Test Reactor (ATR), also located at the INEL, has been producing specialty isotopes for many years. The expertise is presently in place to product isotopes to the highest quality standards. With the PBF serving as the main isotope production facility the ATR can fill in and maintain a constant production schedule when the PBF is down for routing maintenance and refueling. Idaho offers a twin reactor concept that assures consistancy of supply for many years to come.

6 The U.S. currently has no domestic supply of the most widely used medical isotopes. The Idaho PBF reactor can supply 100% of the domestic demand for Mo-99 and still have excess production capacity for the exportation of Mo-99.

The INEL's PBF reactor is clearly the technologically superior choice for isotope production with minimal environmental consequences. Idaho's long history as the world leader in nuclear materials management make it ideally suited for the project.

Support for the project both on a local and state level, is strong. Downsizing of INEL projects and personnel make it imperative that new missions are created to save and expand existing capabilities.

7 DOE intends to privatize the isotope production program. IBTC's present 30 year lease of the PBF reactor puts the privatization plan into effect immediately. No other
8 federal missions will interfere with the operation of Mo-99 production at the PBF, unlike some of the other sites under review.

The humanitarian aspects of the combined National Center for BNCT and the isotope production project makes the INEL's PBF the hands down winner for the national as well as the State of Idaho.

9 After considering the lower start-up costs, mission compatibility and technological superiority, it is clear that INEL' PBF is the logical home of the United States Mo-99 production source.

Sincerely,

Pete T. Cenarrusa
Secretary of State
State of Idaho

Responses to Comment Letter C012

1 Comment noted.

2 Comment noted.

3 The Idaho Brain Tumor Center (IBTC) has informed DOE of its interest in coordinating its efforts with those of DOE; however, IBTC has not submitted any plans for coordinating reactor conversion activities, nor has it made a formal proposal to DOE. In addition, the Department understands that IBTC is investigating the possibility of using other facilities for boron neutron capture therapy (BNCT) and that other reactors under consideration for this project may be useable for BNCT. If the Department decides to proceed with a production alternative for this proposed project, it would welcome a proposal from IBTC for dual use of the reactor facility selected.

4 As shown in Section 5.22, the estimated cost to prepare the INEL facilities is $2.4 million less than the closest alternative (the preferred alternative), and the estimated time to prepare the INEL facilities for full production is tied with the preferred alternative.

The uncertainties associated with the estimated cost of the INEL and ORNL alternatives are higher than for the LANL and the preferred alternative. Cost estimates (including uncertainties) will be an important factor in determining which alternative to pursue for the proposed project. This comment will be provided to the decision maker for this proposed project and will be given due consideration as the Department formulates its decision on the project. In making its decision, the Department will also consider factors such as the environmental impacts of the alternatives, national need for the medical isotopes, production schedules for each alternative, and other important factors.

5 The Advanced Test Reactor was evaluated for the proposed project and was dismissed for the reasons cited in Section 3.4.1.1. The Department is proposing to establish a backup to the existing Canadian supplier and does not believe that it is necessary to establish a backup to its backup.

6 If the decision is made to pursue this project, the Department would act as a backup to the existing Canadian supplier. All the alternatives would have the capability of producing at least 100% of the current domestic demand for Mo-99, but the goal of the proposed project is to ensure that a reliable supply of Mo-99 is available to the U.S. medical community, not to produce Mo-99 for export and compete in the worldwide market for Mo-99.

7 The IBTC has not made a formal proposal to the Department regarding the dual use of the Power Burst Facility (PBF). Therefore, the Department cannot say for certain whether operation of PBF would be conducted privately (by IBTC) for the production of Mo-99 or by DOE.

8 It is possible that the Annular Core Research Reactor (ACRR) could be diverted to support defense missions in case of a national emergency. However, the Department has determined that the probability of needing the ACRR for defense purposes is sufficiently low to preclude disqualifying the reactor from consideration.

9 Comment noted.

BRADY'S

C.A. Brady II
Owner
1930 N. Woodruff Ave.
Idaho Falls, Idaho 83401

Telephone (208)522-6763
Fax (208)522-6787

January 17, 1996

1 I am here in support of locating the Production of Medical Isotopes and the Boron Neutron Capture Therapy Project otherwise known as B.N.C.T. at the I.N.E.L.. These programs optimize the peaceful use of the atom. They will save lives.

The PBF reactor is the most suited reactor for these projects both cost wise and technically.

2 1. The PBF reactor is the only reactor using low-enrichment uranium fuel which reduces waste generation and security requirements.

3 2. The PBF can dispose of the low level waste generated on site while the preferred alternative would require packaging and shipping across state lines to the Nevada Test Site.

4 3. One reactor suitable for both the isotope production and cancer treatment mission; The technical ability to produce 100% of the nation's demand for these medical isotopes.

5 4. The initial expenditure is half the cost, and operation expense is at least one third lower if done a the Power Burst Facility at the I.N.E.L.

6 5. Currently the PBF is the only choice which envisions the private sector taking over production, a good way to demonstrate technology spin off and create jobs in Southeast Idaho.

I urge you to look at all the pertinent criteria and you will see that PBF can do both projects better than any other reactor. Local support is here. We want these projects here in Idaho.

Respectfully,

C.A. Brady II

Responses to Comment Letter C013

1 Comment noted.

2 The Power Burst Facility (PBF) is the only option currently using low enriched uranium fuel. All the other options evaluated in detail have designs for converting to low enriched uranium. The objective is to not build any more highly enriched uranium fuel bundles for any of the other options, but to use the fuel already on hand until the supply is exhausted or, in the case of Annular Core Research Reactor (ACRR), until the burnup limit is reached—see Section 3.3.1.9. Two or three transition cores of both low enriched uranium and highly enriched uranium would be used during the conversion to all low enriched uranium fuel for these options. This is a long-term safeguards advantage, in that it depletes and irradiates the weapons grade material on hand.

It is not true that use of low enriched uranium fuel minimizes waste. More spent fuel bundles are generated per reactor full power year with the use of low enriched uranium bundles.

3 The INEL alternative and the LANL alternative both allow the small quantities of low-level waste generated by the Mo-99 process to be disposed of onsite. The commentor is correct in identifying that both the preferred alternative and the ORNL alternative would require some shipment of low-level waste to the Nevada Test Site (NTS). The NTS is preparing a site-wide environmental impact statement and has included waste generated from the Mo-99 mission in the quantities and description of materials to be stored on the site.

4 While the PBF has been the focus of the Idaho Brain Tumor Center's (IBTC's) efforts to conduct boron neutron capture therapy (BNCT), other reactors under consideration for the proposed project may also be suitable for the conduct of BNCT. If the Department decides to pursue this project, it would welcome a proposal from IBTC for dual use of the reactor facility selected for medical isotope production.

All of the reactors evaluated as reasonable alternatives for the proposed project would (after necessary modifications) have the ability to produce at least 100% of the U.S. demand for Mo-99 and would also be capable, to varying degrees, of conducting synergistic activities.

5 The preparations costs for the INEL alternative, as shown in Section 5.22, are estimated to be about $2.4 million (or about 12%) less than for the preferred alternative. The operations costs for the INEL alternative are estimated to be about $4.4 million (or about 34%) less than for the preferred alternative. However, the uncertainties associated with the cost estimates for the INEL and ORNL alternatives are expected to be greater than for the LANL and the preferred alternatives.

6 The IBTC has proposed to privately conduct boron neutron capture therapy. Their desire or capability to also privately produce Mo-99 is not known, and they have not made a formal proposal to the Department regarding the dual use of the PBF. Therefore, the Department cannot say for cenain whether operation of the PBF for Mo-99 production would be conducted privately (by IBTC) or by DOE.

Statement of Senator Kempthorne

January 17, 1996

I want to offer my enthusiastic support to the local effort
to use the Power Burst Facility and the Idaho Brain Tumor
1 Facility for the production of Molybdenum-99 (Molly-99). In my
view, it makes great sense to couple the Boron Neutron Capture
Therapy (BNCT) program with the production of important medical
isotopes.

As the Department of Energy considers options for the
production of Molly-99, I want to be sure the unmatched
facilities and professional capabilities in Eastern Idaho are
appreciated by the department. To begin with, according to the
2 technical experts I have consulted, the Power Burst Facility is
the ideal reactor for the production of medical isotopes. At the
same time, the PBF can be prepared for this mission in less time
3 and at less cost than any other option being considered by the
Department of Energy. In addition, the professional people and
technical experts involved in the local effort and the INEL's
historic role in reactor operations and nuclear materials
management make Eastern Idaho the logical choice for this new
mission.

As the role of the Department of Energy changes, new
missions for DOE facilities are needed. Fortunately, in Eastern
Idaho we already see private enterprise stepping in to fill some
of the void. The Idaho Brain Tumor Center is an excellent
example of this new private enterprise expansion and the
4 production of Molly-99 in the PBF reactor would complement this
effort.

I strongly support the effort of Dr. Paul and others to add the production of medical isotopes to the new mission for the PBF reactor. This mission makes sense for Idaho and the nation and I urge the Department of Energy to make the selection based on merit. If merit is the criteria for the selection, I am confident we will see Molly-99 production in Idaho in the near future.

Thank you for your time.

Responses to Comment Letter C014

1 Comment noted.

2 The Power Burst Facility (PBF) offers many benefits. It is an open pool type reactor, which is advantageous and can run at relatively low power to conduct the Mo-99 mission. The other reactors considered are similar. PBF is a forced circulation reactor, and three of the others considered are also forced circulation, which helps to assure target cooling.

However, the PBF option requires significant reactor modification, as discussed in Section 3.3.4.9. Also, the targets must be irradiated in the central cavity similar to the Annular Core Research Reactor (ACRR), and neither experimental nor detailed calculation has been performed to assure that adequate target power could be achieved in PBF in this configuration. Two of the other options are very similar to the Cintichem reactor, and target power is relatively assured by both experiment and by calculation. One of the other options, ACRR, has had detailed calculations performed regarding target power, but actual experiments have not been performed.

Each of the reactors of the four alternatives possesses certain attributes and deficits. None are ideal, but all are capable of conducting the proposed project.

3 The Department recognizes that the estimated costs of preparation and operation of the INEL alternative, as shown in Section 5.22, are lower than that of the preferred and other alternatives. However, the Department also recognizes that the uncertainties associated with the estimated cost of the INEL alternative are higher than for the preferred or LANL alternatives. The time required to ready the INEL facilities for full production is estimated to be second fastest and the same as the preferred alternative. If the Department decides to proceed with the proposed action, the information presented in this EIS (including the cost and schedule data), the operational readiness of facilities, and other programmatic factors will be considered in the final selection of facilities for Mo-99 production.

4 The Idaho Brain Tumor Center (IBTC) has informed DOE of its interest in coordinating its efforts with those of DOE; however, IBTC has not submitted any plans for coordinating reactor conversion activities, nor has it made a formal proposal to DOE. In addition, the Department understands that IBTC is investigating the possibility of using other facilities for boron neutron capture therapy (BNCT) and that other reactors under consideration for this project may be usable for BNCT. If the Department decides to proceed with a production alternative for this proposed project, it would welcome a proposal from IBTC for dual use of the reactor facility selected.

Statement of Senator Larry E. Craig
on the
Draft Environmental Impact Statement
for
Medical Isotopes Production Project:
Molybdenum-99 and Related Isotopes
Idaho Falls, Idaho
January 17, 1996

It is a pleasure to offer testimony today on the production of medical isotopes at the Department of Energy's (DOE) National Laboratories.

The involvement of the DOE in medical applications has been of particular interest to me. I have been an advocate of the use of the numerous reactors at the Idaho National Engineering Laboratory (INEL) for medical purposes for a number of years. However, what is at stake here is not just jobs for the working families of Idaho Falls.

The INEL has already made contributions to medical research -- for instance using the Power Burst Facility (PBF) for Boron Neutron Capture Therapy, a breakthrough treatment for brain tumor patients
1 with minimum patient trauma and cost. The production of medical isotopes, continuously needed in the United States, offers the INEL another opportunity to play an important medical role for the nation.

Because of the INEL's critical nuclear expertise developed over 50
2 years, the INEL is the perfect and most logical location to produce these important medical isotopes many patients in our nation need. Our country would benefit significantly from this vital program.

The importance of assuring a dependable, reliable supply of Molybdenum-99 and its daughter product Technetium-99m for medical procedures cannot be overstated. Technetium-99m is used as a principal radiological diagnostic tool for 80 percent of the 36,000 diagnostic procedures performed every day, totaling 10 million procedures every year in the United States. These procedures help to identify medical conditions that would otherwise be identified only by invasive surgery. This isotope is clearly a vital tool in maintaining the health and well being of our citizens.

At present, the United States has only one source of supply of Molybdenum-99 (Mo-99). That source is Nordion International, which produces it at the aging NRU reactor at Chalk River, Ontario. This reactor is just two years away from completing its 40-year design
3 life. NRU not only supplies the entire United States market for Molybdenum-99, it supplies 85 percent of the entire world market. The future of medical isotope production from NRU is in serious jeopardy. This threat is so serious I understand a company has obtained a license to upgrade a 45 megawatt (MW) reactor in the

Netherlands -- clearly a result of the uncertainty about the
Canadian supply. This country obviously needs a domestic supply of
these important medical isotopes.

3 Although there may be other Canadian reactors coming on line in the
future for medical isotope production, I feel it is vitally
important that our Nation have the capability to produce medical
isotopes on our own. We cannot afford to continue our current
vulnerability. As noted in this draft environmental impact
statement (DEIS), our goal is to meet initial domestic production
of only 10 to 30 percent of the Nation's need, I believe we must
4 move forward to assure we can produce 100 percent of our nation's
medical isotope needs.

Today I will speak in support of the alternative discussed in the
5 draft EIS that uses the facilities of the INEL. The PBF reactor at
the INEL may offer multiple advantages in solving our Nation's
medical isotope problems. For example:

1. The INEL offers the potential dual use of an existing
reactor -- for medical isotope production and cancer
6 therapy.

2. INEL offers unsurpassed expertise in reactor operations,
existing reactors, and complete infrastructure support
7 (hot cells and remote handing capabilities, expertise in
handling and shipping spent nuclear fuels, among others)
that can be adapted to the production of these isotopes.
I am perplexed that the Advanced Test Reactor (ATR) is
not considered in this DEIS. I suggest DOE consider ATR
in their final EIS. I understand also that advances are
8 being made in accelerator-based alternative technology
research, and DOE may want to consider this alternative
in the final EIS, as well.

3. INEL offers experienced, effective reactor operations
management. However, in keeping with Congress' insistence
that federal dollars are used as wisely as possible, the
INEL management is actively evaluating the privatization
of reactor facility operations to assure the effective
use of tax dollars.

The Idaho Brain Tumor Center has offered to
9 coordinate its reactor conversion plans for the PBF
with the DOE, potentially saving millions of
dollars.

Isotopes USA and the Idaho State University have
offered private management and operation for the
production of Mo-99.

One of the partners in the INEL management team, 9 Thermo Technology Ventures, is actively researching alternative technologies for isotope production.

10 4. INEL offers the lowest cost alternative for isotope production. We can simply not afford to pursue any alternative but the most cost effective means to meet isotope production needs.

11 5. The PBF reactor is the only alternative in the DEIS that uses low-enrichment uranium at the onset of operations, reducing the wastes generated and the security requirements inherent in using highly enriched uranium.

6. The INEL has already moved into the new management paradigm called for by the DOE, namely running the INEL like a business. The production of medical isotopes would be well suited to this new paradigm.

The new mission for INEL holds strong potential for developing not only national but international markets. I strongly encourage the Department to complete a final EIS on medical isotope production.
12 I believe the DOE has moved far too quickly with far too little data in recommending a preferred alternative for isotope production. I strongly encourage DOE to take another look at the INEL and assemble detailed costs for a wide array of alternatives in the final EIS.

I believe our county would be well served if the INEL were the site for future medical isotope production in United States. Such production is an important applied engineering project for the nation. Applied engineering is what INEL does and does well.

Thank you.

Responses to Comment Letter C015

1 The Department's decision on the proposed Medical Isotopes Production Project will be based not only on the environmental impacts of the alternatives, but also on factors such as cost and schedule, national need, and the potential for cost sharing with other initiatives.

It should be noted that the Power Burst Facility (PBF) is not currently operating (and has not operated since 1987) and thus is not currently conducting boron neutron capture therapy (BNCT). The Idaho Brain Tumor Center (IBTC) has informed DOE of its interest in coordinating its efforts with those of DOE; however, IBTC has not submitted any plans for coordinating reactor conversion activities, nor has it made a formal proposal to DOE. In addition, the Department understands that IBTC is investigating the possibility of using other facilities for BNCT and that other reactors under consideration for this project may be usable for BNCT. If the Department decides to proceed with a production alternative for this proposed project, it would welcome a proposal from IBTC for dual use of the reactor facility selected.

2 The INEL and the other alternative sites have the facilities and skilled personnel available to conduct the medical isotope production activities.

3 Comment noted.

4 If the decision is made to pursue this project, the Department would act as a backup to the existing Canadian supplier. The Department would operate its facilities to produce only as much Mo-99 as is necessary to maintain the capabilities of the facility and staff to produce 100% of U.S. demand in response to an interruption of the existing supply. However, all of the reactors evaluated as reasonable alternatives for the proposed project would (after necessary modifications) have the ability to produce at least 100% of the U.S. demand for Mo-99.

5 Comment noted.

6 Please see response to comment C015-1 above.

7 All of the alternative sites have significant nuclear facilities operations and waste management experience that can be adapted to the production of isotopes.

8 The Advanced Test Reactor is an alternative considered but dismissed in the EIS. The ATR option is discussed in Section 3.4.1.1.

Accelerators are considered but dismissed for the reasons discussed in Section 3.4.1.7. Future accelerator technology may be capable of supporting a Mo-99 mission (see Section 3.4.3.3). Current accelerator technology cannot support the objectives of the proposed project.

9 The Department will consider the potential for privatization of each of the medical isotope production alternatives as it formulates its decision on the proposed project.

The IBTC has informed DOE of its interest in coordinating its efforts with those of DOE; however, as stated above, IBTC has not submitted any plans for coordinating reactor conversion activities, nor has it made a formal proposal to DOE.

The Department is aware of the efforts of Isotopes USA and Thermo Technology Ventures and has met with representatives of these organizations to discuss their interest in Mo-99 production. Their Mo-99 initiatives are discussed in Section 3.4.3.

10 The Department recognizes that the estimated costs of preparation and operation of the INEL alternative, as shown in Section 5.22, are lower than that of the preferred and other alternatives. However, uncertainties associated with the estimated cost of the INEL alternative are higher than for the preferred or LANL alternatives. Cost estimates (including uncertainties) will be one of the factors in determining which alternative to pursue for the proposed project.

11 The PBF is the only option currently using low enriched uranium fuel. All the other options evaluated in detail have designs for converting to low enriched uranium. The objective is not to build any more highly enriched uranium fuel bundles for any of the other options, but to use the fuel already on hand until the supply is exhausted or, in the case of the Annular Core Research Reactor, until the burnup limit is reached—see Section 3.3.1.9. Two or three transition cores of both low enriched uranium and highly enriched uranium would be used during the conversion to all low enriched uranium fuel for these options. This is a long-term safeguards advantage, in that it depletes and irradiates the weapons grade material on hand.

It is not true that use of low enriched uranium fuel minimizes waste. More spent fuel bundles are generated per reactor full power year with the use of low enriched uranium bundles.

12 The Department has used the best available information for all of its analyses and comparisons, including the cost information. Information on restart of the PBF was fairly thorough and was probably a result of the efforts to estimate costs and schedules for conversion of the PBF for BNCT. However, reactor conversion and operation is only a portion of the cost and schedule information requested. Hot cell modification, process line fabrication, target fabrication facility modification, and general processing operational costs also are reflected in Section 5.22 of the EIS. Additional information on the estimated cost of the INEL alternative was obtained subsequent to the publication of the Draft EIS and was used in the preparation of the Final EIS; however, the amount of supporting material associated with these estimates was less detailed than that received from some of the other sites. Thus the EIS contains statements that indicate the margin of error for both the INEL and ORNL estimates are considered larger than for LANL and SNL/NM.

MICHAEL D. CRAPO
2D DISTRICT, IDAHO
HOUSE REPUBLICAN LEADERSHIP
1990 CLASS LEADER
DEPUTY WHIP
WESTERN UNITED STATES
REPUBLICAN POLICY COMMITTEE
DEEF CAUCUS, CO CHAIRMAN
CONGRESSIONAL RURAL CAUCUS
CONGRESSIONAL SPORTSMEN'S CAUCUS
CONGRESSIONAL WATER CAUCUS

Congress of the United States
House of Representatives
Washington, DC 20515–1202

COMMERCE COMMITTEE
SUBCOMMITTEES
COMMERCE, TRADE, AND HAZARDOUS MATERIALS
ENERGY AND POWER
OVERSIGHT AND INVESTIGATIONS
AGRICULTURE COMMITTEE
SUBCOMMITTEES
RESOURCE CONSERVATION, RESEARCH, AND FORESTRY
DEPARTMENT OPERATIONS, NUTRITION AND FOREIGN AGRICULTURE

STATEMENT FOR
HEARING ON PRODUCTION OF MEDICAL ISOTOPES
January 17, 1996

Cancer continues to be the second leading cause of death in the United States. Unfortunately, in spite of a national investment of $23 billion during the past twenty years, cancer cure rates have not significantly improved.

Brain cancer is particularly difficult to treat. We are told that there is currently no viable treatment available within the United States for patients with the most severe form of brain tumor. Treatments such as surgery, radiation, and chemotherapy offer no real cure.

We must fund and develop revolutionary new procedures for treating cancer rather than maintaining our emphasis on improving currently available procedures. BNCT is one of these new treatments that offers promise and hope that one day soon, patients with now-fatal brain tumors can be cured.

In 1992, the Department of Energy designated the Idaho National Engineering Laboratory (INEL) as the "National Center for BNCT Measurement and Development". National Center research has demonstrated non-surgical, brian-tumor treatment feasibility. The Consortium was formed to assure that high-quality, non-surgical BNCT therapy is available to U.S. brain-tumor patients by 1996. This consortium approach reduces large overhead costs and provides a mechanism for using corporate and private charitable contributions as well as federal and state funding to conduct the necessary clinical trials.

The DOE and its predecessor agencies have produced and distributed medical and industrial isotopes through the Department's national laboratories for more than 40 years. In 1990, Congress consolidated all DOE isotope production activities under the Isotope Production and Distribution Program (IPDP). The program's primary responsibility is ensuring that the U.S. health care community has a reliable supply of Molybdenum-99 (Mo-99). Mo-99 decays rapidly into Technetium-99 (Tc-99), which is the most widely used radioactive medical isotope in the United States because of its broad medical applications.

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☐ 2539 CHANNING WAY
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☐ 479 BLUE LAKES BLVD., NORTH
TWIN FALLS, ID 83301
(208) 734-7219

Page 2

The INEL's Power Burst Facility (PBF) reactor has recently been
listed as a potential site of the United States sole source of Mo-
99 isotope production. I believe the PBF facility demonstrates the
most efficient, technologically compatible, and environmentally
1 sound facility for production of the supply of Moly-99 for the U.S.
medical industry and I suggest its designation as such.

The U.S. currently has no domestic supply of the most widely used
medical isotopes. The Idaho PBF reactor can supply 100 percent of
2 the domestic demand for Mo-99 and still have excess production
capacity for the exportation of Mo-99. Further, the PBF, the
humanitarian aspects of the combined National Center for BNCT and
3 the isotope production project makes the INEL's PBF the clear
choice for the production of the nations supply of medical
isotopes.

Thank you

U.S. Representative Michael D. Crapo

Responses to Comment Letter C016

1 Comment noted.

2 If the decision is made to pursue this project, the Department would act as a backup to the existing Canadian supplier. The Department would operate its facilities to produce only as much Mo-99 as is necessary to maintain the capabilities of the facility and staff to produce 100% of U.S. demand in response to an interruption of the existing supply. In essence, the project would act as an "insurance policy" for the U.S. against a Mo-99 supply shortage. The goal of the proposed project is to ensure that a reliable supply of Mo-99 is available to the U.S. medical community, not to compete in the worldwide market for Mo-99. However, each alternative (after necessary modifications) would have the capability to produce 100% of the U.S. demand for Mo-99.

3 The Idaho Brain Tumor Center (IBTC) has informed DOE of its interest in coordinating its efforts with those of DOE; however, IBTC has not submitted any plans for coordinating reactor conversion activities, nor has it made a formal proposal to DOE. In addition, the Department understands that IBTC is investigating the possibility of using other facilities for boron neutron capture therapy (BNCT) and that other reactors under consideration for this project may be usable for BNCT. If the Department decides to proceed with a production alternative for this proposed project, it would welcome a proposal from IBTC for dual use of the reactor facility selected.

OFFICE OF THE GOVERNOR
P.O. BOX 83720
BOISE 83720-0034

PHILIP E. BATT
GOVERNOR

(208) 334-2100

Governor Phil Batt

Testimony prepared for delivery
at the
U.S. Department of Energy
Idaho Falls, Idaho
hearing on the

Medical Isotopes Production Project: Molybdenum-99 and Related Isotopes Draft Environmental Impact Statement

January 17, 1995

To those gathered in Idaho Falls today, I regret that I cannot be there with you. I certainly extend my best wishes to you all.

1 Let me state my position clearly -- I fully support the effort to produce medical isotopes at the Idaho National Engineering Laboratory.

INEL has an available a reactor that is uniquely qualified to produce these important medical products -- the Power Burst Facility. I support bringing such production on line.

2 The Power Burst Facility can be started for significantly less cost than any other facility being considered in the Draft Environmental Impact Statement. For this reason and the others outlined in this testimony, PBF at INEL is clearly the facility the DOE should chose to begin the production of radioisotopes.

3 For far too long this nation has relied on Canada and, to a lesser extent, Europe, to supply the medical isotopes America needs. The time has come for this nation to take care of our own. I commend the Department of Energy for identifying this vital national need. I also commend the DOE for identifying INEL as a possible location for the production of these important products.

I am concerned, however, that the Draft Environmental Impact Statement indicates that the DOE is only looking for backup capability to provide 10 to 30% of the United States Molybdenum-99 (Mo-99) needs. In the final EIS, the DOE should revise the objective and raise the standard. The goal should be to provide 100% of American needs -- and maybe more.

4 The case for this position -- to provide for 100% of production needs -- is clearly made by the Draft EIS. The document plainly states that if the Canadian reactors were shut down, European sources could only provide "only a portion of U.S. demand." The statement also notes that until a backup production facility is brought on line which is capable of producing 100% of American needs, our nation is "vulnerable to an interruption in the supply of this important isotope." (Draft EIS Summary, page V.)

The case is clear. The United States needs to have the capability for full production of these important isotopes. PBF can fulfill that need.

As the DOE looks to meet the needs of our nation, the Department should also look beyond our nations' border. It is not enough to just satisfy the needs of American customers. The DOE should also begin searching out foreign markets for this important American product. Now is the time to begin.

Once again I commend the Department for identifying the need to produce medical isotopes in the United States. I certainly hope that the DOE will choose the Power Burst Facility at INEL for the production of these important materials.

Responses to Comment Letter C017

1 Comment noted.

2 The Department recognizes that the estimated costs of preparation and operation of the INEL alternative, as shown in Section 5.22, are lower than that of the preferred and other alternatives. However, the Department also recognizes that the uncertainties associated with the estimated cost of the INEL alternative are higher than for the preferred or LANL alternatives. Cost estimates (including uncertainties) will be one of the factors in determining which alternative to pursue for the proposed project.

3 Comment noted.

4 All of the reactors evaluated as reasonable alternatives for the proposed project would (after necessary modifications) have the ability to produce at least 100% of the U.S. demand for Mo-99. However, the goal of the proposed project is simply to ensure that a reliable supply of Mo-99 is available to the U.S. medical community, not to capture the U.S. market from the private Canadian firm (Nordion International) or to compete in the worldwide market for Mo-99.

If the decision is made to pursue this project, the Department would act as a backup to the existing Canadian supplier. The Department would operate its facilities to produce only as much Mo-99 as is necessary to maintain the capabilities of the facility and staff to produce 100% of U.S. demand in response to an interruption of the existing supply. In essence, the project would act as an "insurance policy" for the U.S. against a Mo-99 supply shortage.

VoigtDavis, Realtors®

January 17, 1996

Attn: Department of Energy
From: Don Davis
RE: Production of Radioactive Isotopes at (Power Burst Facility) PBF located at the INEL.

To whom it may concern:

I had a wonderful thing happen to me today. My cardiologist advised me that my heart had a abnormal beat. So, today I had the opportunity to have an stress test which used Technisiam to take a video of my heart which may improve my chances of staying around a while longer.

Two years ago I found out that we had the technology at BNCT to operate on and potentially save lifes of cancer patients with some types of Brain Tumors

One week ago, we discovered that a by product of an existing plant PBF
was technisiam. I also found out the this country imports the majority
of it supply. Additionally, I found out that PBF could supply 150% of
1 this countries needs, in fact we could be exporting the stuff. I also
understand that Sandia was given this project which will cost more and
2 take longer to bring on line and their plant will not be as effective
treating Brain Tumors.

This letter is to inform someone in Washington that for business reasons,
community growth, new jobs that I am 110% for this technology here in Idaho
3 Falls. What I can't understand for good sound business reasons why it
wasn't chosen in the first place. Do poor decisions effect the budget?

Sincerely,

Don Davis

Don Davis/Realtor
Voigt Davis Realtors

CC: Senators: Larry Craig
Dirk Kempthorn

Congressman: Mike Crapo
Helen Chenoweth

(208) 524-6000 • FAX (208) 529-0882 • 1908 Jennie Lee Drive • Idaho Falls, ID 83404

Responses to Comment Letter C018

1 If the decision is made to pursue this project, the Department would act as a backup to the existing Canadian supplier. The Department would operate its facilities to produce only as much Mo-99 as is necessary to maintain the capabilities of the facility and staff to produce 100% of U.S. demand in response to an interruption of the existing supply. In essence, the project would act as an "insurance policy" for the U.S. against a Mo-99 supply shortage. The goal of the proposed project is to ensure that a reliable supply of Mo-99 is available to the U.S. medical community, not to compete in the worldwide market for Mo-99.

2 The Department has not made a decision regarding the proposed Medical Isotopes Production Project. A Record of Decision answering the Department's decision will be issued no sooner than 30 days after issuance of the Final EIS. The EIS process is being used to evaluate other alternatives for the production of Mo-99 and related medical isotopes. The Department recognizes that the estimated cost of the INEL alternative is lower than that of the preferred alternative; however, the uncertainties associated with the estimated cost of the INEL alternative are higher than for the preferred alternative. If the Department decides to proceed with the proposed action, the information presented in the EIS (including the cost data), the operational readiness of facilities, and other programmatic factors will be considered in the final selection of facilities for Mo-99 production. Please note also that use of facilities for treatment of brain tumors is not part of the proposed action and is not evaluated in this EIS.

3 Comment noted.

1/17/96

Thomas M Crawford
4905 Foxtrail
Idaho Falls ID 83402
(208) 522-7829

I am a physicist for the Idaho National
Engineering Laboratory, I as an INEL
1 employee would like to express my support
for ~~placing~~ choosing Idaho Falls as the
location of the Medical Isotopes Production
Project. We have the expertise and
2 many of the necessary facilities at the
INEL to support this facility.

I am also chairman of the Bonneville County Republican Central Committee. Our party organization also fully supports bringing the Medical Isotope Production Project to Idaho.

Responses to Comment Letter C019

1 Comment noted.

2 The INEL and the other alternative sites have the facilities, nuclear technology and expertise necessary to conduct the proposed project.

January 17, 1996

Wade P. Carroll

1 America needs a constant and consistant supply of Molly 99, especially since the Canadian source may well drop when we start production. The threat that the New Mexico reactor may be taken over by the Defence Department should disqualify that site.

G. Ross Darnell
339 East 49 South
Idaho Falls, ID 83404

Response to Comment Letter C020

1 The Annular Core Research Reactor (ACRR) is an Office of Defense Programs facility within the Department of Energy. If the ACRR is selected for the Mo-99 production project, its mission would be changed from defense testing to medical isotope production. It is possible that the ACRR could be diverted to support defense missions in case of a national emergency. However, the DOE has determined that the probability of needing the ACRR for defense purposes is sufficiently low to preclude disqualifying the reactor from consideration.

1/17/96

We, the undersigned, support
1 the moli-isotope production at
INEL, Idaho Falls, ID. Our
reasons are based on sound environ-
mental policy & strong community
support. In our opinion, the cost
savings & environmental safeguards
at INEL dictate that it is the
2 most logical and prudent of all
site selections

Kathi Sica - Alliance Title & Escrow Corp
Larry Pettingill - American Heritage Realtors
[illegible] / [illegible] Nelson Mountain River Realty
[illegible]
[illegible]

Responses to Comment Letter C021

1 Comment noted.

2 The Department recognizes that the estimated costs of preparation and operation of the INEL alternative, as shown in Section 5.22, are lower than that of the preferred and other alternatives. However, uncertainties associated with the estimated cost of the INEL alternative are higher than for the preferred and LANL alternatives. The potential environmental impacts of the four production alternatives analyzed in the EIS were found to be essentially the same for each alternative and, in all cases, were found to be low. Cost estimates (including uncertainties) and potential environmental impacts will be important factors in determining which alternative to pursue for the proposed project.

Steven A. Davies
364 8th Street
Idaho Falls, Idaho 83401

January 17, 1996

Mr. Wade Carroll
MIPP EIS Document Manager
Office of Nuclear Energy, Science and Technology (NE-70)
U.S. Department of Energy
19901 Germantown Road
Germantown, Maryland 20874.

RE: PRODUCTION OF MEDICAL ISOTOPES AT THE INEL

Dear Mr. Carroll:

I have been a resident of Idaho Falls, Idaho for the last 6 years. I thoroughly enjoy the quality of life and pristine environment of this region, and have decided to remain in this area regardless of the future of the Idaho National Engineering Laboratory (INEL).

I wish to express my <u>STRONG SUPPORT</u> for the Power Burst Facility (PBF) Reactor at the
1 INEL to be the site chosen by the Department for the production of medical isotopes
(molybdenum-99) in the United States. The economic impact on a smaller region like
Southeastern Idaho by such a program would be much more significant than to the other three
2 reasonable option sites under consideration. The citizens of this community have made major
contributions and many sacrifices in support of the cold war for this country, and are very excited
3 at the prospect of attracting new missions to the INEL.

Thank you in advance for your careful consideration of this issue. Should you have any questions or desire any follow-up discussion, please do not hesitate to contact me by mail, or by phone at (208) 529-9167.

Sincerely,

Steven A. Davies, P.E.

Responses to Comment Letter C022

1 Comment noted.

2 The Department realizes the importance of its laboratories to their respective state and local economies as well as the importance of preserving the valuable technical capabilities each of the laboratories possess. The socioeconomic impacts of the proposed project are presented in Section 5.3.

3 The Department recognizes and appreciates the contributions and sacrifices made during the Cold War by the citizens around the INEL and other DOE facilities.

IDAHO ACADEMY OF SCIENCE

a spectrum of disciplines

909 Lucille Ave.
Pocatello, ID 83201
January 17, 1996

Mr. Wade Carroll
MIPP EIS Document Manager
Office of Nuclear Energy
Science and Technology (NE-70)
U.S. Dept. of Energy
19901 Germantown Road
Germantown, MD 20874

Dear Mr. Carroll:

1 This is to express **support** for using the Power Burst Facility (PBF) at the Idaho National Engineering Laboratory (INEL) to produce medical isotopes. The use of this already existing facility would be practical and would receive broad-based public support in this region.

2 Southeast Idaho already has a strong technical community associated with the INEL. Because many of these people have worked with and understand nuclear technology, this area is largely free from the superstitious fear of everything nuclear that prevails in many regions of this country.

Please select the PBF at the INEL to provide a secure ***domestic*** source of radioisotopes, in this case, largely for medical purposes.

Sincerely,

Philip A. Anderson,
Executive Secretary
(208) 526-3395, daytime
(208) 234-7001, evenings

Responses to Comment Letter C023

1 Comment noted.

2 The Department recognizes and appreciates that the INEL and each of the other alternative sites have strong technical communities.

Steven K. Zohner
1042 Grizzly Ave.
Idaho Falls, ID 83402
Ph. 208-524-4176
Work Ph 208-526-3669
January 10, 1996

Mr. Wade Carroll
EIS Project Manager
Office of Nuclear Energy, Science and Technology (NE-70)
U.S. Department of Energy
19901 Germantown Road
Germantown, Maryland 20874-1290

Subject: Comments on DOE'S draft medical isotope production project: molybdenum-99 and related isotopes environmental impact statement (DOE/EIS-0249D) - SKZ-01-96

Dear Mr. Carroll:

Thank you for sending me a copy of the draft EIS for the medical isotope project. I appreciate the opportunity to comment on this project.

The medical isotope project is indeed necessary. The case made by DOE to establish a dependable source for medical isotopes is well made in the draft EIS. There is uncertainty concerning the direction that Canada will take. At present, DOE must begin establishing a reliable source of medical isotopes regardless of what Canada decides to do in the future.

I have taken the time to read through the complete draft EIS. However, I am going to limit the majority of my comments to the preferred site and the INEL option. I have tried to provide you with the reference page for each of my comments. By doing this it will help you locate and identify the wording in the draft EIS that I am discussing.

1 Acronyms and Abbreviations page xxxiii,
The following acronyms were not listed but were used in the report.
Include becquerel (Bq) The SI unit for radioactivity.
Include electron volt (eV)
Include gray (Gy) The SI unit for absorbed dose
Include kelvin (K) The SI unit for temperature
Include rad
Include rem
Include roentgen (R)
Include volt (V)

Change ^{3}H to H-3 to be consistent with the rest of the document.

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Mr. Wade Carroll
January 10, 1996
Page 2

Why are only GeV and MeV included when eV is not listed? For consistency remove GeV and MeV and define eV, the SI prefixes should be listed in a table but each unit in the abbreviation section should not be listed as a separate unit. For example, curie should be listed but mCi, μCi, nCi, pCi, fCi, aCi, zCi and yCi need not be listed separately. However, a table defining these prefixes should be provided.

Why are only mCi and pCi listed? Again, only the base unit should be in the abbreviation section with the prefixes listed in a separate table.

2 Units of Measure page xxxviii
Include the SI unit for temperature which is the kelvin (K).
Include the SI unit for time which is the second (s).
Include the SI unit for rate which is meters per second (m/s)
Include the SI unit for area which is the square meter (m^2)
Include the SI unit for mass which is the kilogram (kg).

Again, once a base unit has been defined, it is not necessary to list all the metric units that can be made by adding SI prefixes. Thus, under length, mm and μm should not be included because the base unit (m) is already listed.

3 Nomenclature page xxxix
Throughout this report SI prefixes are used. A complete list of these prefixes would help the reader identify all units made by adding one of these prefixes.

SI Prefixes

Factor	Prefix	Symbol	Factor	Prefix	Symbol
10^{24}	yotta	Y	10^{-1}	deci	d
10^{21}	zetta	Z	10^{-2}	centi	c
10^{18}	exa	E	10^{-3}	milli	m
10^{15}	peta	P	10^{-6}	micro	μ
10^{12}	tera	T	10^{-9}	nano	n
10^{9}	giga	G	10^{-12}	pico	p
10^{6}	mega	M	10^{-15}	femto	f
10^{3}	kilo	k	10^{-18}	atto	a
10^{2}	hecto	h	10^{-21}	zepto	z
10^{1}	deka	da	10^{-24}	yocto	y

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example: The base unit curie (Ci) may be changed by adding a SI prefix.

1 Ci	=		3.7×10^{10} Bq
1 mCi	= 1×10^{-3} Ci	=	3.7×10^{7} Bq
1 μCi	= 1×10^{-6} Ci	=	3.7×10^{4} Bq
1 nCi	= 1×10^{-9} Ci	=	3.7×10^{1} Bq
1 pCi	= 1×10^{-12} Ci	=	3.7×10^{-2} Bq
1 fCi	= 1×10^{-15} Ci	=	3.7×10^{-5} Bq
1 aCi	= 1×10^{-18} Ci	=	3.7×10^{-8} Bq
1 zCi	= 1×10^{-21} Ci	=	3.7×10^{-11} Bq
1 yCi	= 1×10^{-24} Ci	=	3.7×10^{-14} Bq

Going through the same listing for all possible units (R, rem, m, eV, etc.) is unnecessary once the base unit has been defined.

Units of Radioactivity page xxxix
"fCi" was skipped in this list. It is not necessary to list all
4 the units that can be made by adding a prefix to the curie.
However, if all the units that may be made by adding a prefix are listed, then all SI prefixes should be used.

Units of Radiation Dose page xxxix
The base unit rad should be listed
The base unit rem should be listed
The base unit gray (Gy) should be listed. This is an SI unit
5 1 Gy = 100 rad
Once the base unit is given, other units that can be made by adding SI prefixes are not necessary.

Numerical (Scientific or Exponential) Notation. page xxxix
"aCi" is listed above in the "Units of Radioactivity" but the unit
6 "atto" is excluded from this list. All of the prefixes used should be defined. This would be accomplished if the SI prefix table is included.

Conversion Table page xli
The listed conversion from nCi to pCi is wrong.
7 To convert nCi to pCi multiply nCi by 1000.

The listed conversion from pCi to nCi is wrong.
To convert pCi to nCi multiply pCi by 0.001.

1 nCi = 1×10^{-9} Ci = 1000 pCi
1 pCi = 1×10^{-12} Ci = 1/1000 nCi

Conversion Table page xli
8 There are 4 different definitions of an ounce. If ounces are used, they should be identified as (a) the avoirdupois ounce (28.35 grams), (b) the

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apothecaries ounce (31.1 grams), (c) the U.S. fluid ounce (29.57 ml) or
8 (d) the British Imperial ounce (28.41 ml). The U.S. dry ounce is the
avoirdupois ounce.

Radionuclide nomenclature p xliii
The half live of Ce-141 is 32.5 days. This is significantly different
9 from the 35.5 days listed.

The remaining half lives are not significantly different to warrant changes.

10. Radionuclide nomenclature p xliii
Footnote (b) identifies "m" as isomers. This is true but the
abbreviation m stands for the "metastable" state of the nuclide.
10 Metastable is defined in the Glossary of terms (p 7.1) but isomer is not
included in this glossary. For these reasons, footnote (b) should be
changed to "Metastable nuclides (isomers) are indicated by the addition
of an m."

11. Security Requirements (general comment)
Unirradiated U-235 creates significant security requirements. The draft
11 EIS does not address the security required, what the current security is
at each site, and what has to be done to upgrade the security of each
proposed site. Facilities at the INEL using or storing purified U-235
are kept under strict security. The INEL has a long history of working
with and protecting the unirradiated U-235. Currently, the INEL has in
place adequate security procedures and trained personnel to meet DOE's
security requirements.

12. "The Power Burst Facility could be used to produce Mo-99 and
concurrently as a Boron Neutron Capture Therapy treatment center. This
approach could incorporate privatization of Mo-99 production early in
the process." p 3.48 The privatization option translates into reduced
costs and less money being taken out of the publics purses. Having a
12 facility that has the best potential for privatization is am important
consideration which seems to carry little weight in the EIS.

13. "Adequate wet and dry spent fuel storage exists on site." This is
referring to the INEL option. p 3.50 This simple declaration is
extremely important. Spent nuclear fuel shipments are being stopped,
banned, tied up in courts by law suites or prohibited from being
transferred into states that did not generate the spent fuel. States do
not want to be a dumping ground for other states waste, especially if it
is nuclear waste. Therefore, being able to handle the spent nuclear
13 fuel at the location it is generated is not only nice, it should be a
requirement for this project.

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14. "Mo-99 production feasibility studies addressed the possibility of conducting all processes in stand alone cells purchased from a viable supplier. Such as arrangement would be of great financial advantage, if
14 these cells could be located in an existing facility close to the Power Burst Facility and possibly even be considered a single facility with the Power Burst Facility" p 3.51 This potential arrangement has significant advantages that the other options lack. Reducing the cost to the taxpayer should carry more weight than this EIS is placing on it.

15. "However, it may be feasible to erect an additional annex to the Power Burst Facility structure, shielded from the main reactor building, and connected to existing Power Burst Facility effluent ventilation and radiation monitoring systems. Such a facility would provide great advantage to the use of stand-alone manufactured cells and eliminate transportation time and liability." p 3.51 Reducing radiation doses to workers and the public should be critical deciding a preferred site.
15 The advantage of this INEL option does reduce DOE's liability due to harm caused by radiation or transportation accidents.

16. Table 3-1, page 3.64 shows the dose to the population within 80 km of the INEL project would be over 10 times lower than DOE's preferred site
16 in New Mexico. In selecting the preferred site why is such little weight placed on the dose to the people around the site? DOE has an option at the INEL which reduces the risk to the population around the production site. This option, from an ALARA standpoint, is a better choice for those living around the facility.

17. Table 3-1, page 3.65 again shows the radiological dose to transportation crews and to the public is lower at the INEL than DOE's preferred site. This seams to violate the whole ALARA concept. Why would DOE choose a
17 site which gives workers and the public higher doses of radiation? I believe that more weight should be given in reducing DOE's liability in the areas of transportation and radiation.

18. Table 3-1, page 3.66 target processing at the INEL is shown to be 10
18 times less likely to have a accident per year than any other option. Other types of accidents are about the same for each site. This 10 fold reduction at the INEL is impressive in preventing potential harm. It appears that accident prevention has been underrated in selecting the
19 preferred site.

19. Table 3-1, page 3.66 shows that the dose to the maximally exposed individual near the INEL would receive nearly 10 times less dose than
19 the maximally exposed individual at DOE's preferred site from an accident during target processing. Dose to the public is a major concern for these people and in obtaining state permits. This much

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19 potential reduction in harm should be am important factor in deciding a
preferred site.

20. Table 3-1, page 3.66 shows that the dose to the population within 80 km
of the INEL due to a target processing accident is 10 times lower than
DOE's preferred site. ALARA concepts should be implemented when
selecting a site. DOE has the opportunity to decrease the potential
harm to the public by 10 fold. The publics welfare should not be
20 underestimated. This approach has been an ugly legacy in DOE's nuclear
history. Safety, both to the workers and to the public must be
consistently guarded to win back the publics confidence.

21. Table 3-1, page 3.68 shows that the INEL site will be $ 2,000,000 less
expensive to construct than DOE's preferred site. More importantly. the
yearly operating costs at the INEL will be nearly $ 4,000,000 less than
21 DOE's preferred site. This 4 million dollar a year savings is extremely
important, especially when the life time of the operation is considered.
In these times of reduced government budges considerable weight must be
given to a operation that will provide an acceptable produce at a
savings of 4 million dollars a year.

22. Table 3-2, page 3.69 shows that the current status of the INEL is in
standby mode while DOE's preferred site is operational. This is a mute
point since it has already been shown that to bring the INEL operation
22 up will cost the public 2 million dollars less than the preferred site.

23. Table 3-2, page 3.69 shows that the hot "cells at the INEL are adequate
but would require minor modifications." while DOE's preferred site would
23 require "New hot cells required for full production." Throwing money at
a problem has been the nuclear industries way of solving problems. The
public is much less tolerant of such expenditures when DOE has an
existing facility that may be used without modifications.

24. Table 3-2, page 3.70 shows that the schedule from the record of decision
to full operation is the same for the INEL and DOE's preferred site.
This point is important. Full production is the end goal. DOE's
preferred site can be partially operational in less time than the INEL
24 but partial operation should not be a determining factor when the life
of the facility is concerned.

25. Table 3-2, page 3.70 shows that the INEL option has significant waste
management advantages over DOE's preferred site. These advantages are
25 "Cradle to grave waste management. No shipping, all waste disposed at
INEL facilities. Liquid low level waste treated and stored on site."
DOE's preferred site does not have cradle to grave waste management. It
was not mentioned that the INEL has been designated by DOE as the lead
lab in waste treatment technology. INEL currently has cradle to grave

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waste capabilities and waste treatment technology will increase at the
25 INEL in the years to come.

26. Table 3-2, page 3.70 shows that the INEL has 35 years of isotope
production experience. DOE's preferred site has no isotope production
experience. In determining the preferred site, a history of isotope
production experience should be a major consideration. It illustrates
that the site has a proven record, has the facilities, has the
26 technological experience and an experienced work force. In Appendix A
page A.1 the INEL is shown to have personnel who have performed the
chemical separation for the medical isotopes. This experience and
knowledge is lacking at DOE's preferred site according to this EIS.

27. Table 3-2, page 3.70 states that at the INEL "PBF lease agreement in
place Idaho Brain Tumor Center for Boron Neutron Capture Therapy. Idaho
Brain Tumor Center interested in shared cost venture." This indicates
that the INEL site has aligned itself with the concept of return on
investment. The INEL site leads the other options in reducing the cost
to the tax payers through shared costs and privatization. The preferred
27 option lacks shared costs and has a very low probability of
privatization.

28. The air quality near the preferred site is listed as nonattainment by
the U.S. EPA for carbon monoxide. Carbon monoxide will increase at this
28 preferred site due to transportation of targets, waste handling etc.
The INEL site air quality has no nonattainment listings. Placing a
facility in a nonattainment area knowing that the operation of the
facility will contribute more carbon monoxide to an area that is already
listed as nonattainment is hard to justify. The INEL option does not
carry such a negative impact, reduces DOE's environmental liability
while allowing for more operational flexibility from state and federal
air regulations. p 4.11

29. "Neither INEL nor any of the surrounding counties is designated as a
nonattainment area (40 CFR 81.313) for the National Ambient Air Quality
Standards (40 CFR 50). Ambient air quality data monitored in the
vicinity of INEL indicate the site is in compliance with applicable air
quality standards." Locating the facility at the INEL would not risk
the health of workers or the public. Locating the facility at DOE's
preferred site knowing that this area is not in compliance with air
29 quality standards is very hard to justify. p 4.83

30 30. Table 4-21, page 4.84. The numbers are small enough that they need not
be expressed in scientific notation.

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31. Table 4-22, page 4.84. It would be less confusing if the unit of measure is change to pCi/m^3. As is, it is confusing to the general public if the Ci/m^3 has been multiplies by 10^{-12} or if it needs to be multiplied by 10^{-12}.

30

32. Table 4-23, page 4.84. Again it is suggested that the unit of measure be change to pCi/m^3, thus eliminating possible confusion about whether the listed value needs to be multiplied value by 10^{-12} or if it has already been multiplied by 10^{-12}.

33. "The planned facility modifications at SNL/NM are the most extensive
31 required at any site." p 5.2. Why is this DOE's preferred site when
other sites require less facility modifications and will operate at
lower yearly costs?

34. Table 5-1, page 5.4 show that the INEL option is less expensive than
DOE's preferred site. The total facility costs for 1996 through 1999
for DOE's preferred site is 47.1 million dollars and labor costs for
this same time period is 226 million dollars. The facility costs for
the INEL option is 14 million dollar less (33.6 million) for facility
costs and 11 million less (215 million) for labor costs. The total
savings of the INEL option over DOE's preferred site is 25 million
32 dollars. From a cost perspective, DOE's preferred site cannot be
justified, especially to the tax payers who will foot the bill.

35. Table 5-3, page 5.8 and Table 5-8, page 5.13. The dose to off site
resident at the preferred site are 10 times higher than for the INEL
option. The dose to on site workers are 10 times higher for the
preferred site than for the INEL option. The off site population dose
33 is 2 times higher than the INEL option. The off site population dose
from hot cell operation at the preferred site is 10 times higher than
the INEL option. How can DOE justify this increased dose associated
with the preferred site when the INEL option has significantly lower
radiological impacts? The public has the perspective that DOE does as
they please and concerns of the citizens come second. I am concerned
that this type of dose discrepancy listed add fuel to this perspective.

36. Waste disposal page 5.34. "Low level radioactive waste would be shipped
from SNL/NM to the Nevada Test Site for disposal." The time frame for
the Nevada Test Site to accept waste is yet unknown. Yes, there is a
34 time frame on paper but the reality is that this paper date continues to
move farther and father into the future. Both the governor and people
of Nevada do not want the waste in Nevada and are actively pursuing
steps to stop such shipments. Accepting this approach to as the
preferred waste disposal is banking on the unknown. It is not prudent

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34 to depend on a waste disposal system that is not functioning or which is
at least near completion.

37. Waste disposal page 5.38 at the INEL option. "In this alternative, all
three steps (fabrication, irradiation, and processing) would be carried
out on site at INEL." "INEL is a cradle to grave waste management
operation.." INEL has been safely managing spent nuclear fuel for over
40 years." The waste disposal at the INEL site is in place and has a
proven track record. There are no uncertainties with the ability of the
INEL to handle the waste. The preferred site bases its waste disposal
on a system that is not operating, has no history of success and is
35 being fought by state governments and local people. It seems extremely
optimistic to place waste disposal is such an uncertain position when
the INEL option shows clear advantages.

38. Table 5-52 page 5.100. This table shows that the INEL option has the
lowest preparation cost of any of the other alternatives. In addition,
the INEL option has the lowest yearly operating cost of any of the
other options. The cost savings of the INEL option are not
36 insignificant. The INEL would save the tax payers nearly 4 million
dollars a year over DOE's preferred site. From the publics perspective,
DOE may as well dig a hole and every year bury 4 million dollars. From
a business perspective, a company would fire the executive who chooses
to pay 4 million dollars more a year over an identical product from
another supplier.

39. DOE's preferred option will result in having to ship the spent fuel to
the INEL. Currently, the state of Idaho has shown an unwillingness to
accept waste generated from out of state sites. There is no reason to
37 assume that the state will change to willingly accept waste generated in
New Mexico at DOE's preferred site. However, if the spent fuel has been
generated in the state of Idaho, there has been no resistance to storing
or treating it at the INEL. page 6.7

40. "Of the sites under consideration in this EIS, the only site that is
located in an area that has nonattainment status for a criteria
pollutant is SNL/NM, which is in an area that is nonattainment for
carbon monoxide." page 6.8 It seems only prudent that the facility
built by DOE should to produce medical isotopes should only be
considered in areas where air quality meets attainment status. Placing
38 this facility in DOE's preferred site will only result in additional
carbon monoxide generation due to transportation needs at this site.

41. The governor of Idaho, Phil Batt and Tom Grumbly, DOE assistant
39 secretary for environmental management signed an agreement in October
1995 that allows spent nuclear fuel shipments to the INEL. However,

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spent nuclear fuel shipments to the INEL will be linked to transuranic waste shipments out of Idaho. The pact prohibits any shipments of spent fuel to Idaho after April 30, 1999, until shipments of transuranic waste from the INEL to the Waste Isolation Pilot Project in New Mexico or another facility are proceeding at a specified rate. DOE's preferred site cannot expect to send its spent fuel to INEL for storage as suggested in the EIS. These shipments will be prohibited after April 1999 unless the INEL can send its transuranic waste to a repository outside of Idaho.

39 The INEL option for the production of medical isotopes has the ability to store the spent fuel at the INEL. The state of Idaho has only objected to bringing spent fuel into Idaho from out of state generators. Throughout the U.S. spent nuclear fuel is accumulating. Currently, each generator of spent nuclear fuel is required to store the fuel on site until DOE has a suitable repository. The deadline for this repository has repeatedly been put farther into the future. Idaho has stopped out of state shipments of spent nuclear fuel into Idaho. Nevada has also successfully stopped the development of a waste repository within its boarders.

Knowing the current political climate, the INEL option has the best waste management ability of any of the proposed sites. All of the waste associated with the medical isotope project could be handled at the INEL.

The U.S. needs a reliable source of medical isotopes. The options discussed in the EIS were all interesting. However, I am concerned that to many assumptions were made concerning radioactive waste storage and the handling of spent nuclear fuel. I feel that it is wrong to assume that the Nevada Test Site will be operational as specified. I also feel that the assumption that the preferred site can sent its spent fuel to Idaho for storage at the INEL is wrong. Evidence indicates that the ability of a site to handle all of the
40 waste generated in the production of medical isotopes will be essential for its operation and the only option presented that can do this is the INEL in Idaho.

Sincerely,

Steven K Zohner

Steven K Zohner

Responses to Comment Letter C024

1 The Department used the acronyms and abbreviations that were believed to be helpful to the domestic public. Also, those units believed to be more commonly known to and used by the public, such as curie in lieu of becquerel were used in the EIS. Temperatures were generally provided in terms of Fahrenheit, which is more commonly understood and used than Kelvin.

Certain of the terms the commentor suggested be included in the list of acronyms were defined in the glossary, such as rem. A search of the document did not uncover the use of the term "gray" in the body of the document. However, gray was mentioned in the dose discussion of the glossary.

2 A mix of SI and English units has been used in the document. SI units which were perceived as common, such as meter, centimeter, kilogram, were used. The Department supports the use of SI units, but has used English units if those terms were believed to be more easily understood by the general public. A conversion table of English/SI units is provided in the Units of Measure section of the EIS (Volume I).

3 A mix of SI and English units has been used in the document. SI units which were perceived as common, such as meter, centimeter, kilogram, were used.

4 SI prefixes which were perceived as common, such as centi, milli, kilo, mega were used. A complete list specifying prefixes not used in the text (such as "fCi") is considered inappropriate.

5 The units of rad and rem are discussed in the glossary. Gray is mentioned in the glossary, but was not used in the body of the document because it is not a commonly used unit.

6 The definition of the prefix "atto" has been added to the numerical notation section.

7 The table has been changed to reflect this comment.

8 The Department used the avoirdupois ounce.

9 The radioactive half-life of cerium-141 was corrected.

10 Isomeric states tends to be a more commonly used term than metastable states. Further, isomer is the appropriate definition as the abbreviation "m" is used in this document. The isotope of interest is an isotope of a different quantum energy eigenstate that usually, but not always, decays to the lower state of the same isotope. Isomer has been added to the glossary, but the footnote has not been changed.

11 No physical security program upgrades are required on any of the sites. All sites have long and well-established existing programs that address the physical security requirements for handling strategic quantities of special nuclear materials. Certain of the sites have handled nuclear weapons, a physical security program far beyond that required for the unirradiated targets. However, any site, including INEL, if selected, would need to establish the appropriate storage materials balance areas, complete with security requirements, for the storage of unirradiated targets near the reactor facility. This is described in general terms for the SNL/NM option in Section 3.3.1.3. Requirements at all other sites would be similar.

Physical security requirements for materials are delineated in 10 CFR 73. All facilities, federal or commercial, are subject to those requirements. On all sites, security requirements for special nuclear materials are part of the special nuclear materials control program. This is generic throughout the DOE complex. Handling and storage of unirradiated targets is specified to be under the special nuclear materials control program at each site.

12 The purpose of the EIS is to analyze the environmental impacts of alternative means of accomplishing the proposed action. Although the potential for privatization is important, the privatization process is not part of this proposed action. Each of the production alternatives has potential for privatization. DOE has solicited expressions of interest from the industrial community for the privatization of any isotope production activity conducted by DOE, including this proposed Medical Isotopes Production Project. If the Department decides to implement the action proposed in this EIS and promising concepts are received from the private sector, the Department would seek privatization proposals on a competitive basis.

13 All alternatives considered have sufficient onsite spent nuclear fuel (SNF) storage capabilities to operate at 100% U.S. demand for at least 5 years. Long-term disposition of SNF will be in accordance with the Record of Decision for the Spent Nuclear Fuel Programmatic Environmental Impact Statement (SNF PEIS) (DOE 1995b) (see Section 5.14).

14 The option of having a hot cell built or moved to the Power Burst Facility (PBF) site has been studied by DOE and discussed with the Idaho site. This would obviate the need for shipping irradiated targets from the PBF to the hot cell, but would have a significant impact on the cost and the schedule.

Similarly, moving a hot cell is impractical. The lead glass windows and manipulators can be scavenged from other cells, if they are adequate, and installed in cells built to be co-resident with the PBF. Three targets irradiated at a target fission power level of 20 kW contain 99,600 curies of activity after an 8-hour cooling time. Few manipulators or windows in hot cell facilities are designed to accommodate this level of activity. A building would also be required. The ventilation system must be designed such that airborne fission products are captured and not released to the atmosphere.

A detailed estimate to build a new hot cell at SNL/NM totals well over the $4.8 million indicated in the EIS for INEL hot cell preparation. The SNL/NM estimate is based on building the cell in an existing building and obtaining manipulators and windows for the cost of shipping only. Several million dollars would need to be added to the Idaho cost estimate if a new hot cell facility were to be added. Also, despite being a parallel path activity, the schedule would most likely be adversely impacted, and a 2-year schedule would probably not be achievable. The building and the cells would need to be completed early (probably within a year) to be capable of establishing the chemical process stations and waste management facilities required for the Mo-99 mission.

15 If the Department proceeds with a production alternative, it will attempt to minimize the impacts from the Mo-99 project for whichever alternative is selected.

16 The lower population within 50 miles of INEL and the remote location of the proposed isotope production facilities result in a smaller collective dose from facility air emissions at that site compared to the preferred alternative at SNL/NM. However, the major component of radiological risk to the public from the isotope production project results from transportation, for which the risks are very similar in both alternatives. The

risk of latent fatal cancer in the offsite population as a result of normal facility operation or accidents is much lower than 1 for both alternatives, such that no health consequences would be expected for any reasonable duration of the project.

The results in Table 3-1, and the corresponding results reported in Section 5 of the EIS, indicate that the doses to the most exposed individual offsite resident and onsite worker from facility operation are similar or higher for the INEL alternative compared to the preferred alternative at SNL/NM. However, the dose to the maximally exposed offsite individual for either alternative is less than 2% of the EPA standard for radionuclide air emissions at DOE facilities (10 mrem/year). If the Department proceeds with the action proposed in this EIS, the ALARA (as low as reasonably achievable) program would be implemented at the selected site in order to limit doses to workers and the public.

17 The commentor observes that the dose to the public and transport crews is lower for the INEL alternative than for the preferred alternative at SNL/NM. However, the radiation dose to the public and crew from transportation of radioactive materials differs by less than 10% at any of the alternative sites other than Oak Ridge. The lowest transportation dose to the public is associated with the Oak Ridge alternative. This is due to its proximity to the radiopharmaceutical companies that would receive medical isotopes from DOE.

If the Department proceeds with the action proposed in this EIS, the ALARA program would be implemented at the selected site to reduce the cumulative radiological impacts of all aspects of the Medical Isotopes Production Project.

18 Two types of target processing accidents were evaluated at all sites: one for processing Mo-99 targets and one for processing iodine-125 targets. Both accidents were evaluated at INEL (see Table 5-44 and Table 5-45); however, only the accident resulting in the highest potential offsite consequences was reported in the summary (Table 3-1). At the INEL, the iodine-125 target processing accident would result in the highest potential offsite consequences. For the other alternatives, the Mo-99 target processing accident was reported in the summary because the potential consequences were greater than for the iodine-125 target processing accident at those sites.

The expected frequency of the Mo-99 target processing accident was assumed to be 1.0/year at all sites because the nature and scope of the process would be similar under all alternatives. The expected frequency of the iodine-125 target processing accident is lower at all sites (0.1/year) because fewer targets of this type would be processed under any alternative. In all cases, the risk of latent fatal cancer from accidents during target processing is much lower than 1, and the differences in risk between the alternatives are not likely to be a major consideration in siting the project.

19 Please see response to comment C024-18 above.

20 If the Department proceeds with the action proposed in this EIS, the Department would implement the ALARA program at the selected site to reduce the radiological impacts from the Mo-99 project. Comparative doses will be considered for the Record of Decision.

21 The Department recognizes that the estimated cost of the INEL alternative is lower than that of the preferred alternative; however, the uncertainties associated with the estimated cost of the INEL alternative are higher than for the preferred alternative. If the Department decides to proceed with the proposed

action, the information presented in the EIS (including the cost data), the operational readiness of facilities, and other programmatic factors will be considered in the final selection of facilities for Mo-99 production.

22 The difference between an operational reactor and a reactor in standby mode is significant because of the steps required to restart a non-operational reactor. Before a non-operational reactor can be restarted, the condition of the facility must be verified, systems must often be repaired, safety documentation must be updated, operators must be trained, operating procedures must be written or updated. Planning documents must be written to guide these activities, and the activities cannot commence before the planning documents are approved.

For an operational reactor, these activities are conducted routinely, and the planning documents are largely in place. The fact that most or all of these activities are ongoing at an operational reactor means that there is less uncertainty associated with the use of an operational reactor than with the use of a reactor that must be restarted. Since the Department is proposing to respond to a near term "window of vulnerability" in the supply of Mo-99, the uncertainties associated with each of the alternatives (especially schedule uncertainties) will be an important factor in the decision-making process.

23 The hot cells for processing the medical isotopes at each of the alternative sites would require modifications, with those at the preferred alternative being the most significant. At the preferred alternative, a new bay of hot cells would be constructed inside the existing Hot Cell Facility (HCF) building, which is adjacent to the Annular Core Research Reactor (ACRR).

Since the ACRR (the preferred reactor) is operational, the estimated cost of preparing this facility for medical isotope production is significantly lower than the other alternatives. Thus, the total cost of this alternative is comparable to others.

24 "Partial operation" of the facility is important in that, if a Mo-99 shortage were to occur in the near future, the Department would be able to supply at least a fraction of the U.S. demand. The Department has proposed the Medical Isotopes Production Project to respond to a near term "window of vulnerability" in the Mo-99 supply situation; therefore, the ability to produce even a small amount of Mo-99 in a short period of time is an important factor and will be considered in the Department's decision on the proposed project.

25 Two of the four alternatives analyzed in detail in the EIS do not have the capability of "cradle to grave" waste management. The Department does not believe this impacts the viability of any of the alternatives. As discussed in Section 5.14 of the EIS, the quantities of waste generated from production of Mo-99 are small and would be handled in accordance with each sites' established waste management programs with few additional impacts.

26 The Department recognizes that all of the alternative sites except SNL/NM have significant experience in the production of isotopes.

27 Private U.S. production of Mo-99 could be accomplished by privatization of a DOE operation or by a separate initiative by the private sector. The process of privatization is not part of this proposed action. The Department published a Notice for Expression of Interest in the *Federal Register* in December 1995 to solicit concepts from private industry for privatization of DOE isotope activities. Businesses interested in pursuing Mo-99 production have been invited to respond to this solicitation. If the Department decides to

implement the action proposed in this EIS and if concepts on privatization of Mo-99 production received from the private sector are promising, DOE would proceed with a request for proposals to facilitate privatization on a competitive basis.

28 The nonattainment status for carbon monoxide in the Albuquerque area would not affect the ability to site or operate the Medical Isotopes Production Project at SNL/NM. The isotope production mission would not result in a measurable increase in emissions of criteria pollutants and therefore would not contribute to degradation of air quality in the region.

29 Please see response to C024-28 above.

30 The approach used is standard.

31 The ACRR/HCF combination at SNL/NM is the preferred alternative for reasons stated in Section 3.3.1.1.

32 The ACRR is the Department's preferred option for the reasons stated in Section 3.3.1.1. The Department recognizes that the estimated cost of the INEL alternative is lower than that of the preferred alternative; however, the uncertainties associated with the estimated cost of the INEL alternative are higher than for the preferred alternative. If the Department decides to proceed with the proposed action, the information presented in the EIS (including the cost data), the operational readiness of facilities, and other programmatic factors will be considered in the final selection of facilities for Mo-99 production.

33 Although the doses for the offsite resident (maximally exposed individual) are smaller for INEL than other alternatives such as the SNL/NM alternative, the projected dose for any of the alternatives is a very small fraction of the regulatory limit.

34 The Nevada Test Site (NTS) is preparing a site-wide environmental impact statement and has included waste that would be generated from the Medical Isotopes Production Project in the quantities and description of materials to be stored on the site. The Department believes that any uncertainty surrounding the NTS's ability to accept the waste from the proposed project is sufficiently small that there will not be an impact on the proposed project.

35 The quantity of waste that would be generated by the proposed project at any of the alternatives is small. The disposal of the low-level waste would take place at NTS for the preferred alternative and for the ORNL alternative. The LANL and INEL alternatives would dispose of the low-level waste onsite in existing DOE approved facilities. All the alternatives have on-going laboratorywide waste management and minimization programs.

Two of the four alternatives analyzed in detail in the EIS do not have the capability of "cradle to grave" waste management. The Department does not believe this impacts the viability of any of the alternatives. As discussed in Section 5.14 of the EIS, the quantities of waste generated from production of Mo-99 are small and thus would be handled in accordance with each site's established waste management program with few additional impacts.

36 The Department recognizes that the estimated cost of the INEL alternative is lower than that of the preferred alternative; however, the uncertainties associated with the estimated cost of the INEL alternative are higher than for the preferred alternative. If the Department decides to proceed with the proposed

action, the information presented in the EIS (including the cost data), the operational readiness of facilities, and other programmatic factors will be considered in the final selection of facilities for Mo-99 production.

37 All alternatives considered have sufficient onsite SNF storage capabilities to operate at 100% U.S. demand for at least 5 years. Long-term disposition of SNF will be in accordance with the Department's Record of Decision for the SNF PEIS.

38 Please see response to C024-28 above.

39 Please see response to C024-37 above.

40 The Department recognizes that "cradle-to-grave" waste management is a benefit of the INEL and LANL alternatives.

January 17, 1996

Mr. Wade Carroll
MIPP EIS Document Manager
Office of Nuclear Energy
Science and Technology (NE-70)
U. S. Department of Energy
19901 Germantown Road
Germantown, MD 20874

ACCEPTANCE FOR USE OF THE INEL POWER BURST FACILITY

Dear Mr. Carroll:

I fully agree with the use of the INEL's Power Burst Facility to produce medical isotopes for
1 medical missions. I see no reason why the United States should be dependent on foreign sources
2 of isotopes when we can produce them here in the states. Also, using an existing reactor to
produce the isotopes further promotes this mission.

Thank you for your consideration.

Sincerely,

Kathryn A. McBride
4414 So. 5th West
Idaho Falls, Idaho 83404

Responses to Comment Letter C025

1 Comment noted.

2 The problem with the Mo-99 supply situation is not that the supply is from a foreign country. The problem is that the entire U.S. supply comes from a single source. It should also be noted that this single source accounts for about 85% of the world supply of Mo-99. If this source were to become unavailable, production facilities in other countries would most likely focus on meeting their own needs first and, in any case, would not be able to meet even half of U.S. demand for Mo-99. Given this supply situation, the Department has proposed establishing a domestic production source to ensure that a reliable supply of Mo-99 is available to the U.S. medical community.

January 17, 1996

Sheryl Doyle
253 W. Elm
Lava Hot Springs, ID 83246

Wade Carroll
MIPP-EIS Document Manager
USDOE - Office of Isotope Production
NE-70
19901 Germantown Rd.
Germantown, MD 20874

Dear Mr. Carroll,

1 As a resident of the state of Idaho, I would like to recommend that the I.N.E.L. be chosen as the site for the production of medical isotopes.

Sincerely,

Sheryl Doyle
(208) 776-5017

Response to Comment Letter C026

1 Comment noted.

January 17, 1996

Mr. Wade Carroll,
MIPP EIS Document Manager
Office of Nuclear Energy
Science and Technology (NE-70)
U.S. Department of Energy
19901 Germantown Road
Germantown, Maryland 20874

Subject:INEL POWER BURST FACILITY FOR MEDICAL MISSIONS

Dear Mr. Carroll:

1 Please include my opinion <u>in favor</u> of utilizing the existing Power Burst Reactor (PBF) for producing Medical isotopes for cancer and heart disease, screening and therapy. It is my understanding this reactor in on the DOE lists as one of four reasonable options for producing the widely used medical isotope, molybdenum-99.

2 I work for Lockheed Martin Idaho Technologies (LMIT) at the INEL, and as such, am familiar with the technology that exists here to facilitate this project. Additionally, the INEL has the expertise to bring what was once a cold war Laboratory to helping medical advancements such as this.

Please note that although I work for LMIT, I was not solicited to provide this recommendation, and do so at my own choice.

Again, I solicit your consideration for the INEL PBF as the final choice for this favorable project.

Sincerely,

Robert B. Clark
6674 North 25th East
Idaho Falls, ID 83401

Responses to Comment Letter C027

1 Comment noted.

2 The Department recognizes and appreciates the contributions that the INEL and the other alternative sites made during the Cold War. Each of the sites under consideration has considerable expertise in projects involving nuclear technologies.

MR Wade Carroll E.I.S. Project Manager
Office of Nuclear Energy Science and Technolgy
U.S. Dept. of Energy 19901 Gernantown Road
Germantown, Maryland 20874-1290

Dear Mr. Carroll

1 I understand that the Sandia.New Mexico site for the production of MO 99 is a number one priority facility. But. transportation is required from the Los Alamos site for final production. Low level waste goes to the Nevada test site. There is no gaurantee that Nevada will continue to accept the Sandia waste. In that light I see some speculation; that may put production of MO 99 at risk.

2 For further consideration, at the Power Burst site at I.N.E.L. Idaho eliminates that risk. By constructing or moving in a Hot Cell from Test Area North or elsewhere to the Power Burst; could be a one stop shop at the Power Burst.

3 To further enhance the Radio-Medical potential the Power Burst facility has been identified for Brain Tumor treatment.

4 Now that Idaho has been destined to receive High Level Waste for the next 40 years waste storage from MO 99 would not be a concern, as you can see at Sandia. There is also a remote possibility that some of the incoming Waste could be used in the production of MO 99.

I submit this comment for consideration.

Clarence F. Bellem
102 East Baseline
Rupert, Idaho 83350

Responses to Comment Letter C028

1 As described in the EIS, some transportation of Mo-99 and small quantities of low-level waste would be required at any of the alternatives considered. The potential impacts of transportation activities are described in Section 5.11. For some of the alternatives, this transportation would take place almost exclusively onsite, while others would require use of public roads. The ORNL alternative and the preferred alternative both would require periodic shipments of low-level waste to the Nevada Test Site (NTS). The NTS is preparing a site-wide environmental impact statement and has included waste generated from the Mo-99 mission in the quantities and description of materials to be stored on the site. The ultimate disposition of waste generated under the proposed project may change based on future decisions resulting from the DOE Waste Management Programmatic EIS (DOE 1995a).

2 The option of having a hot cell built or moved to the Power Burst Facility (PBF) site has been studied by DOE and discussed with the Idaho site. This would obviate the need for shipping irradiated targets from PBF to the hot cells, but would adversely impact both the cost and the schedule.

Similarly, moving a hot cell is impractical. The lead glass windows and manipulators can be scavenged from other cells, if they are adequate, and installed in cells built to be co-resident with the PBF. Three targets irradiated at a target fission power level of 20 kW contain 99,600 curies of activity after an 8-hour cooling time. Few manipulators or windows in hot cell facilities are designed to accommodate this level of activity. A building would also be required. The ventilation system must be designed such that airborne fission products are captured and not released to the atmosphere.

A detailed estimate to build a new hot cell at SNL/NM totals well over the $4.8 million indicated in the EIS for INEL hot cell preparation. The SNL/NM estimate is based on building the cell in an existing building and obtaining manipulators and windows for the cost of shipping only. Several million dollars would need to be added to the Idaho cost estimate if a new hot cell facility were to be added. Also, despite being a parallel path activity, the schedule would most likely be adversely impacted, and a 2-year schedule would probably not be achievable. The building and the cells need to be completed early (probably within a year) to be capable of establishing the chemical process stations and waste management facilities required for the Mo-99 mission.

3 The Idaho Brain Tumor Center (IBTC) has informed DOE of its interest in coordinating its efforts with those of DOE; however, IBTC has not submitted any plans for coordinating reactor conversion activities, nor has it made a formal proposal to DOE. In addition, the Department understands that IBTC is investigating the possibility of using other facilities for boron neutron capture therapy (BNCT) and that other reactors under consideration for this project may be usable for BNCT. If the Department decides to proceed with a production alternative for this proposed project, it would welcome a proposal from IBTC for dual use of the reactor facility selected.

4 The Department does not plan to ship any of the small quantities of waste which would be generated by the proposed Medical Isotopes Production Project to INEL. Only waste generated at INEL would be disposed at INEL. Since the anticipated quantities of low-level waste are small, the Department does not view waste disposal as a significant barrier to implementing production at any of the alternative sites.

Spent fuel from production of medical isotopes would be managed in accordance with the Record of Decision from the Spent Nuclear Fuel Programmatic Environmental Impact Statement (SNF PEIS) (DOE 1995b). Sufficient supply of highly enriched uranium is available for the production of Mo-99; the extraction of uranium from spent fuel for Mo-99 production does not need to be considered.

Jan. 18, 1996

David A. Griffiths
4633 East Caribou Drive
Idaho Falls, Idaho 83401

Mr. Wade Carroll,
MIPP EIS Document Manager,
Office of Nuclear Energy,
Science and Technology (NE-70),
U.S. Department of Energy,
19901 Germantown Road,
Germantown, Maryland 20874

Dear Mr. Carroll:

On Wed. Jan. 17, at the Shilo Inn in Idaho Falls, Idaho, a public hearing was conducted by the Department of Energy to gauge public acceptance for using an INEL reactor for medical missions. I was unable to attend these hearings but wish to convey to you my overwhelming support for such
1 | a venture at the INEL.

Having considered the issues already in past discussions, I know this would have a very beneficial impact not only to the Medical Community but also to the local Idaho Falls economy. We have an important asset in the INEL that I believe can be put to much greater use.

Sincerely,

David A. Griffiths

Response to Comment Letter C029

1 Comment noted.

Pocatello
A MUNICIPAL CORPORATION OF IDAHO

OFFICE OF THE MAYOR
911 North 7th Avenue
P.O. Box 4169
Pocatello, Idaho 83205
(208) 234-6163
FAX (208) 234-6297

PETER J. ANGSTADT
Mayor

Pocatello City Council:
GREGORY R. ANDERSON
J.J. "BABE" CACCIA
ROGER W. CHASE
RON FRASURE
KAREN McGEE
HARRY NEUHARDT

January 24, 1996

Wade Carroll, EIS Documents Manager
Office of Nuclear Energy, Science & Technology
U.S. Department of Energy
19901 Germantown Rd., NE-70
Germantown, Maryland 20874

Dear Mr. Carroll:

The application of radioisotopes to medical diagnostics and therapeutics is an indispensable and on-going component of the American health care system. The United States consumes 80% of the world supply of radioisotopes, yet no U.S. commercial supplier exists. We are totally dependent on foreign entities for the supply of Molybdenum-99, a critical medical radioisotope used for 36,000 medical procedures daily, 100 million laboratory tests and 50,000 therapies yearly. The application of medical isotopes for these diagnostic and therapeutic procedures provides significant advances in the treatment of cancer and other life threatening conditions. The U.S. is the leader in health care, but that enviable position is threatened in this area by our dependence on foreign suppliers. In addition, a shortage of radioisotope supply can delay the development of new drugs.

The Department of Energy's (DOE) complex of facilities offers an unmatched radioisotope capability. The Idaho National Laboratory (INEL), as an integral part of the DOE system, is uniquely equipped to assume the role of national leadership. There exists real opportunities for those who care to look forward to the future and adapt to change. A major asset of the INEL is the scientific knowledge and professional network already available and the successful history of the INEL.

1 In order to be successful as a suppler of medical isotope, there are several critical factors such as reliability of supply, quality of product, cost competitiveness, and continuous improvement. The INEL stands ready to met these challenges.

Sincerely,

Peter J. Angstadt
Mayor

/cb

AN EQUAL OPPORTUNITY / AFFIRMATIVE ACTION EMPLOYER

Response to Comment Letter C030

1 Comment noted.

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Wade Carroll, MIPP-EIS Document Manager
U.S. Dept. Of Energy NE-70
19901 Germantown RD.
Germantown, MD. 20874

January 25, 1996

Dear Mr Carroll;

Due to circumstances with my employment, it was impossible for me to attend the hearings on production of medical isotopes in conjunction with the Boron Neutron Capture
1 Therapy (BNCT) project. I am, however, familiar with the concept and DO support the project.

Along with the many advantages stated in the Chamber of Commerce letter dated January
2 12, 1996, there is also the advantage of the additional business brought to Idaho Falls by those people seeking treatment. Further, the support services required for an influx of out of area people would be enhanced. As well as the turn over of the dollars throughout the economy.

Upon investigation, I can find absolutely no negative results from having the Medical Isotope facility at INEL.

Sincerely Yours,

Ted A. Kasper
Sales Manager

cc:B Sewell

P.O. BOX 3218
IDAHO FALLS, IDAHO 83403

JACKSON (307) 733-4333
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Responses to Comment Letter C031

1 Comment noted.

2 Individuals requiring the use of radioactive isotopes, including Tc-99m, will continue to receive these treatments and diagnostic procedures in hospitals throughout the country. Individuals will not receive or undergo these medical procedures at any of the alternative Mo-99 production sites considered. The Department acknowledges that the initiation of the proposed Medical Isotopes Production Project at any of the alternative sites could provide opportunities for private business to support the project directly or develop derivative initiatives.

The anticipated socioeconomic impacts of the proposed project are discussed in Section 5.3.

SIERRA CLUB

Albuquerque Group
207 San Pedro Avenue NE
Albuquerque, NM 87108
Phone (505) 265-5506

Public Bearing Comment
for the
Medical Isotopes Production Project (MIPP):
Molybdenum-99 and Related Isotopes
Draft Environmental Impact Statement (Draft EIS)

January 30, 1996
Indian Pueblo Cultural Center
Main Auditorium
2401 12th St
Albuquerque, New Mexico, 87104

Wade Carroll, MIPP-EIS Document Manager
U.S. Department of Energy, NE-70
Germantown, Maryland 20874,
Fax 301 903-5434
Phone: 301 903-7731

Bear Mr. Carroll,

The Albuquerque Group of the Sierra Club finds the Draft EIS, when judged by other DOE findings and issues that need to be addressed, to be seriously deficient. Thus, the Albuquerque Group, which has members who would support domestic production of medical isotopes, finds that it has grave reservations about the proposed project at SNL/NM.

The Albuquerque Group requests, for the record, the following concerns be addressed:

1. We request that the Department of Energy provide supporting documentation that the Canadian supply for molybendum-99 is not reliable. Specifically, we request a letter from Canadian sources that stipulates that:

* The Atomic Energy of Canada Limited definitely
1 plans to shut down the Canadian reactor near the end of the century.

* Nordion International and Atomic Energy of Canada Limited will not be able to meet U.S. demand.

Our reason for this request is that we do not believe that the Department of Energy has met a sufficient burden of proof requirement of need that the Canadians are not able to meet U.S. needs. If the Canadians plan to meet our

-1-

needs, then this project represents an unnecessary burden
on American Taxpayers, justifiable only as a job creation
project. If a test of need is not the key reason for this
1 project, the attendant environmental, health, and safety
risks that the project imposes upon the citizens of
A'buquerque are unreasonable and unjustifiable.

2. The Draft EIS does not cite or examine the findings of
vulnerability and adverse conditions noted in D.O.E.'s
Plutonium Working Group Report, September 1994, Volume I
and II, Appendix B, Part 10: Sandia National
Laboratories-New Mexico Site Assessment Team Report.

* On Spent Nuclear Fuel (4.1.14.2) on page 4.20, the Manzano Storage Structures are cited as a facility at SNL/NM for storage. Yet, it fails to discuss the unique landlord problem at SNL/NM. DOE's Plutonium Working Group stated in Volume I:

2 Storage of DOE materials in non-DOE facilities (i.e., the Nuclear Materials Storage Facility and the Manzano Facility) is a vulnerability unique to SNL/NM. DOE does not have control over, or ready access to, these facilities .... Also, if DOE materials have to be removed on short notice, SNL/NM may have no facilities suitable for storage."

In Volume II, it notes an additional vulnerability:
"the lack of safety authorization" for vault storage, and,
"no safety documentation for storage."

The Albuquerque Group wonders why this DOE finding is not in DOE's Draft EIS?

3. On the H~t Cell Facility, critical to target processing and Mo-99 separation, the following Adverse Conditions are noted in Volume II, Appendix B, Part 10, Pages A 10-11:

"Aging," "equipment failure," and "administrative controls." In the narrative description, "seals" are noted to be aging. Equipment failure of safety systems lists cranes and hoists; shielded casks.
3 Inadequate preventive maintenance, equipment fatigue or malfunction are also cited. Some are listed as possible vulnerabilities, others as existing.

The Draft EIS misleads readers when it does not tell the whole story, but simply notes that the "current configuration" of the H~t Cell "would only be able to conduct limited processing activities." And that "A new cell would be constructed ... to enable steady state production of greater than 10% and up to 100% of the U.S. demand for Mo-99." (p. 3.8) ."

4. On the Annular Core Research Reactor, critical to Mo-99
4 target irradiation, the "In-Facility Adverse Conditions"
checked off are: "Aging" and "Potential Water Sources."

-2-

4 Aging for a facility that is 31 years with a design life of 50 years is described as materials deterioration: the lined storage vaults and Dense Pack holes. The latter are stated to be "even more susceptible to the effects of the environment and aging." Since the Dense Pack holes are "located outside, there is a remote chance of water leakage into the holes either through the top of the holes or through the ground into the holes." While these may be low probability, low consequence risks, they are real. That they are not noted in the Draft EIS indicates just how inadequate, if not misleading, the Draft EIS is.

5 5. Storage Vault problems are also noted. Among them are "inadequate seals." Perhaps more disturbing, uncertainties or concerns regarding "Compensatory Measures," note the following weaknesses:

Under the section on Preventive Measures:

* Procedures: ops., maint., Surveillance;
* Material limits
* Training
* Controlled Access

Under the section on Mitigative problems, vulnerabilities and uncertainties relate to:

* Emergency Preparedness
* Emergency Management
* Emergency Planning
* Emergency Procedures
* Emergency Response
* A'arm Systems.

We would like these problems addressed in the EIS.

6 Waste stream management is a critical step in the Cintichem process approved by FDA for the production and separation of Mo-99 sold in the U.S. The Draft EIS -otes that "any waste generated by Mo-99 production would be managed consistent with DOE's complex-wide Programmatic Environmental Impact Statement (PEIS) for waste management (P. 1.4). The PEIS, as noted in the Draft Mo-99 EIS, is still in Draft form. If so, it indicates the nation's waste management problem is still to be resolved. The Albuquerque Group wonders about the wisdom of rushing to produce Mo-99 when the waste management problem remains unsolved.

In this regard, the Albuquerque Group should like to call attention to one disturbing problem:

* DOE has made a letter public that it requested a Blue Ribbon EPA Panel to investigate charges by individuals who contributed to the drafting of the PEIS that the PEIS was not a reliable document because of contractor malfeasance. T-e EPA panel is on record warning DOE that the charges raised should be taken seriously. Acting DOE Under Secretary Tom Grumbly has released the EPA report.

-3-

The resolution of this issue alone warrants a decision to
postpone Mo-99 production in the U.S., for it also suggests
6 DOE is a long way from solving the waste management
problem.

The Albuquerque Group of the Sierra Club holds additional
concerns relating to the production of Mo-99 in the U.S. in
7 general and at SNL/NM in specific. These have to do with:

* Tritium releases and air quality problems. This
problem is glossed over in the Draft (P. 5.8).
* Environmental Justice Issues - impacts on ethnic
8 minorities and disadvantaged people are not fully
analyzed, and
* W-ter consumption; the increased use of water, a
critical and scarce natural resource in a City that
9 has just initiated a major water conservation
program, needs fuller analysis.
* Accident scenarios. The vulnerabilities listed
10 above need to be addressed as well as those mentioned
in the Draft - e.g., plane crashes.

We believe the Draft EIS on the preferred Mo-99 production option is weak in its coverage of these issues. We believe that they too require DOE's closer attention.

We appreciate the opportunity to present our concerns today. We should like all these issues to be addressed in the Final EIS. At this time, we are disturbed by the ommissions and weaknesses. We do not find the Draft EIS to be adequate. We do not find the case made for Mo-99 production to be sound or necessary.

Respectfully submitted,

Jay B. Sorenson
Issue Chair

Richard Barish
Conservation Chair

Susan Gorman
Group Chair
Albuquerque Group
Sierra Club

-4-

Responses to Comment Letter C032

1 The Department has not received, nor does it expect to receive, written notice from Nordion International or the Canadian government stating that they may not be a reliable supplier of Mo-99 in the future. (See letter from Nordion International–C068.)

The problem with the Mo-99 supply situation is not that the supply is from Canada (or from any foreign country, for that matter). The problem is that the entire U.S. supply comes from a single source. It should also be noted that this single source accounts for about 85% of the world supply of Mo-99. If this source were to become unavailable, production facilities in other countries would most likely focus on meeting their own needs first, and in any case would not be able to meet even half of U.S. demand for Mo-99. Therefore, the Department has proposed to establish a domestic production source to ensure that a reliable backup supply of Mo-99 is available to the U.S. medical community.

2 DOE and SNL/NM would plan to store spent fuel generated by the medical isotope production only in DOE-owned and -controlled storage facilities covered by appropriate DOE-approved safety documentation. The report referenced by the Sierra Club addresses only plutonium issues and was intended to "identify the ES&H vulnerabilities associated with the current storage of plutonium at the Department of Energy Facilities." That report addresses plutonium-specific issues which for the most part have no connection with the use of SNL/NM facilities as presented in this EIS. Risks from the handling of plutonium at these facilities is not within the scope of this EIS.

3 The two vulnerabilities identified by the Working Group Assessment Team (WGAT) have no connection to the SNL/NM facilities discussed in the Draft EIS. The Executive Summary of Vol. II, Appendix B, Part 10 states, " The WGAT identified two vulnerabilities associated with plutonium materials storage. The first vulnerability addresses a lack of up-to-date safety authorization basis and documentation for the storage facilities. This deficiency has been previously identified and SNL/NM is currently working on the corrective action. The second vulnerability identified concerns about the lack of package characterization for a [plutonium] metal disk in storage."

Regarding the "aging" of seals, the Plutonium Working Group Report states, "seals are used in experiment and storage vessels and could deteriorate over time..." not that "seals are noted to be aging" as stated in the comment letter.

Regarding "equipment failure," the quoted portion of the Plutonium Working Group Report states, "Equipment failure of safety systems (HVAC) or support equipment (cranes and hoists, shielded casks) can adversely affect the operations in the facility and potential release of radioactive materials to the environment. Equipment failures can be a result of inadequate preventive maintenance, equipment fatigue or malfunction." This statement differs with the commentor's position that "Inadequate preventive maintenance, equipment fatigue or malfunction are also cited."

4 This EIS contains an analysis of the reasonably foreseeable environmental impacts, which is intended to demonstrate the relative magnitude of the maximum consequences associated with each of the alternatives. The types of consequences associated with facility operation under routine and accident conditions are therefore presented for "bounding" normal operations and reasonably foreseeable accidents. Events that are not specifically evaluated in the EIS would therefore have lower consequences than those that are presented. A safety analysis that evaluates all potential accident scenarios is beyond the scope of the EIS; however,

such an analysis would be prepared for all facilities associated with the Medical Isotopes Production Project before initiating activities at any of the alternative sites. In addition, all facilities would be subject to an operational readiness review before they are allowed to restart to ensure that there are no outstanding safety or security issues that remain to be resolved.

5 The current plans, as provided as input to this EIS, do not call for use of the Storage Vault Building nor is it reasonable to foresee that this facility would be used to support the production of medical isotopes. Therefore, the use of that facility is outside the scope of this EIS.

6 The quantity of waste which would be generated by the proposed Medical Isotopes Production Project at any of the alternatives is small. The storage and disposal of the minimal amounts of low-level waste will take place at the Nevada Test Site for two of the alternatives considered; for the other two alternatives, low-level waste will be stored in existing DOE-approved facilities onsite. When the Waste Management Programmatic EIS is finalized, the Medical Isotopes Production Project will ensure that waste generated during project activities is disposed of in a manner consistent with the Record of Decision for that EIS.

7 The effects of all tritium emissions and of other radionuclides that would be released from medical isotope production facilities are evaluated in the EIS. The emissions would result in doses to the maximally exposed offsite individual that are less than 2% of the EPA standard, and no health effects would be expected in the population within 50 miles from these releases (see Table 5-3). Emissions of nonradiological pollutants would likewise not be sufficient to measurably impact air quality in the Albuquerque region.

8 The Department found that there would be small, if any, environmental impacts from the implementation of medical isotopes production at any of the alternative sites. Thus, there are not any anticipated disproportionately high or adverse impacts to ethnic minorities and disadvantaged people that would result from the implementation of the proposed project. Section 5.21 provides a comprehensive analysis of environmental justice issues.

9 This EIS reports that water usage at SNL/NM for the production of medical isotopes would be 40,000 m^3 year (10.6 million gallons/year). This would be only 0.03% of the 40.6 billion gallons of water pumped by the City of Albuquerque in 1995. Seventy-one percent of the water pumped by the City is distributed to single- and multi-family residences.

10 The consequences of an aircraft crash are presented in Section 5.15.1.3 of the EIS. This accident represents the design basis accident for the Annular Core Research Reactor. Similar accidents were also considered for the other facilities (e.g., hot cells), but were found to have risks or consequences that were lower than the accidents evaluated and presented in this EIS.

IANS Statement Re: Production of Medical Isotopes J. C. C. - 01/17/96

170 Fieldstream Lane, Idaho Falls ID 83404

My name is John Commander. I am Vice Chair of the Idaho Section of the American
Nuclear Society, and represent some 900 members located predominately in Southeast
Idaho. I have been authorized by the Section Chair Charles Gilmore, to make a statement
1 concerning our endorsement of the DOE project for the production of medical isotopes
for the screening and therapy of cancer and heart disease; and our endorsement of the
project being located at the Power Burst Facility at the Idaho National Engineering
Laboratory.

We beleive the PBF site is technically and economically superior among the four DOE sites being considered for the Isotope Production Project based upon the following advantages of the INEL siting alternative.

2 The PBF reactor is the only alternative that uses low-enriched uranium fuel, which reduces waste generation and security requirements.

3 Lowlevel waste from operation of PBF can be disposed of on site, whereas waste from the preferred site would require packaging and shipping off site.

4 PBF lower operating cost and lower environmental impact should be given greater consideration.

5 PBF is the only alternative which envisions the isotope production project acquization by private enterprise.

6 PBF is suitable for both the Isotope Production Project and the Boron Neutron Capture Therapy mission.

7 and; PBF provides the technical ability to produce 100 % of the nations demand for these isotopes.

In summary, we beleive that coupling the Isotope Production Project with the BNCT mission will be the most cost effective, saving millions of dollars; will produce on the order of 120 high technology, high compensation jobs for the Southeast Idaho economy; and will provide for the desired technology transfer to the private sector. Southeast Idaho has always supported these kind of projects at INEL, and we are confident that this hearing will provide evidence of staunch support for location of the Isotope Production Project at the INEL.

Responses to Comment Letter C033

1 Comment noted.

2 The Power Burst Facility is the only option currently using low enriched uranium fuel. All the other options evaluated in detail have designs for converting to low enriched uranium. The objective is not to build any more highly enriched uranium fuel bundles for any of the other options, but to use the fuel already on hand until the supply is exhausted or, in the case of the Annular Core Research Reactor (ACRR), until the burnup limit is reached—see Section 3.3.1.9. Two or three transition cores of both low enriched uranium and highly enriched uranium would be used during the conversion to all low enriched uranium fuel. This is a long-term safeguards advantage, in that it depletes and irradiates the weapons grade material on hand.

It is not true that use of low enriched uranium fuel minimizes waste. More spent fuel bundles are generated per reactor full power year with the use of low enriched uranium bundles.

3 The INEL alternative and the LANL alternative both would allow the small quantities of low-level waste to be stored onsite. The commentor is correct in identifying that both the preferred alternative and the ORNL alternative would require some shipment of low-level waste to the Nevada Test Site (NTS). The NTS is preparing a site-wide environmental impact statement and has included waste generated from the Mo-99 mission in the quantities and description of materials to be disposed on the site.

4 The Department recognizes that the estimated cost of the INEL alternative is lower than that of the preferred alternative; however, the uncertainties associated with the estimated cost of the INEL alternative are higher than for the preferred alternative. If the Department decides to proceed with the proposed action, the information presented in the EIS (including the cost data), the operational readiness of facilities, and other programmatic factors will be considered in the final selection of facilities for Mo-99 production.

The potential environmental impacts of the four production alternatives analyzed in the EIS were found to be essentially the same for each alternative and, in all cases, were found to be low.

5 The Idaho Brain Tumor Center (IBTC) has informed DOE of its interest in coordinating its efforts with those of DOE. The Department is aware of this potential for the INEL alternative. Although the potential for privatization of the proposed action in this EIS is important, the process for privatization is not part of this proposed action. Each of the production alternatives has potential for privatization. DOE has solicited expressions of interest from the industrial community for the privatization of any isotope production activity conducted by DOE, including the proposed medical isotopes production project. If promising concepts are received, the Department would seek privatization proposals on a competitive basis.

6 As stated above, the IBTC has informed DOE of its interest in coordinating its efforts with those of DOE; however, IBTC has not submitted any plans for coordinating reactor conversion activities, nor has it made a formal proposal to DOE. In addition, the Department understands that IBTC is investigating the possibility of using other facilities for boron neutron capture therapy (BNCT) and that other reactors under consideration for this project may be usable for BNCT. If the Department decides to proceed with a production alternative for this proposed project, it would welcome a proposal from IBTC for dual use of the reactor facility selected.

7 All of the alternative reactors would (after necessary modifications) have the capability to provide at least 100% of the U.S. demand for Mo-99.

Mr. Wade Carroll, MIPP EIS Document Manager
Office of Nuclear Energy, Science, and Technology (NE-70)
US Department of Energy
19901 Germantown Road
Germantown MD 20874

Dear Mr. Carroll,

This letter is a citizens input regarding the location of a medical isotope generation facility in at the Idaho National Engineering Laboratory(INEL).

1 I favor locating the project in Idaho. Please consider my reasons.

> Idahoans, heretofore benignly accepting of the receipt and processing of spent nuclear fuel at the INEL, have in recent years become hostile to the idea, even though there is no demonstrable health risk to Idahoans.
>
> The cessation of fuel processing at the Idaho Chemical Processing Plant (ICPP) and delays in opening the Waste Isolation Processing Plant (WIPP) are, I believe principally responsible for this shift in public opinion.
>
> Devoutly anti-INEL individuals have offered themselves into running for public office. I believe that, except for South East Idaho, they will sweep the state. This places the INEL in great jeopardy.
>
> The INEL has not convincingly demonstrated a tangible benefit to Idaho, except to the imports who come in to suck up big money jobs, in the opinion of many Idahoans.
>
> Locating the medical isotope production project at the INEL gives the INEL an identifiable, advertizable benefit that will help abate criticism, while other activities continue that are also expedient to the US government.
>
> Locating the medical isotope production facility at the INEL is less expensive than its
> 2 alternatives. Skilled analytical personnel and maintenance workers who are accustomed
> to working in high contamination situations are available without additional training.

I encourage your consideration to these and other opinions expressed, that offer BROAD SUPPORT for locating the isotope production facility at the INEL. Thank you for your attention.

Ben Stutzman
826 Jeri Ave.
Idaho Falls, ID 83402-2539-34
208-523-6418

Responses to Comment Letter C034

1 Comment noted.

2 The INEL and the other alternative sites have the facilities and skilled personnel available to conduct the medical isotope production activities.

January 30, 1996

Mr. Wade Carroll, MIPP EIS Document Manager,
Office of Nuclear Energy, Science and Technology (NE-70),
U.S. Department of Energy,
19901 Germantown Road,
Germantown, Maryland 20874

PUBLIC HEARING

Dear Mr. Carroll:

1 The danger of losing the vitality and preeminence of the Idaho National Engineering Laboratory (INEL) as a national resource is, of course, not a new reason for assigning new projects in the DOE community. We, at a state and local level, however, keenly feel the threat and the implied results of such decisions. I'm sure you are well aware of the precarious position and the great danger this specific facility faces of closing down entirely due to lack of projects in the national perspective. Such an occurrence would be disastrous for the state and local economies, as well as a step backward nationally and internationally. Locating the project for the production of medical isotope (Molybdenum-99) and other continuing projects here would allow the survival of an international, world class facility.

2 While I am not an expert in available resources, I do know initial research has been conducted here. We have the work force, the work ethic, the facilities, and the ability to provide the necessary support.

Please consider, not only the immediate demands of the project, but the larger, broader perspective of the consequences of the decision impacting the DOE community as a whole.

Sincerely,

Rand Ricks

L. Rand Ricks
Instructional Support SPC.

Responses to Comment Letter C035

1 The Department realizes the importance of all its laboratories to their respective state and local economies as well as the importance of preserving the valuable technical capabilities each laboratory possesses.

2 The INEL and the other alternative sites have the facilities and skilled personnel available to conduct the medical isotope production activities.

San José Community Awareness Council, Inc.
(505) 243-4837 FAX (505) 243-3085

"To empower our community to solve our own problems"

2401 Broadway SE, 87102-5009 • P.O. Box 12297 • Albuquerque, New Mexico 87195-2297

January 26, 1996

Wade Carroll
EIS Project Manager
Office of Nuclear Energy, Science & Technology (NE-70)
U. S. Department of Energy
19901 Germantown Road
Germantown, Maryland 20874-1290

Re: Draft DOE/EIS-0249D

Dear Mr. Carroll:

Thank you very much for submitting the above referenced "draft" document for public comment. After review we offer the following response:

1.) Please advise who are the technical advisor(s)/organization that assisted
1 the department in research, assessment and preparation of the document.

2.) Please identify and explain proposed recreational-industrial future land uses.

2 3.) Proposed/planned future use should be discussed including overview and plan of action for the following:

a.) Sandia Withdrawal Area (east of military facility).
b.) Contaminated Landfills, i.e., CHEM WASTE LANDFILL, others.

4.) (2-13) The EA did not adequately address the issue of "Risk Assessment" based on the limited information made available. The conservative assumptions did not sufficiently detail determination for "cleanup" as
3 contaminants of concern were not identified and quantified for <u>all</u> project sites. The types of contaminants, extent of contamination, medium in which contaminants have made contact and potential to come in contact with, and surrounding environment must be considered to achieve a high quality "Risk Assessment". The utility of risk assessments depends on

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3 the validity of existing data, the models used, and the assumptions made in the absence of appropriate data.

5.) (3-17) The existing production wells located at KAFB and Albuquerque influence groundwater flow direction, and potential migration of contaminants is an overarching concern, hence see #4 above. Therefore, a complete overview of contaminants in ER's will assist in remediation effectively and as one "cleanup" scenario may influence another that is in
4 close proximity, and save time and resources.

The SNL's unconfined aquifer allows anything that seeps into the groundwater, regardless of zone, to affect the pumping of wells. Should the water become impacted by pollution, the production wells will be a factor in assisting the spreading of contamination and decreasing the fresh water sources available.

5 6.) (3-30) NEPA is public involvement. Please see attachment "A".

7.) the issue of how the "waste" will be treated should be explained:

6 a.) On-Site
b.) Manifested-Transported
c.) Off-Site

Thank you very much. If you have questions please contact me at (505) 243-4837 or Frances Ortega, (Consultant-Researcher) at (505) 262-1862.

Sincerely,

Dolores S. Herrera
Executive Director

DSH:mkr

7629

Federal Register
Vol. 59, No. 32
Wednesday, February 16, 1994

Presidential Documents

Title 3—

The President

Executive Order 12898 of February 11, 1994

Federal Actions To Address Environmental Justice in Minority Populations and Low-Income Populations

By the authority vested in me as President by the Constitution and the laws of the United States of America, it is hereby ordered as follows:

Section 1–1. IMPLEMENTATION.

1–101. *Agency Responsibilities.* To the greatest extent practicable and permitted by law, and consistent with the principles set forth in the report on the National Performance Review, each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States and its territories and possessions, the District of Columbia, the Commonwealth of Puerto Rico, and the Commonwealth of the Mariana Islands.

1–102. *Creation of an Interagency Working Group on Environmental Justice* (a) Within 3 months of the date of this order, the Administrator of the Environmental Protection Agency ("Administrator") or the Administrator's designee shall convene an interagency Federal Working Group on Environmental Justice ("Working Group"). The Working Group shall comprise the heads of the following executive agencies and offices, or their designees: (a) Department of Defense; (b) Department of Health and Human Services; (c) Department of Housing and Urban Development; (d) Department of Labor; (e) Department of Agriculture; (f) Department of Transportation; (g) Department of Justice; (h) Department of the Interior; (i) Department of Commerce; (j) Department of Energy; (k) Environmental Protection Agency; (l) Office of Management and Budget; (m) Office of Science and Technology Policy; (n) Office of the Deputy Assistant to the President for Environmental Policy; (o) Office of the Assistant to the President for Domestic Policy; (p) National Economic Council; (q) Council of Economic Advisers; and (r) such other Government officials as the President may designate. The Working Group shall report to the President through the Deputy Assistant to the President for Environmental Policy and the Assistant to the President for Domestic Policy.

(b) The Working Group shall: (1) provide guidance to Federal agencies on criteria for identifying disproportionately high and adverse human health or environmental effects on minority populations and low-income populations;

(2) coordinate with, provide guidance to, and serve as a clearinghouse for, each Federal agency as it develops an environmental justice strategy as required by section 1–103 of this order, in order to ensure that the administration, interpretation and enforcement of programs, activities and policies are undertaken in a consistent manner;

(3) assist in coordinating research by, and stimulating cooperation among, the Environmental Protection Agency, the Department of Health and Human Services, the Department of Housing and Urban Development, and other agencies conducting research or other activities in accordance with section 3–3 of this order;

(4) assist in coordinating data collection, required by this order;

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(5) examine existing data and studies on environmental justice;

(6) hold public meetings as required in section 5-502(d) of this order; and

(7) develop interagency model projects on environmental justice that evidence cooperation among Federal agencies.

1-103. *Development of Agency Strategies.* (a) Except as provided in section 6-605 of this order, each Federal agency shall develop an agency-wide environmental justice strategy, as set forth in subsections (b)-(e) of this section that identifies and addresses disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations. The environmental justice strategy shall list programs, policies, planning and public participation processes, enforcement, and/or rulemakings related to human health or the environment that should be revised to, at a minimum: (1) promote enforcement of all health and environmental statutes in areas with minority populations and low-income populations; (2) ensure greater public participation; (3) improve research and data collection relating to the health of and environment of minority populations and low-income populations; and (4) identify differential patterns of consumption of natural resources among minority populations and low-income populations. In addition, the environmental justice strategy shall include, where appropriate, a timetable for undertaking identified revisions and consideration of economic and social implications of the revisions.

(b) Within 4 months of the date of this order, each Federal agency shall identify an internal administrative process for developing its environmental justice strategy, and shall inform the Working Group of the process.

(c) Within 6 months of the date of this order, each Federal agency shall provide the Working Group with an outline of its proposed environmental justice strategy.

(d) Within 10 months of the date of this order, each Federal agency shall provide the Working Group with its proposed environmental justice strategy.

(e) Within 12 months of the date of this order, each Federal agency shall finalize its environmental justice strategy and provide a copy and written description of its strategy to the Working Group. During the 12 month period from the date of this order, each Federal agency, as part of its environmental justice strategy, shall identify several specific projects that can be promptly undertaken to address particular concerns identified during the development of the proposed environmental justice strategy, and a schedule for implementing those projects.

(f) Within 24 months of the date of this order, each Federal agency shall report to the Working Group on its progress in implementing its agency-wide environmental justice strategy.

(g) Federal agencies shall provide additional periodic reports to the Working Group as requested by the Working Group.

1-104. *Reports to the President.* Within 14 months of the date of this order, the Working Group shall submit to the President, through the Office of the Deputy Assistant to the President for Environmental Policy and the Office of the Assistant to the President for Domestic Policy, a report that describes the implementation of this order, and includes the final environmental justice strategies described in section 1-103(e) of this order.

Sec. 2-2. FEDERAL AGENCY RESPONSIBILITIES FOR FEDERAL PROGRAMS. Each Federal agency shall conduct its programs, policies, and activities that substantially affect human health or the environment, in a manner that ensures that such programs, policies, and activities do not have the effect of excluding persons (including populations) from participation in, denying persons (including populations) the benefits of, or subjecting persons (including populations) to discrimination under, such programs, policies, and activities, because of their race, color, or national origin.

Sec. 3–3. RESEARCH, DATA COLLECTION, AND ANALYSIS.

3–301. *Human Health and Environmental Research and Analysis.* (a) Environmental human health research, whenever practicable and appropriate, shall include diverse segments of the population in epidemiological and clinical studies, including segments at high risk from environmental hazards, such as minority populations, low-income populations and workers who may be exposed to substantial environmental hazards.

(b) Environmental human health analyses, whenever practicable and appropriate, shall identify multiple and cumulative exposures.

(c) Federal agencies shall provide minority populations and low-income populations the opportunity to comment on the development and design of research strategies undertaken pursuant to this order.

3–302. *Human Health and Environmental Data Collection and Analysis.* To the extent permitted by existing law, including the Privacy Act, as amended (5 U.S.C. section 552a): (a) each Federal agency, whenever practicable and appropriate, shall collect, maintain, and analyze information assessing and comparing environmental and human health risks borne by populations identified by race, national origin, or income. To the extent practical and appropriate, Federal agencies shall use this information to determine whether their programs, policies, and activities have disproportionately high and adverse human health or environmental effects on minority populations and low-income populations;

(b) In connection with the development and implementation of agency strategies in section 1–103 of this order, each Federal agency, whenever practicable and appropriate, shall collect, maintain and analyze information on the race, national origin, income level, and other readily accessible and appropriate information for areas surrounding facilities or sites expected to have a substantial environmental, human health, or economic effect on the surrounding populations, when such facilities or sites become the subject of a substantial Federal environmental administrative or judicial action. Such information shall be made available to the public, unless prohibited by law; and

(c) Each Federal agency, whenever practicable and appropriate, shall collect, maintain, and analyze information on the race, national origin, income level, and other readily accessible and appropriate information for areas surrounding Federal facilities that are: (1) subject to the reporting requirements under the Emergency Planning and Community Right-to-Know Act, 42 U.S.C. section 11001–11050 as mandated in Executive Order No. 12856; and (2) expected to have a substantial environmental, human health, or economic effect on surrounding populations. Such information shall be made available to the public, unless prohibited by law.

(d) In carrying out the responsibilities in this section, each Federal agency, whenever practicable and appropriate, shall share information and eliminate unnecessary duplication of efforts through the use of existing data systems and cooperative agreements among Federal agencies and with State, local, and tribal governments.

Sec. 4–4. SUBSISTENCE CONSUMPTION OF FISH AND WILDLIFE.

4–401. *Consumption Patterns.* In order to assist in identifying the need for ensuring protection of populations with differential patterns of subsistence consumption of fish and wildlife, Federal agencies, whenever practicable and appropriate, shall collect, maintain, and analyze information on the consumption patterns of populations who principally rely on fish and/or wildlife for subsistence. Federal agencies shall communicate to the public the risks of those consumption patterns.

4-402. *Guidance*. Federal agencies, whenever practicable and appropriate, shall work in a coordinated manner to publish guidance reflecting the latest scientific information available concerning methods for evaluating the human health risks associated with the consumption of pollutant-bearing fish or wildlife. Agencies shall consider such guidance in developing their policies and rules.

Sec. 5-5. PUBLIC PARTICIPATION AND ACCESS TO INFORMATION. (a) The public may submit recommendations to Federal agencies relating to the incorporation of environmental justice principles into Federal agency programs or policies. Each Federal agency shall convey such recommendations to the Working Group.

(b) Each Federal agency may, whenever practicable and appropriate, translate crucial public documents, notices, and hearings relating to human health or the environment for limited English speaking populations.

(c) Each Federal agency shall work to ensure that public documents, notices, and hearings relating to human health or the environment are concise, understandable, and readily accessible to the public.

(d) The Working Group shall hold public meetings, as appropriate, for the purpose of fact-finding, receiving public comments, and conducting inquiries concerning environmental justice. The Working Group shall prepare for public review a summary of the comments and recommendations discussed at the public meetings.

Sec. 6-6. GENERAL PROVISIONS.

6-601. *Responsibility for Agency Implementation*. The head of each Federal agency shall be responsible for ensuring compliance with this order. Each Federal agency shall conduct internal reviews and take such other steps as may be necessary to monitor compliance with this order.

6-602. *Executive Order No. 12250*. This Executive order is intended to supplement but not supersede Executive Order No. 12250, which requires consistent and effective implementation of various laws prohibiting discriminatory practices in programs receiving Federal financial assistance. Nothing herein shall limit the effect or mandate of Executive Order No. 12250.

6-603. *Executive Order No. 12875*. This Executive order is not intended to limit the effect or mandate of Executive Order No. 12875.

6-604. *Scope*. For purposes of this order, Federal agency means any agency on the Working Group, and such other agencies as may be designated by the President, that conducts any Federal program or activity that substantially affects human health or the environment. Independent agencies are requested to comply with the provisions of this order.

6-605. *Petitions for Exemptions*. The head of a Federal agency may petition the President for an exemption from the requirements of this order on the grounds that all or some of the petitioning agency's programs or activities should not be subject to the requirements of this order.

6-606. *Native American Programs*. Each Federal agency responsibility set forth under this order shall apply equally to Native American programs. In addition, the Department of the Interior, in coordination with the Working Group, and, after consultation with tribal leaders, shall coordinate steps to be taken pursuant to this order that address Federally-recognized Indian Tribes.

6-607. *Costs*. Unless otherwise provided by law, Federal agencies shall assume the financial costs of complying with this order.

6-608. *General*. Federal agencies shall implement this order consistent with, and to the extent permitted by, existing law.

6-609. *Judicial Review*. This order is intended only to improve the internal management of the executive branch and is not intended to, nor does it create any right, benefit, or trust responsibility, substantive or procedural,

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enforceable at law or equity by a party against the United States, its agencies, its officers, or any person. This order shall not be construed to create any right to judicial review involving the compliance or noncompliance of the United States, its agencies, its officers, or any other person with this order.

THE WHITE HOUSE,
February 11, 1994.

[FR Doc. 94–3085
Filed 2–14–94; 3:07 pm]
Billing code 3195–01–P

Editorial note: For the memorandum that was concurrently issued on Federal environmental program reform, see issue No. 6 of the *Weekly Compilation of Presidential Documents.*

Responses to Comment Letter C036

1 Section 8 of the EIS contains a comprehensive list and overview of qualifications of the EIS authors and technical contributors.

2 The SNL/NM Withdrawal Area, which includes all of the DOE and U.S Air Force (USAF) Withdrawal Area, is located within the Cibola National Forest. The area has been used by the DOE and the USAF primarily for weapons testing, but land withdrawn by the DOE is also used for research and development missions and training. The USAF also maintains testing and training activities in the Withdrawal Area. Past and present use of the area has resulted in environmental restoration sites and in unexploded ordnance of unknown quantities.

Recommendations for long-term future use of the land within the Withdrawal Area have been developed by DOE, with cooperative input of the EPA and the New Mexico Environment Department. Recommendations took into account the existing known environmental restoration sites within the Withdrawal Area and their current status in terms of permitting, characterization, and cleanup efforts. Costs and technologies associated with cleanup levels were also considered.

These recommendations are used as a decision-making tool for ongoing environmental restoration operations. One of these recommendations is to classify the Withdrawal Area as a recreational site for purposes of future use planning and determination of appropriate cleanup levels. However, this will depend on the status of environmental impacts and environmental restoration in the area. Future missions are likely to be associated with long-term institutional controls which will remain in place for the foreseeable future. As of February 1996, no actual future use plans had been developed for the Withdrawal Area and no change in land use was expected in the foreseeable future.

DOE's *Draft Environmental Assessment of the Environmental Restoration Project at Sandia National Laboratories/New Mexico* (DOE/EA-1140) (DOE 1995h) lists 157 potential cleanup sites at SNL/NM. The specific site locations, contaminants found at the sites, and proposed methods of treatment can all be found in this document. Briefly, DOE proposes to conduct site characterization and cleanup, using a range of treatment options, in compliance with applicable laws and regulations. DOE estimates that the cleanup activities would continue for approximately 10 years, beginning in FY 1996.

The Chemical Waste Landfill (site # 74) also detailed in the above-cited environmental assessment, is located in Tech Area V. It is about 83,000 square feet in area; contains various types of waste, including volatile organic compounds, radionuclides, and metal debris; and would be treated using removal, decontamination, excavation, and capping, among other possible treatments.

The comment appears to refer to "risk assessment" in the sense typically used to determine cleanup requirements for closure of an existing hazardous waste disposal site. Because the project has not yet resulted in any environmental contamination and is not expected to produce extensive quantities of waste or other potential environmental contaminants, this type of assessment would be of minimal value for purposes of the EIS. The EIS focuses on effluents directly associated with the production and distribution of medical isotopes and estimates the quantities of radioactive waste that would result. The components of the waste that would be generated during medical isotope production are identified in Section 5.14 of the EIS.

Any radioactive wastes generated by the production of medical isotopes would either be disposed of at a DOE-approved facility within the generation site (in the case of the LANL or INEL alternatives) or shipped to an offsite DOE approved facility (in the case of the SNL/NM and ORNL alternatives). The impacts of waste disposal would be evaluated by a risk analysis for the ultimate disposal facility, in conjunction with other wastes to be managed at the location. Because the medical isotope waste would be a relatively small fraction of the waste disposed at any site, the consequences of such disposal would likewise be small by comparison to the total, or to any regulatory standard.

4 The medical isotope production process and wastes resulting from the process are not expected to have any reasonably foreseeable impact on the quality of water in the unconfined aquifer at SNL/NM. There are no discharges to the environment of liquid effluents from the process, and any liquid wastes would be treated and converted to a solid form before disposal. Additional water use by the reactor for cooling represents about 3% of the current water use at SNL/NM. Although withdrawal of this water from the aquifer might have some local effects on groundwater flow, it would not be expected to substantially alter the overall distribution of pre-existing contaminants in the unconfined aquifer or to affect water quality on a larger scale.

5 The Department has attempted to actively involve and respond to the public in the NEPA process for the proposed Medical Isotopes Production Project through the public scoping meetings, public comment period, and public hearings held during preparation of the EIS. The Department's public involvement efforts for the proposed project are discussed in Section 1.4. An analysis of environmental justice considerations is provided in Section 5.21.

6 Current waste management practices at the alternative sites are described in Section 4, and management of wastes associated with medical isotope production are addressed in Section 5.14 (treatment and disposal of process waste) and Section 5.11 (transportation). As discussed in Section 5.14, solid radioactive or hazardous waste from the process would be stored temporarily at the process facility to permit decay of short-lived radionuclides, following which it could be further compacted to reduce its volume (depending on the waste composition and capabilities of the facility). Liquid wastes would be treated and solidified to immobilize the hazardous components before disposal.

After the decay period and treatment, the wastes would be packaged in appropriate containers for shipment and final disposal. In the LANL and INEL alternatives, the waste would be disposed of onsite, whereas the SNL/NM and ORNL alternatives propose to ship wastes to an offsite disposal facility. All shipping containers would meet applicable DOE or DOT requirements for onsite or offsite transport of radioactive materials, respectively. The final form of the waste and its disposal packaging would be determined by acceptance criteria at the receiving disposal facility. The criteria are designed to ensure that the facility meets applicable regulatory standards for disposal of potentially hazardous materials.

DISTRICT 21
HOME ADDRESS
BLACKFOOT, IDAHO
OFFICE ADDRESS
CAPITOL BUILDING
BOISE, IDAHO

COMMITTEES
STATE AFFAIRS
TRANSPORTATION

PRESIDENT PRO TEMPORE

Idaho State Senate

SENATOR JERRY T. TWIGGS

January 10, 1996

Honorable Hazel O'Leary
Secretary of Energy
1000 Independent Ave., S.W.
Washington, D.C. 20585

Dear Secretary O'Leary:

1 The Idaho National Engineering Laboratory's (INEL) Power Burst Facility (PBF) reactor has recently been listed as the potential site of the United States sole source of Molybdenum-99 (Mo-99) isotope production. I believe that the PBF represents the most technologically compatible, economically efficient and environmentally sound facility for domestic Mo-99 production and urge its designation as such.

2 Idaho is proud that the PBF will soon focus the world's attention on the implementation of Boron Neutron Capture Therapy (BNCT) at the Idaho Brain Tumor Center (IBTC). The technological partnership between DOE and IBTC is a credit to Idaho and the nation. It is my hope the victims whose maladies will be treated here, whether from Idaho, the United States or around the world, will come to understand, as you and I do, the broad advantages to our lives this government/private sector relationship creates.

3 The production of medical isotopes and the practice of BNCT are technologically compatible projects which can be carried out more efficiently and more cost effectively at the INEL's PBF reactor than at other facilities currently under evaluation by DOE. Both technologies require a constant supply of neutrons and a high flux of neutrons. The PBF produces the ideal neutron flux for BNCT and for medical isotope production. Initial engineering studies show that
4 the Idaho PBF facility can be readied for medical isotope production in 6-12 months less time and for $5 million less than any of the other three finalists being considered for the project.

5 High product quality and consistency of supply are the two most important ingredients when considering a facility for the production of medical isotopes. The Advanced Test Reactor (ATR), also located at the INEL, has been producing specialty isotopes for many years. The expertise is presently in place to produce isotopes to the highest quality standards. With the PBF serving as the main isotope production facility, the ATR can fill in and maintain a constant production schedule when the PBF is down for routine maintenance and refueling. Idaho offers a twin reactor concept that assures consistency of supply for many years to come.

Secretary O'Leary
January 10, 1996
Page 2

6 The U.S. currently has no domestic supply of the most widely used medical isotopes. The Idaho PBF reactor can supply 100% of the domestic demand for Mo-99 and still have excess production capacity for the exportation of Mo-99.

The INEL's PBF reactor is clearly the technologically superior choice for isotope production with minimal environmental consequences. Idaho's long history as the world leader in nuclear materials management make it ideally suited for the project.

Support for the project both on a local and state level is strong. Downsizing of INEL projects and personnel make it imperative that new missions are created to save and expand existing capabilities.

7 DOE intends to privatize the isotope production program. IBTC's present 30 year lease of the PBF reactor puts the privatization plan into effect immediately. 8 No other federal missions will interfere with the operation of Mo-99 production at the PBF, unlike some of the other sites under review.

The humanitarian aspects of the combined National Center for BNCT and the isotope production project makes the INEL's PBF the hands down winner for the nation as well as the State of Idaho.

9 After considering the lower start-up costs, mission compatibility and technological superiority, it is clear that INEL's PBF is the logical home of the United States Mo-99 production source.

Sincerely,

Senator Jerry T. Twiggs
President Pro Tem

Senator James E. Risch

Senator Grant Ipsen

Senator Moon Wheeler

Senator Hal Bunderson

Senator Evan Frasure

Senator David Kerrick

Senator John Andreason

Senator Ric Branch

Senator Robert L. Geddes

Senator Laird Noh

Senator Clyde Boatright

Senator Robert R. Lee

Senator Judith Danielson

Senator Mel Richardson

Secretary O'Leary
January 10, 1996
Page 3

Senator Denton Darrington
Senator Marguerite McLaughlin
Senator Claire Wetherell
Senator Dean Cameron
Senator Stan Hawkins
Senator Rex Furness
Senator Gordon Crow
Senator John Sandy
Senator Cecil Ingram
Senator Lin Whitworth
Senator John Hansen

Responses to Comment Letter C037

1 Comment noted.

2 Comment noted.

3 The Idaho Brain Tumor Center (IBTC) has informed DOE of its interest in coordinating its efforts with those of DOE; however, IBTC has not submitted any plans for coordinating reactor conversion activities, nor has it made a formal proposal to DOE. In addition, the Department understands that IBTC is investigating the possibility of using other facilities for boron neutron capture therapy (BNCT) and that other reactors under consideration for this project may be usable for BNCT. If the Department decides to proceed with a production alternative for this proposed project, it would welcome a proposal from IBTC for dual use of the reactor facility selected.

4 As shown in Section 5.22, the estimated cost to prepare the INEL facilities is $2.4 million less than the closest alternative (the preferred alternative), and the estimated time to prepare the INEL facilities for full production is tied with the preferred alternative.

The uncertainties associated with the estimated cost of the INEL and ORNL alternatives are higher than for the LANL and the preferred alternative. Cost estimates (including uncertainties) will be an important factor in determining which alternative to pursue for the proposed project. This comment will be provided to the decision maker for this proposed project and will be given due consideration as the Department formulates its decision on the project. In making its decision, the Department will also consider factors such as the environmental impacts of the alternatives, national need for the medical isotopes, production schedules for each alternative, and other important factors. Since the Power Burst Facility (PBF) is one of the alternatives analyzed in detail, DOE is free to select this alternative to produce Mo-99. The Department's decision will be documented in the Record of Decision.

5 The Advanced Test Reactor (ATR) was evaluated for the proposed project and was dismissed for the reasons cited in Section 3.4.1.1. The Department is proposing to establish a backup to the existing Canadian supplier and does not believe that it is necessary to establish a backup to its backup.

6 If the decision is made to pursue this project, the Department would act as a backup to the existing Canadian supplier. All the alternatives would have the capability to produce at least 100% of the current domestic demand for Mo-99, but the goal of the proposed project is to ensure that a reliable supply of Mo-99 is available to the U.S. medical community, not to produce Mo-99 for export and compete in the worldwide market for Mo-99.

7 The IBTC has not made a formal proposal to the Department regarding the dual use of the Power Burst Facility (PBF). Therefore, the Department cannot say for certain whether operation of the PBF would be conducted privately (by IBTC) or by DOE.

8 It is possible that the Annular Core Research Reactor (ACRR) could be diverted to support defense missions in case of a national emergency. However, the Department has determined that the probability of needing the ACRR for defense purposes is sufficiently low to preclude disqualifying the reactor from consideration.

9 Comment noted.

William J. Berry
2660 St. Charles Ave.
Idaho Falls, ID 83404
208-523-4183.

Mr. Wade Carroll, MIPP-EIS Document Manager
U. S. Department of Energy
Office of Isotope Production and Distribution, NE-70
19901 Germantown Road
Germantown, MD 20874

February 2, 1996

Dear Mr. Carroll,

Upon further review of the MIPP-EIS copy I was provided at the Idaho Falls hearing, I have the following additional comments.

1 I do not understand the reason research reactors using highly enriched uranium (HEU) would be transition to the use of low-enriched uranium (LEU) fuel. The only possible reason I can think of is that DOE is concerned that using HEU is contrary to supposed Department non-proliferation policies. Whatever the reason for the transition, DOE should perhaps consider that plutonium is unavoidably produced in reactors using LEU and, in fact, is the element responsible for much of the energy at the end of the fuel cycle. Considering that the general public erroneously believes the "sound bite" that plutonium is the most toxic substance known to man, DOE may be faced with a greater problem managing the spent fuel from a reactor using LEU and seems to have little justification for the transition in fuel type.

2 I am also confused as to why low-level wastes (LLW) from the preferred alternative would be transported to the Nevada Test Site (NTS) when LLW from the Omega West Reactor alternative would be managed at Los Alamos National Laboratory (LANL). LANL is much closer to Sandia than the NTS and apparently must have the capability to manage the LLW. Is this a means of avoiding the controversy of transporting the LLW to LANL through Santa Fe? Once again the Power Burst Facility appears to be more favorable than the preferred alternative as offsite transportation of targets and LLW would not be required.

3 The EIS also indicates that DOE prepared an Enviromental Assessment (EA) for implemention of the preferred alternative and determined that an EIS was necessary based on the EA and public comments received. The alternatives analysis under the National Environmental Policy Act is intended to be impartial and one might question whether the analysis in the MIPP-EIS met this criterion or, alternatively, if DOE prepared an EIS in support of a predetermined outcome. Several portions of the impact analysis, i.e. those portions where the preferred alternative is clearly not the environmentally preferable alternative, suggest that DOE indeed has a predetermined plan and the EIS was prepared to go through the motions of complying with NEPA.

Please consider these comments in preparation of the Final Environmental Impact Statement.

Sincerely,

William J. Berry

Responses to Comment Letter C038

1 The commentor correctly points out that plutonium is "unavoidably" produced in reactors using low enriched uranium. The amount of plutonium produced in research reactors, however, is a minor fraction of the amount of fuel used to power those reactors and is nominally less than that needed to produce a nuclear weapon. The amount of highly enriched uranium needed to fuel many research reactors, however, is above the amount needed to fabricate a nuclear weapon. Moreover, use of plutonium in a nuclear weapon would require the extraction of the material from spent fuel through a process known as reprocessing, a complicated procedure. Highly enriched uranium can be used directly in the fabrication of nuclear weapons. It is for these reasons that, since 1978, the United States has sought to minimize and eventually eliminate the international civil commerce in highly enriched uranium. This policy was restated in President Clinton's Nonproliferation and Export Control Policy issued on September 27, 1993.

The majority of foreign research reactors using U.S. enriched fuel have agreed to convert to the use of high density low enriched uranium fuels, developed by the United States as part of the Reduced Enrichment for Research and Test Reactors (RERTR) program. This program is also proceeding with the development of low enriched uranium targets that will enable research reactors to economically produce Mo-99 from low enriched uranium, as opposed to highly enriched uranium, further reducing international commerce in weapons-usable materials. It is expected that the majority of foreign reactors will make use of the new low enriched uranium targets once they become commercially available.

The DOE has over three decades of experience in transporting and storing spent nuclear fuel and targets containing both enriched uranium and plutonium. Several recently completed environmental impact statements verify that the management of these materials can be safely accomplished with only minor environmental impacts.

2 The low-level waste disposal facilities at LANL are only approved to dispose of waste generated on the LANL site. They are not able to accept materials from other facilities including other DOE facilities such as SNL/NM. The closest DOE-approved facility able to accept the small amount of low-level waste that would be generated by medical isotope production at SNL/NM is the Nevada Test Site.

3 The Department had previously proposed to conduct the Medical Isotopes Production Project using the Chemistry and Metallurgy Research facility at LANL and the Annular Core Research Reactor and Hot Cell Facility at SNL/NM and issued an environmental assessment on this proposal. Based on the environmental assessment and the comments received, the Department decided to prepare an EIS.

The Department has not decided if and where to conduct the proposed project and believes that the EIS provides a fair representation of each alternative from which the decision maker will choose.

FOUR HILLS VILLAGE HOMEOWNERS ASSOCIATION

January 22, 1996

Mr. Wade Carroll, MIPP-EIS Document Manager
U. S. Department of Energy, NE-70
19901 Germantown Road
Germantown, Maryland 20874

Subject: Medical Isotopes Production Project
Molybdenum-99 and Related Isotopes
Draft Environmental Statement
December 15, 1995

Dear Mr. Carroll,

1 After careful review of subject EIS, we find no significant impacts or issues associated with the subject program. In fact, we find several positive factors in your choice to locate such a facility at Sandia National Laboratories and Los Alamos National Laboratories. First, the annular core research reactor at Sandia Laboratories is a working reactor. This should mean considerable surety in the cost and schedule estimates over the other possible choices. It also means that this preferred location should get into beneficial production earlier than the other possibilities. This is a very worthwhile goal since the rather old Canadian reactor, producing medical isotopes, could be forced out of service at any time for repairs.

Another positive factor is that this provides an opportunity for the two Laboratories to participate in a commercial operation rather than a military operation and a business that could, in the future, lead to spin-off or associated businesses in the greater Albuquerque area.

I am writing on behalf of the Four Hills Village Homeowners' Association. There are slightly over 1200 homes in Four Hills Village and we are the closest non-military residential neighborhood to the Kirtland Air Force Base and one of the closest residential areas to Sandia's Technical Area V where the reactor and hot cell are located. While the normal business of the Association is delegated to an elected Board of Directors, we were able to put this matter before the entire membership at our Annual Membership meeting on January 11, 1996. I am pleased to report that the general membership unanimously supported the installation of the isotopes production program at Sandia and Los Alamos.

P.O. BOX 13611 • ALBUQUERQUE, NEW MEXICO 87192 - 3611

As one of the most likely impacted neighborhoods, our conclusion that the program offers no significant risk to the public, and the general strong support of the residents of the Village are factors that we hope will be taken into account in DOE's decision on this matter. This is a highly commendable project and we encourage the conversion of the Sandia reactor from a weapons mission to a medical isotopes production mission.

Sincerely,

Robert H. Multhaup
President

Response to Comment Letter C039

1 Comment noted.

GREGORY E. ROMRIELL, D.M.D.

Dear Mr. Carroll,

Regarding the location of medical isotope
1 production facilities, I must press the issue
for situating them here. I am a citizen, a
rare native resident, who feels that we
need a domestic supply of these medical
isotopes and welcome their presence in our
area. The more strident and shrill voices in
our community are those of the Snake River
alliance and friends who hysterically object
to anything nuclear! Obviously, none of
them has needed the benefit of medical
isotopes for diagnosing or treating cancer.

This facility at INEL has been one of the
pre-eminent sites for the development of peaceful
uses for nuclear energy in the whole world.
Taking this project away after the preliminary
work has begun would be demoralizing to
2 those who have already invested themselves
into it. Please realize that the Snake River
alliance crowd does not speak for me, and

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GREGORY E. ROMRIELL, D.M.D.

it does not speak for most people of my acquaintance. Most people are not swayed by the irrational fear mongering promulgated by the media and the nuclear-phobes. We mostly want the availability of these isotopes protected, and we welcome an employer who will provide living wages.

3 Please keep the medical isotope project at INEL. With the best nuclear physics program and hazardous waste management program here at ISU, we are uniquely and imminently equipped to sustain this type program.

Sincerely,

Leslie Romriell, born and raised in Pocatello

4544 YELLOWSTONE CHUBBUCK, IDAHO 83201 TELEPHONE 237-6430

Responses to Comment Letter C040

1 Comment noted.

2 The Department has not yet made a decision regarding if and where to conduct the proposed Medical Isotopes Production Project. The Department's decision on this project will not impact the other isotope production activities that are currently conducted at the INEL.

3 The proposed Medical Isotopes Production Project would be a new project and is not currently being conducted at the INEL. As stated above, the Department has not yet made a decision regarding if and where to conduct the project, and the Department's decision on this project will not impact the other isotope production activities that are currently conducted at the INEL.

Jan. 20, 1996

Wade Carroll
U.S. Dept. of Energy

Dear Mr. Carroll,

1 We are writing to you to express our support for making our INEL site into a Treatment Center for Brain Tumors, their therapy and Isotope Production for such care.

The facility here between Blackfoot, where we live, and Arco, is a superior area and we urge you to seriously consider and approve this site in Idaho for this much needed medical facility.

2 Not only will it be a great and desperately needed service for those with brain tumors, etc, but it will also enable our area to benefit with the needed jobs and funds.

Thank you,

Don & Elaine Mangum

We do have an excessive number of brain tumors here and need this facility in our area

Responses to Comment Letter C041

1 Comment noted.

2 The EIS evaluates the potential impacts of the proposed Medical Isotopes Production Project at various alternative sites, including the INEL. Possible treatment facilities that might operate concurrently yet independently of the Mo-99 mission (such as boron neutron capture therapy) are not part of the Department's proposed action or stated purpose and need.

questions by

1/26/96

341 Louisiana Ave
O R TN 37830
423-483-5250

Paul Kasten, ORNL retiree, UT adjunct professor

Specific evaluation of many factors were performed,
concerning environmental factors, times to production (initial and
full), ~~or~~ reactor capacity factors, storage capabilities,
etc. Also, a recommendation was made on the preferred
alternative facility for Tc 99m production. But the process
for evaluating the ~~proposed~~ ranking of alternative
facilities was not given. ~~What~~ Were there
specific criteria used in the evaluation, and what
weighting were they given? What was the basis
1 for the weighting factors? Seems as if what was
done was to conclude ~~off~~ all factors were a
"wash" except for the time to initial, limited
production. I hope that the final statement
will specifically give the criteria and
weighting factors. ~~Would~~ Please comment on the
above.

2nd question
Who will make the final decision, and
2 will it be a technical or a political decision?

Responses to Comment Letter C042

1 The criteria for identifying the reasonable alternatives are presented in Section 3.1. Each of the criteria had to be met before a facility was considered to be a reasonable alternative. No weighting factors were applied to the criteria.

The reasons for identifying the preferred alternative are presented in Section 3.3.1.1.

2 In addition to the analyses contained in this EIS, the Department will consider other programmatic factors, as appropriate, in making its decision on the proposed production of Mo-99. The rationale for the Department's decision will be documented in a Record of Decision that will be issued following completion of the Final EIS. The Record of Decision will be signed by either the Secretary of Energy or the Director of the Office of Nuclear Energy, Science and Technology.

COMMENT

ON THE
U.S. DEPARTMENT OF ENERGY
DRAFT ENVIRONMENTAL IMPACT STATEMENT
FOR THE
MEDICAL ISOTOPES PRODUCTION PROJECT

PLEASE PRINT CLEARLY

NAME: Uri Gat
STREET ADDRESS: 239 Gum Hollow Road
CITY Oak Ridge STATE Tn ZIP CODE: 37830
TELEPHONE: 423-483-7609 work: 423-574-0560

1 COMMENT: A new project is required to use SI. Specifically: Rem → Sv; Ci → Bq and ft → m

SIGNATURE Uri Gat
DATE 1996-01-25

Response to Comment Letter C043

1 Comment noted; changes have been incorporated throughout the document as appropriate.

COMMENT

ON THE
U.S. DEPARTMENT OF ENERGY
DRAFT ENVIRONMENTAL IMPACT STATEMENT
FOR THE
MEDICAL ISOTOPES PRODUCTION PROJECT

PLEASE PRINT CLEARLY

NAME: Robin Seydel
STREET ADDRESS: 1940 Poplar Ln SW.
CITY ABQ STATE NM ZIP CODE: 87105
TELEPHONE: (W) 265-4631 (H) 242-6134

COMMENT:

1 At the evening session - Scientists made presentations to the public. It is imperative to have scientists not on DOE payroll - scientists that represent a community - view to participate on the presentation panel - a more balanced and understandable information on these issues of tremendous impact to the health and well being of our communities

SIGNATURE Robin Seydel
DATE 11/30/96

Response to Comment C044

1 The purpose of the public hearings is to present the results of the environmental analysis to the public and to obtain public comments on the content of the Draft EIS.

Moly 99 hearing comments:

As a citizen living in Albuquerque, and a representative of the Water Information Network, I would like to make comments on the public health factor of having a nuclear reactor running 24 hours a day near our city of 600,000 people, and the financial costs of this project to taxpayers.

You may remember that back in December of 1994, a DOE spokesman,
Dr. Charles Massey, actually said that operation of the isotope
reactor will definitely "add unfortunately" to the background level of
radiation in our environment here in Albuquerque. The Environmental
Impact Statement also confirms this and states there are already 8
1 other hazardous sources of radionuclide pollutants at the Kirtland
AFB/Sandia National Lab complex.

Living near the lab, I find this extremely alarming. The Albuquerque area has a high level of radioactivity from past above ground nuclear weapons tests, accidental nuclear reactor leaks, undocumented accidents with lab plutonium, and leaks into the ground.

Before a decision can be reached, there must be more discussion of
possible ill-health effect and the nuclear waste that will be
2 generated if this project is allowed to happen. SNL has no authority
for permanent storage or disposal of radioactive wastes, LLW or
spent fuel on site.

Nuclear waste will therefore be shipped through our city of
Albuquerque, and destined for Nevada. Let us discuss the
radioactive materials transportation route and identify communities
at risk from potential transport related impacts. Have there been
3 contacts made with local governments and community organizations
along those routes? Travel in or out of SNL requires transit through
residential neighborhoods along Gibson, Wyoming, Eubank Boulevards,
or, Broadway south of Rio Bravo if the Kirtland Base south exit is to
be used. Have the communities been told of this potential risk?
Have any contacts with residents or their representatives been
made?

4 The Moly 99 EIS fails to effectively implement both the spirit and letter of the Federal Executive Order on Environmental Justice and fails to recognize the diversity of the communities in close proximity to identified sites and indicates no effort to directly involve those communities in project-related planning, assessment or any form of direct dialogue or communication .

5 I call for a full EIS to be done including an assessment of toxic chemicals found in Albuquerque known to synergistically react with radioactivity and therefore weaken our resistance to other diseases.

We citizens are not ignorant of the fact that toxic chemicals are being released into our air and water with Intel releases, increased air operations at the expanded airport, and past hazardous incidents at Kirtland AFB/Sandia NL.

6 My primary concern is for the people living in the Albuquerque area, yet another reason to stop this program is that citizens tax dollars will be used to subsidize Moly 99 production. This is simply corporate welfare. SNL and the UNM School of Pharmacy plan to operate this nuclear reactor for a private firm. This publicly owned reactor would produce medical isotopes which would be sold by a private pharmaceutical supply company to hospitals. Hospitals could then charge our insurance company's a substantial price for the DOE/UNM isotopes. Taxpayers will also pick-up research and liability costs for accidents at the nuclear reactor. It is very convenient that a private company can escape liability when a government agency is involved as a partner. The start-up cost of this project is $34 million and an additional cost of $12 million per year. In this time of social program cuts, I don't feel this is the proper use of our tax dollars.

But as I have already stated, money isn't my main concern , it is the health of those of us living here.

7 The citizens of Albuquerque and Isleta Pueblo have fought against radioactivity being dumped in our sewer system. We certainly do not want radioactivity released into our air either.

A 1994 study of Bernalillo County white female breast cancer
deaths, by epidemiologist Jay M. Gould, found a 26.7% mortality
8 increase over the past 30 years. Gould says New Mexico has the
highest, 31% increase of any state in the Union. Interestingly, the
DOE chooses not to recognize the Gould research nor his conclusion.

Besides being corporate welfare, this project is great PR for the
labs. Sandia NL can now state how wonderful they are in helping the
health of citizens, while making them ill in the first place by their
continuing nuclear weapons work, the real reason for the labs
existence. We are not fooled by this PR campaign, as you bring up
medical doctors to site the needs for Moly 99. The supply from
9 Canada is not a problem, that is a false statement.

I do not want a nuclear reactor running 24 hours a day, with a
possibility of an accident occurring. The reactor in Canada has been
10 sited 150 miles away from Ottawa, while here in Albuquerque the
reactor,presently shut down, but proposed to open, is in our
backyard.

Once again, I demand a comprehensive EIS on the cumulative and
synergistic effects of possible radiation exposure combined with
the toxic releases already being emitted in Bernalillo County.

Susan Diane
Water Information
Network
PO B 4524
Alby NM
87106
255-4072

Responses to Comment Letter C045

1 The EIS is required to consider the cumulative impacts of the proposed action with other ongoing or anticipated actions at the candidate sites, and it does so in Section 5.16. With respect to radiological air quality, the proposed action plus the other activities at SNL/NM would result in a dose of 0.17 mrem to the most exposed individual. This is less than 2% of the EPA standard for radionuclide emissions from DOE facilities (10 mrem/year).

If the proposed action were implemented, the collective dose to the population within 50 miles of SNL/NM would increase by less than 0.01% compared to that from background radiation. This small increase from normal operation of the isotope production facilities, or from any reasonably foreseeable accidents, would not be expected to measurably increase the risk of cancer fatality experienced by the 610,000 residents living in the vicinity of the laboratory.

2 SNL/NM and ORNL do not have the capability of "cradle to grave" waste management and will require low-level waste be shipped to the Nevada Test Site. As discussed in Section 5.14 of the EIS, the quantities of waste generated from production of Mo-99 are small and thus would dovetail into each sites' established waste management programs with little impact. All alternatives considered have sufficient onsite spent nuclear fuel (SNF) storage capabilities to operate at 100% U.S. demand for at least 5 years. Analysis in the SNF Programmatic EIS (SNF PEIS) has shown that there will be minimal impacts from such interim storage. Long-term disposition of SNF will be in accordance with the Department's decision for the SNF PEIS.

3 Any shipments of radioactive material that might occur as a result of DOE implementing the Medical Isotopes Production Project at SNL/NM would be conducted in accordance with Federal and state standards for transportation of radioactive materials. Transportation routes would be chosen according to established guidelines to minimize risk to workers and the population along the corridor. Appropriate planning for routing of these shipments and contingencies for emergency response in cooperation with state, local and tribal governments would be in place prior to removing these materials from the SNL/NM site.

4 The purpose of Section 5.21 is to identify the potential for disproportionately high and adverse effects on minority and low income communities. Census blocks generally follow recognizable groups of residences within existing urban boundaries and recognizable boundaries in rural areas. For purposes of estimating impacts on humans from environmental contamination, distance and direction from the source of contamination are the factors that matter. Thus, populations were examined based on distance and direction out to a radius of 80 km (50 miles) to take in all of the area most likely to be affected by an airborne release at each site. In examining the locations of low-income and minority households, Section 5.21 indicates that under some adverse atmospheric conditions, low-income and minority households could be disproportionately affected in a worst-case accidental release, although the effect in each case is expected to be minimal. However, under prevailing atmospheric conditions, higher income, non-minority populations would be most affected.

The Department has attempted to actively involve and respond to the public in the NEPA process for the proposed Medical Isotopes Production Project through the public scoping meetings, public comment period, and public hearings held during preparation of the EIS. The Department's public involvement efforts for the proposed project are discussed in Section 1.4. An analysis of environmental justice considerations is provided in Section 5.21.

5 The EIS identifies the anticipated impacts from the proposed Mo-99 project at each of the alternative sites. Additionally, it evaluates the cumulative impacts at each alternative site from the proposed project.

6 The Department has proposed the Medical Isotopes Production Project to ensure that a reliable supply of Mo-99 is available to the U.S. medical community. If the Department decides to pursue this project, the Mo-99 would be sold at prevailing world market rates. DOE does not intend to artificially lower the cost paid by pharmaceutical companies for Mo-99 and would thus not artificially increase the profits realized by these companies on sales of Mo-99. Therefore, the Department believes that it would be incorrect to label isotope production by the Department as a subsidy to private industry or "corporate welfare."

If the decision is made to pursue this project, the Department would act as a backup to the existing Canadian supplier. The Department would operate its facilities to produce only as much Mo-99 as is necessary to maintain the capabilities of the facility and staff to produce 100% of U.S. demand in response to an interruption of the existing supply. In essence, the project would act as an "insurance policy" for the U.S. against a Mo-99 supply shortage. The goal of the proposed project is to ensure that a supply of Mo-99 is readily available to the U.S. medical community.

As stated in the EIS, DOE supports the production of Mo-99 by private industry. If a private company begins reliably producing Mo-99 in the U.S., DOE will phase out its production of Mo-99.

7 The potential impacts of radioactive releases from the proposed Medical Isotopes Production Project, which are analyzed in Section 5, would be unlikely to result in any health effects to the surrounding population.

8 The implication that New Mexico has higher rates of breast or other cancers than other areas appears to be unfounded. In fact, the total cancer death rates in New Mexico are lower than all but two other states. Both the overall cancer rates and breast cancer deaths in New Mexico are well below the national average, and they are also lower than those of either Idaho or Tennessee (the other two potentially affected states in the EIS alternatives).

Reference: American Cancer Society, 1994. "Cancer Facts and Figures 1994," American Cancer Society, Atlanta, Georgia.

9 The problem with the Mo-99 supply situation is not that the supply is from Canada (or from any other foreign country, for that matter). The problem is that the entire U.S. supply comes from a single source. It should also be noted that this single source accounts for about 85% of the world supply of Mo-99. If this source were to become unavailable, production facilities in other countries would most likely focus on meeting their own needs first and, in any case, would not be able to meet even half of U.S. demand for Mo-99. Given this supply situation, the Department has proposed establishing a domestic production source to ensure that a reliable supply of Mo-99 is available to the U.S. medical community.

10 Comment noted. However, the reactor in Albuquerque is not shut down, but is currently operational.

Kenneth D. Dobbin
1843 Blue Heron
West Richland, WA. 99353

February 8, 1996

Mr. Wade Carroll
EIS Project Manager
Office of Nuclear Energy, Science
and Technology (NE-70)
U. S. Department of Energy
19901 Germantown Road
Germantown, Maryland 20874-1290

Dear Sir:

The "Medical Isotopes Production Project: Molybdenum-99 and Related Isotopes Draft Environmental Impact Statement" (EIS) is seriously flawed in three areas, which I must bring to your attention. This EIS does not adequately consider a single-point failure, does not provide a realistic analysis of the continuous production requirement, and does not adequately investigate less expensive alternatives.

Selection of only one alternative leaves no backup when a catastrophic
failure occurs. The EIS states that the Canadian supply will be shut down
near the end of the century with no certainty of replacement and that
European suppliers are too far away and cannot produce adequate
quantities. Therefore, two domestic reactors must be considered to assure a
1 supply of Mo-99.

None of alternatives alone, when closely scrutinized, can satisfy the continuous production requirement, that reactor outages will be less than six days. The only way to satisfy that requirement is to have two reactors, also satisfying the first concern, mentioned above.

The EIS dismissed, prematurely, the lowest cost option. The Fast Flux Test
Facility (FFTF), located in Washington State, is being considered to produce
tritium. The tritium mission would in essence pay for the reactor that could
provide low cost Mo-99 simultaneously. These missions are complimentary
2 and provide a synergism that the EIS ignored. The FFTF is the newest and
safest of all the Department of Energy (DOE) reactors and has 22-30 years of
life left. Analyses show that the FFTF is the cheapest source of tritium that
will pass the scrutiny of the public and is likely to be selected for that
mission. The FFTF should be selected as a second, low cost Mo-99 producer
that would satisfy both concerns mentioned above.

3 One additional benefit of the FFTF is that a private consortium will likely operate the facility. Advanced Nuclear and Medical Systems (ANMS) has given the DOE a proposal to privatize the FFTF. This would satisfy the DOE's long-term goal, stated in the EIS summary, of private sector domestic production of Mo-99.

Please consider repairing these flaws before the final EIS is issued.

Sincerely,

Kenneth D Dobbin

Kenneth D. Dobbin

cc: Senator Slade Gorton
Senator Patty Murray
Congressman Doc Hastings

Responses to Comment Letter C046

1 The Department is not proposing to replace the Canadian reactor. Instead, the Department is proposing to establish a backup to the Canadian reactor. If the DOE decides to pursue this project, it will operate its Mo-99 facilities at full production capability only in the event of a Mo-99 supply shortage. Each of the alternative reactors has the capability to keep reactor outages to less than six days.

At this time, it appears that the Canadians will ultimately build two new reactors for Mo-99 production. If it becomes apparent that the Canadians are going to be unable to build even one new production reactor, DOE will assess the world supply situation at that point and may investigate the possibility of establishing further production capability.

2 The Department is conducting a study of the viability of the Fast Flux Test Facility (FFTF) for tritium production, but no decision has been made. The FFTF cannot produce 100% of the U.S. demand for Mo-99 on a continuous basis for the reasons cited in Section 3.4 and therefore has been dismissed from consideration for this project.

Regarding the issue of FFTF as a backup source of Mo-99, the Department is proposing to establish a backup to the existing Canadian supplier and would not desire to establish backup to this backup.

3 As discussed in Section 3.4, the FFTF cannot meet the selection criteria for a Mo-99 production facility. If the FFTF is restarted in response to the proposal from Advanced Nuclear and Medical Systems (ANMS), the private consortium may wish to produce Mo-99 in FFTF. In such case, DOE would review its Mo-99 production plans and modify them if appropriate, recognizing that FFTF cannot provide a continuous supply of Mo-99.

HEALTH PHYSICS SOCIETY

[illegible]
[illegible]
[illegible]
WILLIAM A. MILLS
[illegible]
[illegible] MD [illegible]
Telephone: (301) [illegible]
FAX: (301) [illegible]
[illegible]

2 February 1996

Mr. Wade Carroll
EIS Project Manager
NE-70
U. S. Department of Energy
19901 Germantown Road
Germantown, MD 20874-1290

RE: Medical Isotopes Production Project

Dear Mr. Carroll:

1 The Health Physics Society strongly supports securing a reliable source of molybdenum-99 (Mo-99) in the United States.

Mo-99 is the source, by radioactive decay of technicium-99m (Tc-99m), the short-lived radionuclide of choice for tens of thousands of daily nuclear medicine procedures conducted in the United States.

The sole current source for Mo-99 is an aging, 40-year-old Canadian nuclear reactor, whose future life is limited; and there is no viable alternative available to the medical community. To assure the continued availability of Mo-99, it is essential that the United States take steps to establish its own secure domestic source. Therefore, we are most supportive of the current activity of the Congress and the Department of Energy to follow its Environmental Impact Statement with expeditious implementation of the development of the facility necessary to produce a secure supply of this uniquely valuable medical tool.

The Health Physics Society is an organization of over 6,400 scientists and other professionals who are dedicated to the safe and beneficial use of radiation.

Sincerely,

William A. Mills
President

WAM:al

Response to Comment Letter C047

1 Comment noted.

COMMENT

ON THE
U.S. DEPARTMENT OF ENERGY
DRAFT ENVIRONMENTAL IMPACT STATEMENT
FOR THE
MEDICAL ISOTOPES PRODUCTION PROJECT

PLEASE PRINT CLEARLY

NAME: withheld
STREET ADDRESS:
CITY STATE ZIP CODE:
TELEPHONE:

COMMENT: See attached

SIGNATURE:
DATE 2/2/96

Comments

Draft Environmental Impact Statement for
Medical Isotopes Production Project

In attending the afternoon session of the public meetings held in Albuquerque, NM, I felt compelled to comment on some of the comments I heard from representatives of the intervenor groups that were present.

1. The issue of the government subsidizing this program is not appropriate or applicable to an EIS. This policy issue is one for the US Congress and these people have the same access to that forum as any citizen in the US, so their continual harping on this non-environmental issue demonstrates their inability to take their baseless complaints to the correct authorities. The reason these comments should be dismissed by the DOE are:

a. If the project is undertaken by private commercial interests the ENVIRONMENTAL IMPACTS WOULD BE THE SAME. Therefore, the comment is useless for completion of the EIS. It simply does not matter whose name is on the front door, the risks, environmental issues, waste issues, etc. would be the same.

b. The Federal government subsidizes many American industries so that the products are cheaper to individuals within our society. This means that we all pay a small amount of money via taxes to enjoy some individual reduction in cost of the products such as milk, beef, tobacco, utilities, timber, railroads, home mortgages, and on and on. Therefore, the concept of government subsidies to industry and citizens is wide-spread and well accepted in the USA. If they believe this is such a problem, then the issue is MUCH BIGGER than the medical isotopes project. However, they only seem to bring it up against industries and projects they do not like. They do not seem to object to tourism, agricultural, or medical subsidies from which they personally may want to benefit.

c. The alleged amount of the subsidy (which may not even occur if the going price is high enough) is insignificant--$12 million dollars is less than a $1.00 per person, so we are not taking about a major debt issue. I think we would also like to have these medical therapies available at a cheaper cost as a society. If the private sector is left in charge--especially the current situation where one company holds a monopoly on production--the cost can become enormous. Then you guessed it--the taxpayer will subsidize the treatment at the other end through medicare, medicaid, a whole host of federal subsidy programs, and through increased cost in our private insurance (our employers will pay more too, reducing their ability to pay us more). So, the taxpayer will PAY ANYWAY, whether it is up front at production, or at the end through medical programs--especially the one these intervenors suggested--a NATIONAL HEALTH CARE SYSTEM which will cost all of us a ton of money through taxes or payroll losses. These people really do not understand economics, but even if they did, such policy issues are not relevant topics of an EIS.

d. The statement that New Mexicans will not have access to the medical benefits of this program is ludicrous. If you are poor in this state, you go to UNM hospital and receive any necessary medical treatment, including these therapies. And surprise, surprise, who pays the bill--the TAXPAYER. This false statement is aimed at flaming emotions of uneducated people. If SWOP, SWRIC, and the Physicians groups really want to help poor New Mexicans (and I hope they would *not* discriminate against those who have white skin) they should provide them with information about the services that are available instead of making false statements in public EIS meetings.

c. The physicians group is really hypocritical, in that they as a profession will certainly receive full and HIGH reimbursement for these medical therapies, mostly through government subsidy. How can they care if the subsidy occurs at the beginning or end of the process since they would never consider waiving their fees?

1 2. As to the issue of public participation--the previous EA effort and this EIS has had more public participation than any NEPA document I have seen at DOE. Just because the intervenors lie, bring up non-related issues, and use the press for their money-raising efforts, does not mean that relevant comments have not been addressed. They need an enemy to justify their existence. Their comments on lack of public participation are false and again irrelevant to approval of this document and this project. They always make this comment when they simply have no rational technical issue to bring up.

2 3. NTS has plenty of technical capability to receive the small quantities of radioactive waste this project will generate. The NIMBYs of NV create political barriers, just as they do in New Mexico, but there is certainly no technical issues related to waste disposal at the NTS site. If the intervenors object to the transportation and removal of the waste to NTS, perhaps they would support development of a disposal site in NM. It is clearly feasible and can be technically controlled quite well. In fact, it could become an incredible opportunity for New Mexico to develop high paying jobs (versus minimum wage tourism - related jobs) and economic development if we built a disposal site here and would help NM make a positive contribution to the national welfare. Capacity of offsite waste disposal sites again is not an issue for this EIS.

4. As to New Mexico dealing with the consequences of being a producer of these isotopes (dealing with the waste issues, etc.) I am a native New Mexican--born and lived in this State all of my life--and I would be very proud to have this process/facility in my state, making such an important contribution to the health care of this county and, yes, even the world, if possible. New Mexico has benefited tremendously from the DOE and national lab facilities present in this state--in fact we would probably be the 50th state in the nation for income, health care, and every other positive rating scale for life without these facilities. The benefits have far outweighed any negative consequences of having these facilities in our state. We depend entirely on the rest of the country to provide us with most of the goods and services we consume because we produce and export so little. It is time for New Mexico to begin to recognize that making a positive contribution to the country and to ourselves means using the facilities and residents of the state (all races, colors, creeds) to meet national policy objectives, including medical isotopes, radioactive waste disposal (a natural for a state with low population densities and the tremendous technical expertise available in NM), technology transfer, etc. Our assets include a large unpopulated land base, access to cutting edge research and technology, strong history in the atomic energy area, and facilities that are available for transition from nuclear bomb

research to peace time use of these materials to benefit mankind. If we/they do not agree with national policy, then we/they should go to Congress to make changes and stop harassing the Federal agencies and employees who are simply doing their best to implement the jobs assigned to them by the President and/or Congress. I object to any insinuation by these people, that NM should or even could isolate itself and survive as a separate political/economic entity. If US policies are so bad, why are so many people trying to come here to live?

3 In order to positively respond to these comments, I expect the DOE to expeditiously approve the EIS, approve the project plans for this project at the preferred and/or feasible location, and get Mo-99 into production in this country, preferably in New Mexico. There are a lot of silent citizens who would approve of this action and who do not believe or even understand the objections of the small number of minority intervenors who seem to oppose everything and never provide any positive solutions to the problems they so vocally introduce. The conclusion of the EIS is clear: THERE ARE NO SIGNIFICANT ENVIRONMENTAL IMPACTS IN THE CONSUMMATION OF THIS PROJECT AT SANDIA NATIONAL LABORATORIES.

Responses to Comment Letter C048

1 Comment noted. The Department's public involvement efforts for the proposed project are discussed in Section 1.4.

2 The commentor is correct in identifying that both the preferred alternative and the ORNL alternative would require some shipment of low-level waste to the Nevada Test Site (NTS). The NTS is preparing a site-wide environmental impact statement and has included waste generated from the proposed Medical Isotopes Production Project in the quantities and description of materials to be disposed of on the site.

3 Comment noted.

298 Call Avenue
Idaho Falls, Idaho 83402
Sunday, February 04, 1996

Mr. Wade Carroll, MIPP-EIS Document Manager
U.S. Department of Energy
Office of Isotope Production and Distribution, NE-70
19901 Germantown Road
Germantown, Maryland 20874

Subject: Comments on the Draft Environment Impact Statement
for the Medical Isotopes Production Project: Molybdenum-99 and Related Isotopes

Dear Mr. Carroll:

After reviewing the Draft Environmental Impact Statement on the production of Mo-99 and attending both of the Idaho Falls hearings on the DEIS, I have the following comments:

1 1. It was unclear from the presentation at the hearing and from the document what the criteria actually resulted in the ACRR being chosen the preferred alternative. At the hearing, when asked this question, you stated that the time to initial production of Mo-99 was the deciding factor. Certainly cost and ultimate production capacity were not the deciding factors, since the PBF is superior to the ACRR in both of these categories.

2 2. Many of us having experience in the restart of reactors would seriously challenge the estimate that the ACRR could be capable of initial production of Mo-99 within 12 months. If it is to use modified TRIGA fuel and a modified core design, then a longer time would be required for safety analyses and environmental documentation.

3 3. Defense Programs would retain the option for reclaiming the use the ACRR from the production of Mo-99 whenever it is deemed necessary for national security. This retained option on the part of Defense Programs would seems to be a great obstacle in attracting private investment to the further production of Mo-99.

4 4. The quality of the cost estimates for PBF production was questioned in the document and at the hearing. However, it was acknowledged that the correspondents at the PBF provided all data requested. In order that a fair comparison between the alternatives be made, it is vital that the cost comparisons be made in equal detail.

5 5. The use of the PBF for Mo-99 production is complementary with its use for Boron Neutron Capture Therapy (BNCT). I have contacted the group designing the BNCT treatment procedures and found that the reactor could be used simultaneously for the production of Mo-99 and for BNCT treatment. The simultaneous use of the reactor for these two purposes is an attribute that none of the other alternatives possess.

I agree with the DEIS in that it indicates that there are no significant environmental reasons for choosing one option (e.g. the ACRR) over another (e.g. PBF).

6 Because of the cost advantages for the PBF as shown in the DEIS and because of the possibility for simultaneous Mo-99 production and BNCT treatment in the PBF, I think that it is imperative that the designation of the ACRR as the preferred alternative be reconsidered.

Sincerely yours,

J. Stephen Herring

Responses to Comment Letter C049

1 The Annular Core Research Reactor/Hot Cell Facility (ACRR/HCF) combination at SNL/NM is the preferred alternative for target irradiation and processing for the reasons stated in Section 3.3.1.1.

2 The ACRR is currently operational and, if selected for the project, would run for a period of time using its current fuel. The target to be irradiated can be placed in a vacant fuel location if the central core modifications are not complete, thereby completely obviating the need to modify the reactor for this low-level production period. The current hot cells would be modified to be capable of processing a limited number of targets. This can be completed within six months to a year.

Routine production would require the full reactor modifications, including completion of all the safety analysis submittal and completion of an operational readiness evaluation. This would require the full 28 months to complete.

3 It is possible that the ACRR, the preferred reactor for the proposed project, could be diverted to support defense missions in case of a national emergency. However, the Department has determined that the probability of needing the ACRR for defense purposes is sufficiently low to preclude disqualifying the reactor from consideration. This low probability need is not believed to significantly reduce the preferred alternative's potential for privatization.

4 The Department has used the best available information for all of its analyses and comparisons, including the cost information. Information on restart of the Power Burst Facility (PBF) was fairly thorough and was probably a result of the efforts to estimate costs and schedules for conversion of the PBF for boron neutron capture therapy (BNCT). However, reactor conversion and operation is only a portion of the cost and schedule information requested. Hot cell modification, process line fabrication, target fabrication facility modification, and general processing operational costs also are reflected in Section 5.22 of the EIS. Additional information on the estimated cost of the INEL alternative was obtained subsequent to the publication of the Draft EIS and was used in the preparation of the Final EIS; however, the amount of supporting material associated with these estimates was less detailed than that received from some of the other sites. Thus the Final EIS contains statements that indicate that the margin of error for both the INEL and ORNL estimates are considered larger than those for LANL and SNL/NM.

5 The Idaho Brain Tumor Center (IBTC) has informed DOE of its interest in coordinating its efforts with those of DOE; however, IBTC has not submitted any plans for coordinating reactor conversion activities, nor has it made a formal proposal to DOE. In addition, the Department understands that IBTC is investigating the possibility of using other facilities for BNCT and that other reactors under consideration for this project may be usable for BNCT. If the Department decides to proceed with a production alternative for this proposed project, it would welcome a proposal from IBTC for dual use of the reactor facility selected.

6 Comment noted.

Dear Mr. Carroll,

About ten years ago my Mother was diagnosed with having rectal cancer. At that time a treatment facility was not available around the Idaho Falls area, therefore leaving her no alternative but to have the treatments administered in Salt Lake City, Utah which was the closest facility at that time.

Her treatment consisted of double doses of radiation and chemo-therapy over a seven week period. She became very ill and required constant care and bed rest, therefore requiring that she remain in a facility in Salt Lake City. There was no option for coming home for periods of time and then returning for her treatments, she had to stay there virtually alone for the entire seven week period.

There were times when family members could stay with her for a few days, however with all of us working and having commitments to our own families we could not be with her as much as was needed because of the location. She had to depend on a nurse at the facility, a complete stranger, to tend to her needs, this was very uncomfortable for her and us. This was a devastating experience for the entire family. At a time when my Mother needed her family so desperately we were unable to help her.

If there had been a treatment facility closer to Idaho Falls my Mother would not have been alone during that frightening time when she needed so very much to be at home. We could have been there to help and give her support through a potentially life threatening experience. I pray to God this never happens again.

1 It is my opinion that having a treatment facility at the INEL is an absolute necessity. There are many people who could benefit from this life saving service. If one life is saved, if a family can be there to help and support their loved one and if that person can remain in their own home after each treatment, these are the strongest justifications needed for this type of facility. It is so very important to have your family with you during a time of such uncertainty, sickness and fear, everyone deserves that right!

Yours truly,

Debby S. Christensen
CRC Idaho Inc.

Response to Comment Letter C050

1 The EIS evaluates the potential impacts of the proposed Medical Isotopes Production Project at various alternatives including the INEL. Possible treatment facilities that might operate concurrently yet independently of the Mo-99 mission (such as boron neutron capture therapy) are not part of the Department's proposed action or stated purpose and need.

b.l.a.s.t.

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Feburary 1, 1996
Arroyo Hondo, NM

Howdy Folks,
These are comments on your Medical Isotopes Production Project:
Molybdenum-99 and Related Isotopes Draft EIS DOE/EIS 0240D

Section 6.0 Regulatory Framework mentions Floodplains and Whetlands,
and we want to know how many acres of wetlands and floodplain will
be impacted 1. in construction, 2. by aperation, 3. by runoff, 4.
by catching downwind contamination, 5. by waste storage and 6. by
1 transpostation. This same list of questions should also be applied
to lands protected by Native American, Archaeologival, and Historic
Preservations Laws;as well as habitat protected by the Endangered
Species Act, Migratory Bird Treaty and Protection Eagle Act.
Under each alternative, that is, of course.
(And at each location.)

Obviously the optomistic title of Table B-8 is true that if and
when there is Routine or Incident-free Transportation, which must
mean accident-free, there will be no fatalities, but then there are
2 daysand there are accidents. All the technically disinformation on
potential for serious accidents mirrors the delusion represented by
so many Environmental Impact Statements. Can the preparers and the
decission makers be sued by the victims of any such improbable act?

True Fiction seems to be thegenre of the need and purpose segments, too.
With downsizing the governmnt and privitazation, one must remember
that credibility counts! If there were truely a need would private
industry not leap at the opportunity? Is not this another plot to
keep great funds into DOE budget accounts? Why does it seem like
3 a good excuse to keep Y-12 live and kicken? How will the end products
be marketed? Does DOE have other cottage industries? Please name
and explain how the other DOE owned interstate commerice opperations
work and for whom? Both Y-12 and LANL's CMR buildings should be
sealed in cement and used as monuments to the trillions of our
national resources dumped into destruction.Probably the other sites
you intend to use come under the previous comment, but i don't
know.

Since LANL is under contract with the University of California,
and may continue under their management or other, but the Oak
4 Ridge and ~~Hanford~~ (*) plants have other managers... How will management
operations and revenue of this business enterprise work?

(*) Oops, that's INEL & NTS

Technology changes so quickly and we kneed to know wheather this one
might be outdated before it earns back the taxpayers investment?
How long will it take to earn back that investment. We do presume
that this will be a fundraiser for the coffers acording to
your best possible spin on the scam? Do you have detailed prog-
5 nostications on the financial future? Economic impots should
include supples plus transportation plus waste management plus
overhad and should exceed projected income enough to pay off the
construction costs. As well as the common interpretation of the
impact on the local communities.

We currently have on hand an EA for Proposed CMR Building Upgrades.
If this prpopsed alternative is approved, will it upset or alter
the CMR Proposal? How do these two parallel documents intermesh,
6 or do they? Were they not planned to compliment each other or
is this one an excuse to support that one since the CMR Bldg. is
seriously outdated and dangerous?

With the cold war's mythological end, of course it is an improvement
to see DOE moving toward public health projects. We thought, perhaps
there are other people in DOE now doing research to find new
technology to replace radioisotope methods. Often with health things,
7 the public pays for government research and development and some
private company makes the big profits. But, is there not some
kind of new lasar immaging in the works? How many years will be until
a new mode and method will replace radioisotopes? And, how big a
gamble is it to put such a large investment into an antiquated and
contaminated facility?

We want to know how the implementation of this program will impact
the Reconfiguration PEIS, the Waste Management PEIS, the Site I
Wide PEIS for each Lab involved, the CMR Upgrade, and each and all
8 other studies and plans which will be altered to accomodate it?
Will any of these studies need to be ammended? If so which ones
and please include all details in the final EIS.

Pollution problems must be thoroughly addressed too! Safe disposal
of both waste and the used isotopes need clear definition and
plan beyond the waste produced by the operation of the program.
9 If you are going to but these toxins into medical communities all
over the country, you must help plan for safe and secure disposal
of them too. Do you have any plans to recycle the used targets?
Are any such disposal programs now being used under the super-
vision of your department?

We love you, and we love our earth home
and all her prescious creatures,
In light and peace,

bonnie bonneau

ditto nowakoski

Responses to Comment Letter C051

1 The total area disturbed by proposed additions or modifications to any facility at the alternative sites would be much less than 1 acre (see Section 5.2). All activities described in the EIS would utilize existing facilities or would occur in previously developed areas at these sites. None of these activities would occur in areas designated as wetlands or floodplains, nor would they occur in locations or facilities that have been identified as having resources of ecological, historical, archeological, or cultural significance. If such resources were discovered during the course of implementing the project, activities would cease and appropriate agencies would be consulted to ensure that their ecological, historical, archeological, or cultural value would be preserved.

Likewise, routine operations, waste management, and transportation would involve only existing or currently planned facilities and infrastructure at the alternative sites. Therefore, no impacts on sensitive ecological habitats or on historical, archeological, or cultural resources would be anticipated. Environmental contamination resulting from medical isotope production activities would be minimal and would comply with all applicable regulations governing facility operation, transportation, and waste management to ensure protection of the public and the environment.

2 The fatalities referred to in Table B-8 result from vehicle emissions that would occur even in the absence of any accidents (see the text of Section B.1.2.2). Some of these impacts would occur even in the absence of the need to transport medical isotopes (scheduled air carrier activity, for example). The transportation accident analysis ~~used~~ region-specific statistics for traffic and aircraft incidents, as well as the probability of harm to the public from such incidents, and they represent the best information currently available on the risks of such events.

The risks, as well as the benefits, to the public associated with transporting medical isotopes will be taken into account by DOE in its final decision on whether to implement the project, and at which site, if any, it should be located. The possibility of legal action and the probability of such an action by a member of the public would certainly depend on the circumstances of the event and are not within the scope of environmental impacts considered in this EIS.

3 The Department would prefer that the private sector assume responsibility for ensuring that a reliable supply of Mo-99 is available to the U.S. medical community; however, private industry has thus far been unwilling to do so. Therefore, DOE has proposed to conduct the Medical Isotopes Production Project. If private industry is able to ensure a reliable supply of Mo-99 on its own, the Department would phase out its production activities.

One of the charters of the Department of Energy is to produce and make available radioactive isotopes for medical and scientific purposes utilizing the Department's extensive scientific and technical capabilities and facilities. At present, the U.S. is totally dependent on foreign sources of Mo-99, the radioactive parent of the important medical isotope Tc-99m. A prolonged interruption in Mo-99 supply would make it impossible to conduct the more than 30 different types of diagnostic examinations that rely on Tc-99m-based radiopharmaceuticals. These examinations are conducted about 36,000 times each day in the U.S. and include bone and liver scans for cancer detection, kidney function tests, brain scans, and a variety of other clinical tests. The inability to conduct these diagnostic procedures could seriously impact the health and well-being of U.S. citizens in need of these diagnostic procedures. In addition, the practice of nuclear medicine represents a sizeable part of the U.S. health care industry. Thousands of jobs could be jeopardized by an interruption in the supply of Mo-99.

The importance of the supply of Mo-99 to the U.S. medical community was highlighted by a position statement submitted to the Department of Energy by the Society of Nuclear Medicine and the American College of Nuclear Physicians. These organizations stated, "it is particularly urgent that the U.S. Government work to establish a reliable, uninterrupted supply of Mo-99 as the source of Tc-99m, the main radioactive isotope used in diagnostic nuclear medicine." The petition further stated, "the United States cannot remain vulnerable to foreign crisis and inadequate backup supplies."

The Department has proposed the Medical Isotopes Production Project to ensure that a reliable supply of Mo-99 is available to the U.S. medical community. If the Department decides to pursue this project, the Mo-99 produced would be sold at prevailing world market rates. DOE does not intend to artificially lower the cost paid by pharmaceutical companies for Mo-99 and would thus not artificially increase the profits realized by these companies on sales of Mo-99. Therefore, it would be incorrect to label isotope production by the Department as a subsidy to private industry or "corporate welfare."

If the decision is made to pursue this project, the Department would act as a backup to the existing Canadian supplier. The Department would operate its facilities to produce only as much Mo-99 as is necessary to maintain the capabilities of the facility and staff to produce 100% of U.S. demand in response to an interruption of the existing supply. In essence, the project would act as an "insurance policy" for the U.S. against a Mo-99 supply shortage. The goal of the proposed project is to ensure that a supply of Mo-99 is readily available to the U.S. medical community.

The Mo-99 and related medical isotopes would be marketed through the Department's Isotope Production and Distribution Program and would be sold to intermediaries (e.g., radiopharmaceutical companies) or end users as appropriate.

4 The ORNL and the INEL are managed and operated for the Department by Lockheed-Martin Incorporated. The Nevada Test Site is managed and operated for the Department by Bechtel Corporation. If the Department decides to pursue this project, the management and operating contractor at each involved site will conduct the actual production operations (including waste management), and the Department will fund and oversee the contractor activities.

Revenues generated from the sale of medical isotopes would be realized by the Department's Isotope Production and Distribution program, which would use the funds to offset the operating costs of the medical isotope production facilities.

5 If the Department decides to pursue this project, the amount of revenue generated by the proposed project would depend on both the quantity of isotopes sold and the market price of those isotopes. Compatible projects may also be found that could use the capability of the production facilities and thereby help offset costs. Based solely on Mo-99 production, a facility would have to sell in the range of 30% to 40% of the U.S. demand for Mo-99 to cover annual operating costs. If less Mo-99 is sold, DOE will provide funding to maintain operations at the minimum required level. Current projections are that the Mo-99 market will grow at a rate of 5% to 10% per year for the foreseeable future.

The socioeconomic impacts of the proposed project are discussed in Section 5.3 of the EIS.

6 As discussed in Section 1.6, the two documents are not interdependent and were not planned to either complement or support each other. The upgrades to the Chemistry and Metallurgy Research facility are independent of the Mo-99 production process.

7 The Department has considered a variety of non-reactor-based sources for substitutes to Tc-99m. However, none of these potential options are either mature enough technologies or could become readily available in the near term. Initiation of the Department's proposed action is not intended to discourage or deter continued development of new long-term options for production of Mo-99 or alternative technologies to the use of Tc-99m.

8 Section 1.6 of the EIS describes the relationship of the Mo-99 EIS to other DOE NEPA documents. The only document that will require modification is the Nevada Test Site (NTS) site-wide EIS. The NTS is preparing a site-wide environmental impact statement and has included waste generated from the Mo-99 mission in the quantities and description of materials to be stored on the site.

9 All of the major potential sources of pollution associated with facility operations to produce 100% of the current U.S. demand for Mo-99 have been considered in Section 5 of the EIS. Any radioactive wastes generated by the production of medical isotopes would either be disposed of at a DOE-approved facility within the generation site (in the LANL or INEL alternatives) or shipped to an offsite DOE-approved facility (in the SNL/NM and ORNL alternatives). The impacts of waste disposal would be evaluated by a risk analysis for the ultimate disposal facility, in conjunction with other wastes to be managed at the location. Because the medical isotope waste would be a relatively small fraction of the waste disposed at any site, the consequences of such disposal would likely be small by comparison to the total or to any regulatory standard.

The small quantities of radioactive waste generated by the end users (hospitals and medical clinics) would be disposed of according to the arrangements currently in place by those users. It should be emphasized that these users are currently receiving and using Tc-99m generators in their operations and that under the actions proposed in the EIS, only the source of the isotope could change. The types and quantities of isotopes used in medical procedures by these institutions would remain the same as their current practices under any alternative, unless the current Canadian supplier ceased production and no backup supply were available.

Management of radioactive material by commercial institutions, including the pharmaceutical manufacturers, medical isotope end users, and commercial radioactive waste disposal facilities, is regulated by the Nuclear Regulatory Commission (NRC). The end users typically return spent Tc-99m generators to the pharmaceutical manufacturers, where the nonradioactive components are recycled. The activity level of the residual radioactive material remaining in the generators would be very low because the Tc-99m rapidly decays to Tc-99, which has a long radioactive half-life (216,000 years) and thus a low activity level. This waste would be disposed of, along with other radioactive wastes generated by the pharmaceutical companies, in an NRC-licensed radioactive waste facility. Any NRC-licensed commercial radioactive waste disposal facility must undergo a NEPA review similar to this EIS before construction, and it must meet all NRC standards for licensing, operation, and decommissioning of the facility during its life cycle.

At present, the stainless steel target shells would not be recycled unless new technology developments made it practical or possible to do so. Activation of the stainless steel during irradiation in the reactor would make the material difficult to handle without incurring excessive worker exposure. These shells would be compacted to the extent possible at each particular site and ultimately disposed of as radioactive waste. The enriched uranium target could be recycled from the process waste stream using a procedure developed by DOE, and such recycling would occur under at least one of the EIS alternatives.

85 Claymore Lane
Oak Ridge, TN 37830
February 7, 1996

To: Mr. Wade Carroll, EIS Project Manager
US DOE, NE-70, 19901 Germantown Rd.
Germantown, MD 20874-1290

From: Barbara A. Walton (423) 482-5652

Subject: Draft Environmental Impact Statement (EIS), Medical Isotopes Production Project: Molybdenum-99 and Related Isotopes, December 1995

I commend the DOE for its responsiveness to the scoping meeting held in July and for getting the subject document to me by the start of the public comment period, so I could read it prior to the public meeting held January 25, 1996.

My review of the subject document reveals several deficiencies:

1. The month of January is missing from Tables D-2, D-3 and D-4.

1 2. On page 4.57, the first sentence of section 4.3.7 is completely wrong; the reference, Culp, concerns Sandia not Oak Ridge.

2 3. The availability factor was given near the bottom of page 3.41 for the Oak Ridge Research Reactor; it should also be given for the other alternatives. This is especially of interest for all alternatives that require modification; the outage duration should also be given for these cases.

3 4. Costs for the INEL reactor core modification (see top of p. 5.101) should be included as well as costs for expansion of spent nuclear fuel storage from 300 to 1000 elements for SNL/NM-ACRR.

4 5. Uncertainties about costs should be bounded if possible; these should also include factors such as lack of experience and the use of burst reactors in steady state.

5 6. The schedule given on Table 3-2 should also indicate the level of production (as % of US demand) for those timeframes of less than full production.

6 7. The impact of any DOD use of the ACRR (p. 3.26) on meeting DOE goals should be more completely addressed.

7 8. The time required for FDA licensing should be included in the schedules.

I am very concerned that this document puts forward a preferred alternative, which is the most
8 expensive of the four capable of meeting the DOE goal as stated on p v. This is not justified by
environmental consequences (p. xii), schedule, or technology, as presented in this document. The
Oak Ridge alternative is best suited on the basis of being designed to do this type of production
9 with all the needed facilities in close proximity and a reactor designed to operate in a continuous
mode (compare resources required for modification, Table 5-47). Costs should be computed on a
life-cycle basis and Section 5.22 expanded. At a time when the government is cutting back on
10 many fronts and trying to balance the federal budget, it is imperative to give a greater emphasis to
costs in the decision making process.

Barbara A. Walton

Responses to Comment Letter C052

1 Data for the month of January were not available; however, the EIS has been changed to reflect the correct reference as indicated in the commentor's second comment (see Section 4.3.7).

2 Because of the differences in design and mission, availability factors cannot be directly compared. For instance, both the Power Burst Facility (PBF) and the Annular Core Research Reactor (ACRR) were designed as burst experimental facilities. Significant periods of time (weeks, perhaps months) are required to develop and install a given experiment. During this development and modification/installation period, the facility is not available, nor is it needed, for operation. This would lead to both a poor availability factor and capacity factor, even if the facility had a perfect operating record with no unplanned shutdowns.

Outage durations also cannot be directly compared. Again, a facility whose mission is routine weekly operation with a 1-day refueling cannot be fairly compared to facilities whose mission is to develop, install, and conduct complex experiments requiring weeks of down time.

For these reasons, the durations were not given for other facilities. However, the EIS does mention in Section 3.3.2.4 that the Omega West Reactor had a forced outage rate of less than 2%. Both this and the availability factor of the Oak Ridge Research Reactor were salient attributes regarding the quality and reliability of the facilities.

3 The costs of the INEL reactor core modifications were not available at the time the Draft EIS was issued, but have now been included in Section 5.22 of the Final EIS.

The cost of upgrading the SNL/NM storage pool was not included in the estimate because in a backup role until Maple I and II are constructed, 300 bundles would easily serve as adequate spent fuel storage. It can store the fuel from 6 years of full production operation. The DOE objective is not to engage in full production and compete with the Canadian supplier, but rather to fill in the gap if the Canadian supplier fails for some reason.

4 The Department described the estimated costs and schedules in Section 5.22 of the EIS. The figures provided are based upon the best available data; where the uncertainty of the numbers was considered to be greater than for the other alternatives, the EIS notes it.

Factors such as operational history are mentioned in the EIS. Two of the reactors considered have operated in "burst" mode. The ACRR has operated in this mode for most of its operational history. The PBF reactor also has operated in burst mode for much of its history, but has operated successfully at steady state for extended periods of time.

5 During the startup periods, it is anticipated that only enough targets will be irradiated and processed to demonstrate to the Food and Drug Administration the capability of the facilities to produce Mo-99 consistently. This could be as few as a target every few weeks. The objective would be to have the capability of continuously producing approximately 10% of U.S. Mo-99 demand during this period, with an emergency supply capability of approximately 30% of the U.S. demand for Mo-99. There is no interest in a move to full production as long as the Nordion supply is stable.

6 ACRR is an Office of Defense Programs facility within DOE. The possible diversion of the ACRR for defense use is highlighted in the EIS because in an emergency, the ACRR is more likely than the other reactors considered in the EIS to be used for defense purposes. However, the DOE has determined that the probability of needing the ACRR for defense purposes is sufficiently low to preclude disqualifying the reactor from consideration.

7 The schedules presented in the EIS include the anticipated FDA approval times.

8 The ACRR/Hot Cell Facility combination at SNL/NM is the preferred alternative for target irradiation and processing for reasons stated in Section 3.3.1.1.

9 In the EIS, the Department has evaluated factors such as resources required for modification (Section 5.13) and compatibility of facilities with the proposed project (in Section 3.3).

10 The costs for the modification of facilities and facility operations are presented in Table 5-1 and Table 5-52. An analysis of these costs and the projected revenues specific to this proposed project will be evaluated for each alternative as information for the Record of Decision process. Since each alternative proposes the use of existing facilities and the Department is already responsible for facility-related costs, such as facility decommissioning, an incremental cost analysis (rather than a life-cycle cost analysis) was considered appropriate information for the decision-making process for the proposed project.

COMMENT

ON THE
U.S. DEPARTMENT OF ENERGY
DRAFT ENVIRONMENTAL IMPACT STATEMENT
FOR THE
MEDICAL ISOTOPES PRODUCTION PROJECT

PLEASE PRINT CLEARLY

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CITY ALBUQUERQUE STATE NEW MEXICO ZIP CODE 87111
TELEPHONE: (505)275-6145

COMMENT:

Formal Comments on draft Environmental Impact Statement titled: Medical Isotope Production Project: Molybdenum-99 and Related Isotopes

1 - No where is there input from the Canadian government or from the Canadian company currently manufacturing Moly 99 that states "they" are dropping out of Moly 99 Production in Year 2000. If those letters exist then they must be in the EIS. The whole premise of this EIS is that Canada and its company want out--if they don't then stop this effort!

2 - Page XI, Table S-1, "Alternatives considered But Dismissed". Some alternatives are dismissed primarily due to "not meeting near term goals for Moly 99 production". This appears self-serving for Sandia Labs particularly if Canada and its company hasn't provided written confirmation of dropping out of Moly 99 Production in Year 2000. 3 You must really address in the EIS why "near term goals are needed", what they really mean to users of Moly 99 and allow the private business sector to provide individual input to EIS.

4 - Page B.21 - "Integrated population risk assessment B.1.3.1 statement", and Para 4, states "accidents on the road are difficult to eliminate" and "only a relatively small fraction of accidents involve conditions that are severe enough to result in a release of radioactive materials" and Page B-22 accident frequency - states - "the conditional probabilities of encountering accident conditions in each severity category were taken from a NRC document (Fischer et al, 1987". This EIS must include real data on nuclear shipments via air, vehicle, river and rail in the US. Moly 99 is going to be distributed everywhere and the distribution system one is set from Canada and started prior to EIS(s) being required. Utilizing data from

SIGNATURE David Tracy
DATE 6Feb96

4 the Fischer 1987 study, which is almost 10 years out of date, seems questionable. The world has changed, nuclear transportation technologies changed, laws and rules changed, needs changed and technology conditions have changed dramatically. Based on this, you must add and update transportation data and utilizing up-to-date severity categories or do a separate EIS.

5 - At no time does this EIS address the new use of 11 million gallons of water required from rare water resources below Albuquerque and Kirtland. This EIS should contain input from both entities as to what the loss of 11 million gallons a year means to them. Also, this EIS should address how much water will be returned, in what condition, and how. this is a real environmental concern and must be addressed. The paragraphs in page 4.11 to 4-13, 5.9 don't even attempt to address this issue--just quality and barely.

6 - Page XXXV "Acronyms and Abbreviations" and pages XVII to XXV "Contents" don't address a real critical issue that of NAFTA. Even para 4.1.3 "Social Economic Environment" don't address this critical and political treaty. Canada is one of the signatory countries and this is taking business away from them and permitting US Government (DOE) and its contractor (SNL) to take it away from Canada and (its private company). You MUST address this issue as NAFTA concerns government -vs- private enterprise and government investment into private enterprise. Insist you get the Department of Commerce (DOC) provide a letter to include in the EIS that states this proposal doesn't violate NAFTA. Also, request you include a paragraph in 6.0 "Regulatory Framework" on NAFTA compliance.

7 - Insist that you definitely describe the safety/transportation/public health plans for the selected Sandia National Labs alternative - provide real draft plans to include starting out at Sandia Labs level then Albuquerque level then New Mexico level and then nationwide. This is a totally new distribution system and must be included in the EIS.

8 - Insist you add a paragraph on water management in chapter 6.0 "Regulatory management". It should thoroughly address removal of water from the Albuquerque and Kirtland aquifer, waste water return and cite the regulatory documents utilized.

9 - concerning "near term goals for Moly 99 production" in Table S-1, Page XI - insist you include in EIS what the goals are, why, and their impact on private sector, US Government and NAFTA.

10 - Reference. Page IV "Who has Produced Molybdenum-99" and "How Molybdenum-99 is produced". If Oakridge stopped producing Moly 99 in deference to US commercial sources in 1966, which is a good reason, then has DOE offered to share the Lintichen Process (which it owns) with US industry? Insist you explain why in EIS and if not why not? Who has DOE offered it to in US business community? When? and Why they refused. Also insist that EIS "fully"explain all the accepted Processes to produce Moly 99? Who has them? Rank order the processes. This issue is totally unexplained technically, economically and commercially.

Responses to Comment Letter C053

1 The Department has not received, nor does it expect to receive, written notice from Nordion International or the Canadian government stating that they may not be a reliable supplier of Mo-99 in the future. (See letter from Nordion International-C068.)

The Department has proposed to establish a backup capability in case the Canadian supply becomes unavailable. It should be noted that the entire U.S. supply and about 85% of the world supply of Mo-99 comes from this single Canadian source. If this source were to become unavailable, production facilities in other countries would most likely focus on meeting their own needs first and, in any case, would not be able to meet even half of U.S. demand for Mo-99. Therefore, the Department has proposed to establish a domestic production source to ensure that a reliable supply of Mo-99 is available to the U.S. medical community.

2 As stated above, the U.S. is entirely dependent on a single reactor in Canada for its entire supply of Mo-99. It is this near term "window of vulnerability" to which the Department proposes to respond. Therefore, options that could not provide the capability to produce 100% of the U.S. demand in the next few years were not considered in detail. SNL/NM was not responsible for making this decision.

3 The need for a near-term backup supply of Mo-99 is addressed above. The private sector, including isotope producers, distributors, and users, has been given an opportunity to comment on the proposed action and the Draft EIS.

4 Based upon the lack of changes to cask design or shielding requirements since the Fischer et al. (1987) document and analyses, the Department determined that use of this reference is appropriate.

5 The total water use from operation of the Annular Core Research Reactor at SNL/NM would increase from the current average of 5000 gal/day to 29,000 gal/day, compared to total water use at SNL/NM of 1,000,000 gal/day (Section 4.1.13) or total water use in the Albuquerque region of 90,000,000 gal/day. This represents less than a 3% increase in water use at SNL/NM, or 0.03% increase in water use for the region, and would not be expected to substantially impact availability or quality of water in the aquifer.

6 The problem with the Mo-99 supply situation is not that the supply is from Canada (or from any other foreign country, for that matter). The problem is that the entire U.S. supply comes from a single source. Since the Department would operate its facility as a backup to the existing Canadian supplier, the production project would not be in competition with the Canadian company and would not be in violation of the North American Free Trade Agreement.

7 The EIS is one of a series of safety, environmental, and health assessments that would be required before the medical isotopes project could proceed. After the decision is made as to whether and where to implement the project, detailed engineering designs would be prepared, and safety, security, and operational readiness reviews would be conducted before and during actual operations. In addition, any facilities and operations proposed by the project would be included in the host site's emergency preparedness plans, and each would be subjected to permitting reviews by state and Federal regulatory agencies.

The transportation analysis includes evaluation of the routine and accident consequences associated with distribution networks at each of the alternative sites. As with facility siting, preparation of detailed and specific plans for emergency response associated with transportation would be premature until the actual transportation modes and routes are identified.

8 Water use is discussed in Sections 5.13 and 5.16 in relation to the total usage at SNL/NM, and disposal and treatment of wastewater is discussed in Section 6.18, which cites the applicable regulatory standards. No routine liquid effluents other than normal sanitary waste would be expected from the project, and any liquid wastes containing radioactive or hazardous materials would be treated and solidified before being disposed of in a DOE-approved disposal facility.

9 The near-term goal, as stated in the EIS, is to provide the capability to produce 100% of the U.S. demand for Mo-99 in case of a supply shortage. DOE has also stated in the EIS that it would operate as a backup and would phase out production if the private sector begins reliably producing Mo-99, so there is no anticipated impact on private industry or the North American Free Trade Agreement.

10 When Cintichem Corp. decided to withdraw from the Mo-99 production and supply market, it advertised the availability of the rights to the Cintichem process. Cintichem received no interest from the U.S. private sector. Since DOE has had the rights to the process, it has not formally offered the Cintichem process to private industry, but industry is aware that the Department has it and would be willing to license it to private industry. To date, industry has not been interested because the process requires the fission of uranium in a nuclear reactor and, at current market rates for Mo-99, industry would not be able to operate a privately owned reactor and sell Mo-99 at a profit.

There are currently only two FDA-approved processes for producing Mo-99 for use in the U.S. They are the AECL/Nordion process and the Cintichem process. Both are capable of producing quality product. The principal drawback of the Nordion process is the relative quantity of liquid waste produced. The Cintichem process is discussed in Section 3.1.2 and Appendix A of the EIS. The Nordion process is proprietary, so the details of the process are not available to the Department.

3136 Sandstone Drive
Idaho Falls, ID 83404
January 24, 1996

Mr. Wade Carroll
MIPP EIS Document Manager
Office of Nuclear Energy
Science and Technology (NE-70)
U. S. Department of Energy
19901 Germantown Road
Germantown, MD 20874

Dear Mr. Carroll:

1 As a resident of Eastern Idaho, I fully support the use of the Power Burst Facility at the Idaho National Engineering Laboratory (INEL) as the preferred site for providing a reliable supply of molybdenum-99 and related medical isotopes.

I am a native of Eastern Idaho and have lived around the INEL all my life. I truly believe that the site has operated in a safe manner for years and every care is taken to protect the environment and people. In addition, I would like to see this facility/reactor, which my tax dollars helped build, put to good use rather than dismantled.

I believe that the INEL would be the best site for this project and know that this would be an excellent use of the existing technology and facilities.

Sincerely,

M. Ilene McKnight

Response to Comment Letter C054

1 Comment noted.

To: Wade Carroll
U. S. DOE
Office of Isotope Production
NE-70
19901 Germantown Rd.
Germantown, MD 20872

From: Greg Gerber
1945 1st Street
Idaho Falls, Id
83401-4308

Sir,

Thank you for letting me participate in the recent meeting you held in Idaho Falls. I feel you need to address and answer the following items in the final EIS.

1. You need to explain where, how, and by which
Organization that 11.5 million dollars has already been
spent on ACRR. If its as I suspect, the money was spent
doing the same Analysis, Reports, Safety Analysis Reports,
Environmental Assessments, Environmental Evaluations,and
various other required documentation. If any of the other
Facilities had this money they also might have been the
preferred site for Moly-99 production. This 11.5 million
dollars give the ACRR an unfair advantage. This money
should have been added to the cost of the ACRR to relate its
true cost. I won't buy that this money was spent on
1 research and development. This production of Moly-99 is a
proven process with proven techniques. To the public, it
appears that this money was spent under the table to bring
Moly-99 production to ACRR with no Public input. And now
DOE is trying to justify bringing Moly-99 to ACRR since the
DOE already spent the money there. Not fair or ethical.
Whatever facility gets this project, let it be for the right
reasons--Technical capability and cost to the taxpayer.

2. Although necessary SAR reviews are include in the cost
estimates I feel the ACRR SAR review budget is much to low.
With each type of Core refuel with different types of HEU
2 and LEU fuel will require the necessary(required) change in
the SAR documentation. It will also require the necessary
physics testing after changeout of each different type.
This is an added cost and was not mentioned or discussed in
this document.

3. Although at any of the sites in the report their is a
very small risk of a Reactor Accident, some weight must be
given to how far each Site is located away from large
3 population centers. ACRR is located 1 1/2 to 3 1/2 miles
from the outskirts of a very large city. It would seem to
me that the farther a facility is away from a large
population center the better it would seem the the general
public.

4. Another matter of cost is not mentioned here. Although
4 full time employees and budgets are mentioned for all sites,
no mention of labor rates is given. Is some weight given to
the Site with the lowest labor rate???

Sincerely Greg Gerber

Responses to Comment Letter C055

1 Any funds previously spent on the Annular Core Research Reactor are not relevant to a choice among alternative facilities for decisions concerning future program activity. Only the investment requirements and operations expenditures following a Record of Decision are relevant for the purposes of the EIS. The EIS provides estimates of the remaining costs to complete and operate the proposed Medical Isotopes Production Project at each of the sites. A more complete description of the EIS cost estimate assumptions and past expenditures has been added to Section 5.22.

2 The costs associated with modification or restart of potential medical isotope project facilities were obtained from the alternative sites to the extent possible, and they represent the best information available when the EIS was prepared. In some cases, the costs to bring safety documentation up to date take into account work that was accomplished for other purposes prior to preparation of the EIS and therefore represent incremental expenses necessary to complete work on the safety analysis report (SAR) updates.

All of the reactors would operate initially using existing fuel stockpiles and would not undertake core reconfigurations to convert to other fuel types until some time in the future, if it were necessary to do so at all. In such cases, the SAR updates accompanying the reconfiguration effort would be completed in conjunction with ongoing reactor operations and would not necessarily add to the cost of reactor operations during that time.

3 The accident analysis in Section 5.15 accounts for the size and relative distances to major population centers in calculating the dose and risk of fatal cancer in the surrounding population. For example, the population dose from isotope production operations at INEL and LANL, which have relatively small and remote surrounding populations, is lower than that for SNL/NM and ORNL, where the population centers are larger and nearer to the site. The resulting risks to the population for latent fatal cancers also reflect these differences, although the risks at any site would be small.

4 Labor rates did factor into the cost figures presented at each alternative. Some of the differences shown in Section 5.22 for each of the alternatives are directly attributable to the variations in labor rates.

COMMENTS ON DOE/EIS-0249D
MEDICAL ISOTOPES PRODUCTION PROJECT:
MOLYBDENUM-99 AND RELATED ISOTOPES

Robert D. Ulrich
1254 Zener
Pocatello, Idaho 83201

1 1. Page viii: The statement that no private company is available in the near future to take on Mo-99 production is not quite correct. It is my understanding that the Idaho Brain Tumor Center (IBTC) group has proposed a joint venture to DOE for the use of PBF as both Mo-99 production and treatment of cancer (BNCT) part of this proposal was to privatize the Mo-99 production. This action would eliminate all but the start up costs for DOE future Mo-99 production would be at IBTC expense not DOE's.

2 2. Page 3.48 The statement about PBF holding 19 targets may or may not be correct when drawn out it looks more like 24 or 25 targets would fit, the space would be 8.25" in diameter, not 6" as stated in option 1. Also the PBF reactor can accept targets greater in length up to 48", it seems this would greatly increase the capacity of production. If all three options were used PBF could produce more Mo-99 than would be required for several years use.

3 3. Page 3.50 I am uncertain about which modification to the PBF reactor are being referred to (3.3.4.9) the only mods required would be a target holder, mods would be needed for BNCT but these would be paid for by the IBCT people and would be done around the Mo-99 schedule.

4 4. Page 3.51 The statement that shipments from PBF to the hot cells would travel on US 26 is incorrect it is actually Idaho 33 instead, also the traffic figures for that highway include much of the onsite traffic since this road runs through the site and is the only way to get from the south end of the site to the north end.

5 5. Page 4.5 Looking at the Maps on page 4.4 it appears that the ACRR is located within a very short distance of a major population area, where as PBF is more isolated, the nearest town (population of about 15) being 7 miles away, with a town of 1200 being 25 miles away and to reach greater pop. would have to go 42 miles to Blackfoot. Idaho Falls is even further.

6 6. Page 4.8 It appears from statements on this page that ACRR is directly on several major faults, if one of these caused a problem once again the supply of Mo-99 would be in jeopardy. True PBF is located in the inter-mountain west which has some seismic activity, and several faults are close, but to my knowledge it is not sitting directly on a fault.

7 7. Page 4.89 The table showing highway traffic on state route 33 does not mention much of this traffic shown is associated with the INEL since this route passes through the INEL and is the only route from north to south on the site.

8 8. Page 5.66 - 5.15.4.2 the statement that PBF and the Omega West Reactor are similar is wrong, the only way they are similar is that they are both reactors. Omega West is fuel with MTR plate type fuel constructed of aluminum, whereas PBF is fuel is made of Zirconium Oxide clad with Stainless Steel. Omega West fuel has a fairly low melting point as opposed to that of PBF which is in excess of 2500 degrees C. After all PBF was designed to test reactor fuels in the test space without incurring core fuel damage. It has been shown in various reports that the PBF fuel should never melt, the aluminum support structure would melt first, but even this should not endanger the fuel integrity, PBF is probably the most stable reactor ever built any where in the world.

9 9. Page 5.101 I am not sure what mods are being referred to, the only mods needed would be for BNCT and would be funded by them not DOE.

10 10. There are numerous references in this document stating the costs estimate given for PBF could be greatly higher than stated, due to lack of time to prepare, I don't think so these numbers have been gone over and over the last several years as different parties have done estimates for the conversion of PBF for BNCT.

11 11. There as several places mentioning that low waste generated at ACRR would have to be shipped to the Nevada Test Site, PBF does not have this problem our waste would be stored at the INEL.

12 12. Page 5.38 5.14.4 It appears from statements in this EIS that PBF is better equipped to handle and store spent fuel generated during Mo-99 production.

13 13. I was unable to find any reference to where ACRR gets it water supply, is its supply limited as is the case in most of the southwest or is like PBF's and comes from a mostly inexhaustible supply.

14 14. It is clear that the only logical choice from a technical and cost basis is the site the Mo-99 production at the PBF in conjunction with BNCT, this would not only reduce start-up costs but would totally eliminate operating costs for future production, it would also eliminate shipping waste off site for storage since the INEL can do it all.

Thank you for your time and consideration of these points.

Robert D. Ulrich

Responses to Comment Letter C056

1 The Idaho Brain Tumor Center (IBTC) has informed DOE of its interest in coordinating its efforts with those of DOE; however, IBTC has not submitted any plans for coordinating reactor conversion activities, nor has it made a formal proposal to DOE. In addition, the Department understands that IBTC is investigating the possibility of using other facilities for boron neutron capture therapy (BNCT) and that other reactors under consideration for this project may be usable for BNCT. If the Department decides to proceed with a production alternative for this proposed project, it would welcome a proposal from IBTC for dual use of the reactor facility selected.

Although the potential for privatization of the proposed action in this EIS is important, the process for privatization is not part of this proposed action. Each of the production alternatives has potential for privatization. DOE has solicited expressions of interest from the industrial community for the privatization of any isotope production activity conducted by DOE, including the proposed Medical Isotopes Production Project. If promising concepts are received and the Department proceeds with the action proposed in this EIS, the Department would seek privatization proposals on a competitive basis.

2 The 6-inch diameter is a typographical error and was corrected in Section 3.3.4.4 of the EIS. Using a standard geometric spacing configuration to attempt to keep the thermalization of neutrons consistent among the targets would presage a 37-target arrangement (rather than the suggested 24 or 25 targets) as the next step beyond the 19-target configuration. An adequate water space between the targets is required for both cooling and moderation.

Target length has little to do with production. Most cores could accommodate targets with greater than 18 inches of active material length. Target power level dictates the production rate. The concern is possessing hot cell facilities capable of handling targets that have been irradiated for a week at slightly greater than 20 kW. After a 6-day irradiation followed by a 6-hour cooling period, a single 20 kW target contains about 35,000 curies of activity. Three targets (the typical number anticipated to be shipped to the Test Area North [TAN] annex) would contain over 100,000 curies of activity. Hot cell walls 50 inches thick (2.35 gms/cm^3 or greater) with windows and manipulators designed for that level of curie content are required. This quality of hot cell is not commonplace. Lengthening the targets to 36 inches of active material length would basically double the hot cell curie requirements. No available hot cells at the INEL possess 200,000+ curie ratings.

It should be recognized that all the considered facilities are capable of producing greater than the current domestic industry demand.

3 Besides modifying the central cavity, which is a significant modification, the reactor control system would need to be modified for a continued steady state, non-pulse mode. The transient rods would need to be removed and fixtures for target irradiation placed in the vacant locations. Cooling flow to the central cavity would need to be appropriately established along with the normal core cooling flow in lieu of the contained loop that currently exists. Flow balance valves for the central irradiation cavity would have to be designed and installed to assure that appropriate target cooling flow is established without flow-induced vibration of the targets occurring. The core would need to be redesigned to supply a hardened spectrum of neutrons to the central irradiation cavity. Concentration of the power to the core center would be needed to establish the appropriate flux levels without needing to operate the reactor above 10 MW to make the facility competitive regarding fuel utilization.

4 Section 3.3.4.9 of the EIS was changed to correctly identify the proposed route.

5 The observations listed in the comment are substantially correct. The benefits of locating the facilities in a remote location are reflected in lower radiological consequences for normal operation and accidents at the facilities.

6 The geologic features of the Albuquerque area, including faults and other seismic hazards, are reflected in requirements for building construction in this region. The design criteria for facilities at the SNL/NM are consistent with the Uniform Building Code 2B seismic hazard of the area. Building codes for the other alternative sites likewise reflect the relative seismic hazards associated with those locations.

7 Section 4.4.11.1 mentions that State Route 33 passes through the northern portion of the INEL and provides access to the northern INEL site facilities. The comment is also true regarding highways 20 and 26. Most of the traffic on these roads is also associated with site activities.

8 The statement in Section 5.15.4.2 refers to the fact that the design basis accident scenarios for each reactor are similar. The technical basis of the comment is substantially correct. The EIS attempted, to the extent possible, to utilize existing safety documentation and other analyses in developing accident scenarios that would represent the design basis accidents for facilities considered in the Medical Isotopes Production Project. However, the Power Burst Facility (PBF) safety analysis report (SAR) is outdated and does not contain sufficient information on radiological emissions associated with the design basis accidents evaluated in the document. Based on information contained in the PBF SAR, a coolant flow blockage in the core leading to overheating and fuel element damage was included as a credible design basis accident. This is similar to the type of accident evaluated for the Omega West Reactor (OWR) and for which a radionuclide release estimate was available. Therefore, the OWR release estimate was used to evaluate a similar accident at the PBF and also at the Oak Ridge Research Reactor in the absence of more recent analyses specific to those facilities. The release estimates were combined with site- and facility-specific information (stack parameters, meteorology, and location with respect to potential receptors) to estimate the consequences to workers and the public from these accidents.

In addition, the estimated radionuclide releases for fuel damage scenarios (from whatever cause) at OWR and ACRR were similar, and use of the OWR scenario to represent emissions from an accident at the PBF should bound the consequences of a design basis accident at that facility. Assuming a lower release or accident frequency based on the thermal characteristics of PBF fuel might result in a lower risk estimate; however, this would not likely change the conclusions reached in the EIS because the accident risk associated with operation of any of the facilities is low.

Also, the idea that the fuel at the PBF will not melt until >2500°C is achieved is not correct. The fuel meat (without fuel clad and liner) in a crucible will not melt until about 2500°C. This is also true of all the other uranium-oxide-fueled facilities, which is all of the reactors considered. The PBF fuel is stainless clad, zirconium-calcium cladding lined, uranium oxide-zirconium-calcium mix pellets. Uranium oxide melts at 2600°C, stainless steel melts at 1400°C, and zirconium melts at 1852°C. During the fuel rod melting process, a eutectic is formed between the uranium oxide fuel and the cladding, be it zirconium or stainless steel, causing a greatly reduced melting temperature of the combined metals. The reason for this phenomenon is similar to the reason that solder melts at temperatures much lower than that of either tin or lead.

If the interface between the cladding liner and the cladding reaches 1400°C, the fuel rod cladding will begin to melt; the cladding will melt more rapidly if a eutectic forms and the melting point drops to much less than

1400°C. The zirconium-calcium clad liner should assuage this problem somewhat. Something similar will probably happen between the liner and fuel meat. It is true that the PBF fuel has a higher melting point than the aluminum clad OWR fuel. However, the OWR fuel, without cladding, in a crucible would not melt until 2600°C is achieved, slightly higher than the PBF.

9 As discussed in Section 3.3.4.9, several modifications would be required to conduct medical isotope production. Besides modifying the central cavity, which is a significant modification, the reactor control system would need to be modified for a continued steady state, non-pulse mode. The transient rods would need to be removed and fixtures for target irradiation placed in the vacant locations. All material removed from the central cavity would require disposal, a legacy waste cost and man-hour/man rem cost. Legacy disposal costs are involved in the transient rods and mechanisms. Cooling flow to the central cavity would need to be appropriately established along with the normal core cooling flow in lieu of the contained loop that currently exists. Flow balance valves for the central irradiation cavity would have to be designed and installed to assure that appropriate target cooling flow is established without flow-induced vibration of the targets occurring. The core would need to be redesigned to supply a hardened spectrum of neutrons to the central irradiation cavity. Concentration of the power to the core center would be needed to establish the appropriate flux levels without needing to operate the reactor above 10 MW to make the facility competitive regarding fuel utilization.

10 The Department has used the best available information for all of its analyses and comparisons, including the cost information. Information on restart of the PBF was fairly thorough and was probably a result of the efforts to estimate costs and schedules for conversion of the PBF for BNCT. However, reactor conversion and operation is only a portion of the cost and schedule information requested. Hot cell modification, process line fabrication, target fabrication facility modification, and general processing operational costs also are reflected in Section 5.22 of the EIS. Additional information on the estimated cost of the INEL alternative was obtained subsequent to the publication of the Draft EIS and was used in the preparation of the Final EIS; however, the amount of supporting material associated with these estimates was less detailed than that received from some of the other sites. Thus the Final EIS contains statements that indicate the margin of error for both the INEL and ORNL estimates are considered larger than those for LANL and SNL/NM.

11 The Department recognizes that "cradle-to-grave" waste management is a benefit of the INEL and LANL alternatives.

12 All alternatives considered have sufficient onsite spent nuclear fuel (SNF) storage capabilities to operate at 100% U.S. demand for at least 5 years.

13 Water use in the Albuquerque region is considered in this EIS. SNL/NM obtains its water from onsite wells at Kirtland Air Force Base (KAFB) and supplements it with water purchased from the Albuquerque municipal water system. The total water use from operation of the Annular Core Research Reactor at SNL/NM would increase from the current average of 5000 gal/day to 29,000 gal/day (Section 5.13), compared to total water use at SNL/NM of 1,000,000 gal/day (Section 4.1.13) or total water use in the Albuquerque region of 90,000,000 gal/day. This represents less than a 3% increase in water use at SNL/NM, or 0.03% increase in water use for the region, and would not be expected to substantially impact availability or quality of water in the aquifer.

14 Please see response to comment C056-1 above.

The Department recognizes that "cradle-to-grave" waste management is a benefit of the INEL and LANL alternatives and will consider this factor in making its decision on the proposed project.

THERMO TECHNOLOGY VENTURES INC.
501 W. Broadway, Suite 200
Idaho Falls, ID 83402
(208) 523-6149, Fax (208) 524-8460

February 9, 1996

Mr. Wade Carroll, NEPA Document Manager
Office of Isotope Production and Distribution, NE-70
U.S. Department of Energy
19901 Germantown Road
Germantown, Maryland 20874

Attn: Medical Isotope Production Project EIS

Dear Mr. Carroll:

Please take this as our official response to the draft EIS.

As we discussed, Thermo Technology Ventures in conjunction with MIT and the DOE's Idaho National Engineering Laboratory, is working on a new and superior method of producing the valuable isotope Mo^{99}/Tc^{99m}. The TTV team is creating a method based on developments at MIT using linear accelerator technology instead of nuclear reactors, as described in my August 7th letter to you; a copy is enclosed. This method is environmentally safe, requires no Government funding, and satisfies the US requirement in a timely way.

TTV's private enterprise approach is a non-nuclear reactor solution with the following benefits:

- **No Government funding is required** - Private enterprise with its own capital at risk
  - The Government can avoid spending $45M for nuclear reactor facility modification and operating costs
- **Environmentally safe** - Accelerator technology that is kinder to the environment
  - No hazardous waste to dispose of
  - 1 No bomb grade U235 is required
- **Assured source of supply** - Multiple accelerator production sites
  - No single point of failure that would jeopardize the supply base
  - Built-in redundancy with a network of multiple sites with overlapping coverage
- **Satisfies the entire US requirement** - Capable of producing all of the country's Tc^{99m}
  - Potential of filling the need as quickly as Government subsidized Tc^{99m}

We have made substantial progress toward our program over the past six months. Irradiations by MIT at both the NIST and RPI accelerators have confirmed production estimates and computer modeling. Technical feasibility is proven. Prototype designs are being demonstrated by the INEL that will offer enhancements to purification and separation systems that are currently available. In addition, our business analysis indicates this has excellent potential as a new

Page 1

A subsidiary of Thermo Electron Corporation venture. As a result we are in the final stages of forming a joint venture between Thermo Electron and a major US radiopharmacy company to commercialize the MIT and INEL technology.

I would also like to add that, with the additional work done by MIT and the INEL, we are able to increase the throughput of these accelerators. This will enable us to satisfy the US demand with a total of 20 accelerator centers instead of the 40 that were originally projected. As a result, we can fill the US requirement in a much shorter time frame than originally planned. The first production center will open in the summer of 1997. After that, a number of accelerator sites will be installed and will be ready to supply the entire US demand as early as December 1999. That date is earlier than the expected decommissioning of the Canadian NRU facility, which currently provides the country with most of its Moly99. Also, we expect further increases in the efficiency of the accelerator production centers as MIT continues to develop clever target designs and the INEL enhances its purification and separation process. This will make it possible to satisfy the country's demand in an even quicker time period than currently estimated.

2 This project anticipates no Government funding. The Government could accelerate this schedule and ensure initial deployment of the accelerator centers in the US by providing incremental financing to this venture. That would enable the purchase and deployment of capital equipment in a shorter time period and cover markets that would be too aggressive for venture capital. If this were to happen, accelerator centers would be in place, producing Mo^{99}/Tc^{99m} in the same time frame as DOE's preferred option, the ACRR at Sandia.

Following are the major milestones that have been accomplished:

- Technical feasibility testing was conducted in July '95 and January '96
  - These tests validated throughput calculations on accelerator sizing and target design. Additional testing using enriched target material is being scheduled.

Work is in progress to:

- Establish a joint venture which is expected to be consummated this spring
- Irradiate an enriched target and produce Tc^{99m} that is suitable for FDA submission by June 1996
- Acquire purification technology that will back up the work being performed by the INEL

To create the environment for private enterprise to satisfy our country's need for Tc^{99m}, the US Government should:

3 - Consider this approach superior to Sandia (or any other nuclear reactor alternative) and be prepared to halt the funding to Sandia as the TTV team completes its development program

4 - Identify and implement a strategy with the Canadian government that would phase out the Canadian government's subsidized Mo^{99}/Tc^{99m} as the TTV team phases in private enterprise Mo^{99}/Tc^{99m}

I recommend that modifications be made to the draft EIS to include the TTV team's accelerator approach to producing Mo^{99}/Tc^{99m} as follows:

> Paragraph <u>3.2 No Action Alternative</u> should include a subparagraph stating that TTV's
> 5 accelerator production centers will be installed in the next three years and that these centers will have the capability of suppling the US requirement for Mo^{99}/Tc^{99m}.
>
> Paragraph <u>3.3 Alternatives to Accomplish the Proposed Action</u> should identify the TTV team as having the preferred approach. If the US Government needs earlier deployment of these accelerator production centers, it could consider funding the TTV team at a level
> 6 that would accelerate implementation and enable earlier deployment.
>
> Paragraph <u>3.4 Alternatives Considered and Dismissed</u> should delete all reference to TTV's program since it will be included in the paragraphs as stated above.

Supporting this private venture would obviate the need for the Government to spend taxpayers' hard-earned dollars on a solution that is less than optimum during this period of fiscal crisis. TTV's approach will supersede the DOE plan with an inherently better solution within the same time period. If the DOE proceeds with investing in nuclear reactor produced Mo^{99}/Tc^{99m}, it
7 would represent a very serious threat to the formation of private capital to support this market. *This venture will not be capitalized if there is a cheap, government subsidized source of* Mo^{99}/Tc^{99m} *in the marketplace.*

The TTV team's accelerator production method is ready for commercialization. It is environmentally safe, requires no government funding, satisfies all of the US requirement, and is more competitive than any of the alternatives listed in the draft EIS.

We would be happy to meet with you and your technical staff to brief you on our approach. Also, I look forward to working with you and your office to ensure that this accelerator approach is properly represented in the EIS.

Sincerely,

Richard F. Testa
Director, Venture Development

Enclosure: Summary - Accelerator production of Mo^{99}/Tc^{99m}
August 7, 1995 letter to Wade Carroll

THERMO TECHNOLOGY
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August 7, 1995

Mr. Wade Carroll, NEPA Document Manager
Office of Isotope Production and Distribution, NE-70
U.S. Department of Energy
19901 Germantown Road
Germantown, Maryland 20874

Attn: Medical Isotope Production EIS

Dear Mr. Carroll:

It was nice talking with you this afternoon. As discussed, a member of Thermo Technology Ventures attended your meeting held in Idaho Falls on July 24 which sought environmental impact statements regarding the proposed isotope production project.

Thermo is in the process of evaluating an alternative production method for Tc99m, the daughter product of Molybdenum-99. Our approach is to use linear accelerators to directly produce Tc99m. This approach offers:

- A distributed production source, with no single point of failure as in reactor production
- No generation of radioactive waste
- High purity Tc99m with no possibility of hazardous contamination
- High activity Tc99m is produced
- Simplified handling and distribution since the linear reactors are close to the hospitals that use the product

We believe that this approach offers reduced costs and greater flexibility to address the national need for Tc99m.

The proposed production of Mo99 in the Sandia ACR reactor or at other federal sites will severely impact our private production plans and the ability to raise venture capital for this venture. Our project is depending upon the government providing private enterprise with its traditional incentives to enter into production of Tc99m. Also, our project will provide the American people with the right amount of surety that there will be an uninterrupted supply of this needed isotope at reasonable prices.

The suggestion that was made at the public scoping meeting of having DOE provide funding to assist the private sector would be helpful in developing this technology. I would like to work a phased program with the DOE to determine what funding is available for these efforts in order to encourage the private sector to develop the required infrastructure to produce Tc99m.

I look forward to working with you. Please put me on the distribution list for follow-up and related efforts regarding Tc99m.

Sincerely,

Richard F. Testa

Richard F. Testa
Director, Venture Development

A subsidiary of Thermo Electron Corporation

SUMMARY INFORMATION

Accelerator Production of Mo^{99}/Tc^{99m}

A safe and economical way to produce a medical isotope that is critical in over 10 million procedures per year in the United States and whose current supply is in jeopardy:

Thermo Technology Ventures, Inc., in conjunction with the Massachusetts Institute of Technology and DOE's Idaho National Engineering Laboratory/Lockheed Martin Idaho Technologies is developing an alternative production method for technetium 99m (Tc^{99m}), the daughter product of molybdenum 99 (Mo^{99}).

- MIT's department of nuclear engineering created a novel and proprietary invention that makes linear accelerator based production of Tc^{99m} technically feasible
- Lockheed Martin Idaho Technologies is developing a process to refine the accelerator produced Tc99m and prepare it for delivery to hospitals and radiopharmacies
- Thermo Technology Ventures is forming a joint venture to commercialize this technology

The production of medical isotopes is a growing market with a very fragile supply base:

Medical isotopes are used for diagnostic and therapeutic purposes and are supplied primarily through nuclear reactors. Technetium 99m (Tc99m), the most important and fastest growing medical isotope, is currently produced in nuclear reactors by irradiating enriched Uranium 235 to form the fission product isotope Mo99. This isotope, with a half-life of 66 hours, decays to Tc99m, which has a half-life of 6 hours and is used in over 90% of the nuclear diagnostic imaging scans. In the United States, there are ten million radiopharmaceutical diagnostic imaging scans per year that use Tc99m, half of the world-wide usage.

The nuclear reactor based production and distribution channel is long, cumbersome, hazardous, expensive, and subject to disruption. Currently, the entire US supply of Tc99m is produced by one reactor, the aging, 38 year old, heavily subsidized Canadian NRU reactor at Chalk River, near Kanata. The Canadian government would like to close this reactor. It is currently under litigation from Nordion, a Canadian based company that distributes Mo99 in North America, to enforce a 23 year supply contract that will expire in 2011. Nordion is owned by MDS Health Group, a Toronto based company established in 1969 and now the largest health and life sciences company in Canada. The Canadian nuclear reactor is expected to be closed by the year 2000. The Canadian government is considering investing in two smaller reactors solely for the production of Mo99/Tc99m.

Nordion receives the Mo99 from this Canadian reactor. They purify the isotope and package it for shipment. Nordion then distributes the isotope to its US customers: DuPont Merck, Amersham, and Mallinckrodt. These customers package the Mo99 in Tc99m generators and distribute these generators directly to hospitals and radiopharmaceutical companies. Hospital pharmacy staff and radiopharmaceutical companies extract the Tc99m from the generator and

October 26, 1995 Thermo Technology Ventures, Inc.

package the isotope per prescribed unit dose to be used directly by the physicians. Since the half-life of Tc99m is very short, it's imperative that the source be close to the hospitals, making distribution key to fulfilling customer requirements. The half-life of Mo99 is 66 hours. Therefore, generators are in constant movement from multiple sites back and forth to the reactor.

Linear accelerator produced Tc99m greatly simplifies the now awkward, expensive, and hazardous production and distribution system.

Accelerator produced Tc99m will bring the manufacture of the isotopes closer to the hospital sites and provide customers with a viable, long term, redundant, and local source of supply and is competitive with current world pricing.

This new accelerator concept is quickly moving from the conceptual design and feasibility stage to development. Tests have already been conducted proving the feasibility of production and patents have been applied for. Thermo Technology Ventures' business plan calls for development to be complete and FDA approval obtained by December 1996, with regional production centers to begin operation in 1997. About five years will be required for complete implementation to supply the entire U.S. demand by regional production centers, with the interim balance to be supplied by reactor produced Mo^{99}.

Forty accelerator centers will supply 100 percent of the United States demand for Tc^{99m}. These accelerator centers would be located at or near medical facilities which would greatly simplify handling and transportation of the Tc^{99m}.

TTV is discussing this concept with selected medical isotope suppliers to establish a joint venture to manufacture and distribute the Tc99m. TTV has also provided the DOE Isotope Production and Distribution's Environmental Impact Study with information regarding this accelerator produced Tc99m so they can include this source of production in their planning documents and investment considerations for the Sandia reactor.

No Government subsidy is required:

This industry initiative represents a viable commercial alternative to government subsidized nuclear reactor based production. As private enterprise makes the accelerator based Tc^{99m} product available, reactor based Mo^{99}/Tc^{99m} will be phased out ensuring an uninterrupted supply of Tc^{99m} for the US population. This network of accelerator centers will provide an economical, highly reliable, and indigenous supply of Tc^{99m} that will be commercially available, replacing reactor produced Mo^{99}/Tc^{99m} and other medical isotopes.

Multiple benefits of accelerator produced Tc99m:

This new accelerator concept offers many improvements over the current Mo^{99}/Tc^{99m} nuclear reactor based production method which has been used exclusively over the past 30 years. These improvements are:

- No single point of failure
  Over 40 distributed production sources, networked together will be able to produce the total US requirement of Tc99m

- No generation of radioactive or hazardous waste
  Current reactor based production produces fission products which must be disposed of and is currently not considered in the pricing of the Tc99m

- No use of enriched uranium 235
  Weapons grade uranium 235 is used in the current process of producing Mo99, providing for an increased national security risk and increased costs of handling, protecting, and accounting for this material. The enriched U235 is currently not recycled and is stored as waste with tight security required to divert possible diversion to weapons production.

- High purity Tc^{99m} with no possibility of hazardous contamination
  The reaction within the accelerator beam produces very low impurity levels, with no possibility of carryover of hazardous fission products into the Tc99m as in reactor fission produced material.

- High specific activity Tc^{99m} is produced
  Each accelerator produces high specific activity Tc99m comparable to the current product.

- High productivity
  Each accelerator produces enough Tc99m to supply 1,000 unit doses a day for distribution to local hospitals and radiopharmacies.

- Simplified handling and distribution
  No clumsy generators are required to transport the isotope. Tc99m will be packaged at the manufacturing site and delivered directly to the hospitals. The extra work required to purify the reactor produced Mo99, shipping it to generator manufacturers, who in-turn, repackage for shipment to hospitals and radiopharmacies who have to extract Tc99m from the generators and finally repackage it for unit dose requirements is all eliminated. This new procedure saves time, is responsive to customer demand, and has improved safety with less hazardous waste and reduced worker radiation dose.

Note: Thermo Technology Ventures, Inc., headquartered in Idaho Falls, Idaho, was formed to commercialize technology within the INEL. TTV is a wholly owned subsidiary of Thermo Electron Corporation, a $2 billion corporation located in Waltham, Mass.

Lockheed Martin Idaho Technologies, headquartered in Idaho Falls, Idaho, was formed to maintain and operate the INEL. LMIT is a department of Lockheed Martin Corporation, located in Maryland and the largest government contractor.

Accelerators provide a means of accelerating charged particles such as electrons, protons or deuterons to high energies. In a linear accelerator, commonly known as a LINAC, a beam of electrons is injected into an accelerating tube and accelerated to high energy. Accelerating sections are connected to a high frequency alternating voltage from a high powered oscillator. Electron accelerators produce high energy photons by impact of the accelerated electron on a tungsten target.

Responses to Comment Letter C057

1 The Thermo Technology Ventures (TTV) concept, including the benefits of a non-reactor production facility, is discussed in Section 3.4.3.3 of the EIS.

2 If funding is to be provided to investigate a new concept, Federal procurement regulations require that the Department issue Request for Proposals or that the company investigating the new concept send an unsolicited proposal to the Department. In December 1995, the Department published a Notice for Expression of Interest in the *Federal Register* to determine if there is interest among private sector companies in privatizing various DOE isotope production operations. If the Department proceeds with the action proposed in this EIS and if the response to the Notice for Expression of Interest indicates that there is significant interest in privatizing some isotope production operations or there are potentially viable alternative concepts to produce isotopes (such as Mo-99), the Department would issue a Request for Proposals.

Thermo Technology Ventures (TTV) contacted the Department in October 1995 to inquire about how to submit a proposal for Federal funding for their concept, and the Department responded in October with the requested information. To date, no request for funding has been received from TTV.

3 As stated in the EIS, if the Department decides to pursue this project, it would phase out production of Mo-99 as private sources begin reliably producing Mo-99. If TTV begins reliably producing Mo-99 in sufficient quantities to satisfy 100% of U.S. demand before the Department's production facility comes on line, then the Department would halt the project.

4 A private company in Canada, Nordion International, is currently supplying Mo-99 to the U.S. Nordion contracts with the Canadian government for irradiation services in the National Research Universal (NRU) reactor to produce its Mo-99. Nordion has informed the Department and the medical community that it intends to build two new reactors using private funds to replace the NRU, which is scheduled to shut down in 2000.

5 Section 3.2 on the no action alternative addresses the impacts of not proceeding with the proposed action given the current environment. It does not address future possible or probable events. Section 3.2.2 has been modified to reflect recent progress by TTV in the development of its accelerator concept.

6 As stated in the comment letter, the earliest that the TTV concept could be supplying the entire U.S. demand for Mo-99 is December 1999. While the Department would welcome the production of 100% of the U.S. demand by TTV or any other private company, this concept cannot meet the purpose of and need for the proposed action for the reasons discussed in Section 3.4.3.3 and, therefore, must remain in the category of Alternatives Considered but Dismissed with respect to this proposed action.

7 As discussed in Section 3.4, the new technologies that are being investigated do not appear to hold the potential to produce 100% of the U.S. supply of Mo-99 in the near term (within 1 to 3 years). Therefore, these options are not considered in detail in the EIS. However, the Department will continue to monitor the progress of these new technologies and would stand prepared to phase out its production if these new technologies begin reliably producing Mo-99.

As stated in the EIS, the Department intends to operate only as a backup to the existing Canadian supplier. The Department will only produce and sell Mo-99 in sufficient quantities to maintain the capability of the facilities and staff to produce 100% of the U.S. demand for Mo-99 in case of a supply shortage. The Mo-99 would be sold at the prevailing world market rates therefore, the Department does not believe that its proposed project would represent a cheap, subsidized source of Mo-99 in the marketplace.

IDAHO BRAIN TUMOR CENTER

2560 Channing Way, Suite 206
P.O. Box 2367
Idaho Falls, Idaho 83403-2367

February 8, 1996

The Honorable Hazel O'Leary
Secretary of Energy
Department of Energy
1000 Independence Ave, S.W.
Washington DC, 20585

Dear Secretary O'Leary,

The Idaho Brain Tumor Center (IBTC) strongly supports the selection
1 of the Power Burst Facility (PBF) in Idaho as the Department of
Energy's (DOE's) primary choice for the production of Molybdenum 99
for the following reasons:

The mission of the Idaho National Engineering Laboratory (INEL) includes medical uses for nuclear technology. The two New Mexico labs under consideration, Sandia and Los Alamos, are defense mission labs. We urge DOE to support the current lab-assigned mission of PBF at INEL and support medical technology at INEL.

INEL currently has 20 years of experience in producing Cobalt 60
and other medical isotopes for the medical community. This
2 experience is not present at Los Alamos and Sandia. DOE should
capitalize on the experience of INEL in making it's decision to
choose PBF as the primary site for Mo 99 production.

DOE has prioritized bringing Mo 99 into the realm of the private
sector for production of medical isotopes. The PBF at INEL is best
3 set up to make this happen the soonest because of DOE's lease with
the Idaho Brain Tumor Center. Privatization is well under way
through this arrangement.

The Annular Core Research Reactor (ACRR) at Sandia is a Department
of Defense Reactor Facility which disqualifies it for
commercialization. This restriction severely limits the
reliability of ACRR as either a primary or secondary Mo 99 back up.
4 In the event that there is a DOD use for the ACRR, the defense
priority would be superior to the medical isotope priority and
millions of patients would suffer. The medical community in this
country will seriously and vocally question that type of decision
making.

INEL's PBF reactor currently has a commercial lease and a plan to
treat cancer patients using BNCT. The Mo 99 mission is compatible
5 with the BNCT mission. The selection of PBF at INEL enhances both
missions and this best supports INEL's overall mission of medical
use for nuclear technology.

IDAHO BRAIN TUMOR CENTER

6 It would be erroneous for DOE to make it's decision based upon suggestions that Sandia can be in medical isotope production in 22 months versus 28 months for PBF. The current Environmental Impact Statement (EIS), (page iv) indicates by DOE's own admission that the Canadian source is not seriously questioned for at least three to four years. Therefore the goal of having earliest production of small amounts (10%) of Mo 99 should not drive the selection of Sandia simply because Sandia has a 6 month earlier window.

7 There is ample evidence to suggest to DOE that National Policy interests compel DOE to seriously look at a 100% or more production of USA needs for Mo 99. A loss of the current foreign supply is likely to be a complete loss and a back up of 10-30% would not sustain minimum US needs for any prolonged period of time (EIS pp v). There are, in many quarters, dicussions regarding claims that DOE's arbitrary decision made in conjunction with foreign based isotope producers and distributors, to limit U.S. Mo 99 production to between 10% and 30% of domestic use, circumvents important national policy. This decision rightfully belongs at the President's cabinet level and/or the Congress of the United States. Dependency on foreign sources threatens supply in time of national emergency, drives up prices for hospitals, doctors and patients, and runs counter to administration goals of providing increased access to medical care for all Americans.

8 There are five hot-cell facilities at the INEL site. Only one, the TAN hot-cell facility was considered by DOE. Four other facilities are actually better alternatives than TAN. Some of these hot-cell facilities would require no shipping of radioactive material and radioactive waste on public highways and across state lines. 9 The choice of New Mexico would require shipment of radioactive material and radioactive waste on public highways and has received strong negative environmental impact comments from residents of New Mexico.

The INEL hot-cells are clearly superior to any of the preferred choices offered at the other sites. Especially if INEL uses one of the two Chem Plant's modern and available units.

There is overwhelmingly positive public support in Idaho for the Moly 99 mission. Not a single negative oral statement was made in either of the two, very well attended Idaho public hearings. People in Idaho want Mo 99 production in Idaho. They want a medical mission to succeed for the nuclear industry.

IDAHO BRAIN TUMOR CENTER

10 The analysis of the PBF option in the EIS indicates considerably more reactor modification work and cost than are necessary. INEL employees stated that some of their cost estimates were doubled by the EIS authors in their EIS report. The public hearing in Idaho revealed that already existing cost estimates for the PBF option were much more detailed and actually cost considerably less than those submitted in the EIS. When employees of INEL testified that their cost sheets were disregarded and some of their cost numbers were doubled, DOE representatives replied that DOE thought some of the cost "looked too low" so they arbitrarily raised them.

11 DOE's selection of Sandia would require design and manufacture of new fuel and also requires initial use of highly enriched Uranium which increases security risk and waste. PBF uses low, enriched fuel and is the superior alternative to Sandia in this regard.

12 PBF has a clear advantage over ACRR at Sandia because of the availability of existing fuel and the ability to operate PBF on a reduced power design for PBF. ACRR would require new fuel and would require doubling of design power making PBF a clear choice.

13 The cost for PBF to produce 100% of domestic need is lower for both start up and operation than the preferred option at Sandia as indicated in the EIS, even though cost savings (items 11 and 15) were not considered. Over 25 years, this represents savings in excess of a hundred million dollars.

Sincerely,

Francis Paul, M.D.

CC: Assistant Secretary Terry Lash DOE, Wade Carroll DOE, Senator Larry Craig, Senator Dirk Kempthorne, Congressmen Mike Crapo, Congressmen Helen Chenoweth, Governor Philip Batt, Western Partners

Responses to Comment Letter C058

1 Comment noted.

2 As presented in Table 3-2, LANL and ORNL also have significant experience in the production and distribution of isotopes.

3 The Idaho Brain Tumor Center (IBTC) has informed DOE of its interest in coordinating its efforts with those of DOE. The Department is aware of this potential for the INEL alternative. Although the potential for privatization of the proposed action in this EIS is important, the process for privatization is not part of this proposed action. Each of the production alternatives has potential for privatization. DOE has solicited expressions of interest from the industrial community for the privatization of any isotope production activity conducted by DOE, including the proposed Medical Isotopes Production Project. If promising concepts are received, the Department would seek privatization proposals on a competitive basis.

4 The Annular Core Research Reactor (ACRR) is an Office of Defense Programs facility within DOE, not a Department of Defense facility. It is possible that the ACRR, the preferred reactor for the proposed project, could be diverted to support defense missions in case of a national emergency. However, the Department has determined that the probability of needing the ACRR for defense purposes is sufficiently low to preclude disqualifying the reactor from consideration and does not diminish its potential for privatization.

5 The IBTC has informed DOE of its interest in coordinating its efforts with those of DOE; however, IBTC has not submitted any plans for coordinating reactor conversion activities, nor has it made a formal proposal to DOE. In addition, the Department understands that IBTC is investigating the possibility of using other facilities for boron neutron capture therapy (BNCT) and that other reactors under consideration for this project may be usable for BNCT. If the Department decides to proceed with a production alternative for this proposed project, it would welcome a proposal from IBTC for dual use of the reactor facility selected.

6 The entire U.S. supply of Mo-99 is produced in a single reactor in Canada. If this supply were to become unavailable, the U.S. would face a Mo-99 shortage. The preferred alternative could produce a small amount of Mo-99 six months after the Record of Decision. The ability to produce a fraction of the U.S. demand in a short period of time is important because, if a Mo-99 shortage were to occur in the near future, the Department would be able to supply at least part of the U.S. needs.

7 All of the reactors evaluated as reasonable alternatives for the proposed project would (after necessary modifications) have the ability to produce at least 100% of the U.S. demand for Mo-99. If the decision is made to pursue this project, the Department would act as a backup to the existing Canadian supplier. The goal of the proposed project is to ensure that a reliable supply of Mo-99 is available to the U.S. medical community; thus, 100% of the U.S. demand would be produced only during times when the Canadian supply was unavailable. The goal of producing 10%-30% of the U.S. demand on a continuing basis is to allow the U.S. facilities to respond quickly to the need to supply 100% of the demand when necessary.

The Department's decision on the proposed project will be documented in a Record of Decision that will be signed by the Secretary of Energy or the Director of the Office of Nuclear Energy, Science and Technology.

8 The options considered were to use the Test Area North (TAN) Annex hot cell facility or to build new facilities adjacent to the Power Burst Facility (PBF). The new cells would cost approximately $4,500,000 to

$5,000,000, which would significantly increase the cost of the INEL PBF option. Of the five existing hot cells the commentor cites, two (the Hot Fuel Examination Facility and the Fuel Conditioning Facility) are currently in use and are not available for Mo-99 production. A third, the Test Reactor Area Hot Cell, is not adequate for Mo-99 production. Of the two remaining hot cells, the TAN Annex was chosen over the Idaho Chemical Processing Plant (ICPP) hot cells because the modifications costs would be similar and because using the TAN Annex provides a bounding environmental analysis in the EIS. This would not preclude use of the ICPP hot cells for Mo-99 production.

9 As described in the EIS, some transportation of Mo-99 and small quantities of low-level waste would be required at any of the alternatives considered. For some of the alternatives, this transportation would take place almost exclusively onsite, while others would require use of public roads. The ORNL alternative and the preferred alternative at SNL/NM both would require periodic shipments of low-level waste out of state to the Nevada Test Site.

10 The modifications required for full production are described in Section 3.3.4.9. The cost estimates used in the analysis in Section 5.22, as well as the basis for these estimates, were discussed with cognizant INEL personnel.

11 The PBF is the only option currently using low enriched uranium fuel. All the other options evaluated in detail have designs for converting to low enriched uranium. The objective is to not build any more highly enriched uranium fuel bundles for any of the other options, but to use the fuel already on hand until the supply is exhausted or, in the case of ACRR, until the burnup limit is reached (see Section 3.3.1.9). Two or three transition cores of both low enriched uranium and highly enriched uranium would be used during the conversion to all low enriched uranium fuel for these options. This is a long-term safeguards advantage, in that it depletes and irradiates the weapons grade material on hand.

It is not true that use of low enriched uranium fuel minimizes waste. More spent fuel bundles are generated per reactor full power year with the use of low enriched uranium bundles.

12 The amount of PBF fuel is limited. With all available fuel on hand, the PBF can run for only 1000,000 - 150,000 MW hours. At a power of 10 MW, the fuel will last approximately 625 days. The PBF fuel is one-of-a-kind and will be quite expensive to replace. It requires a special manufacturing run on a one-of-a-kind design at a fuel manufacturing facility. Conversely, the TRIGA type fuel that would be used to replace the existing fuel in ACRR is very common and is relatively inexpensive to produce. The new ACRR fuel would be phased in as the burnup limit on the existing fuel is reached (see Section 3.3.1.9).

Regarding the increased power requirements at the ACRR, the SNL/NM alternative includes the design, equipment modifications, and licensing efforts required for the power upgrade. The design calculations and safety basis upgrade to address the power increases have been completed. These efforts and the hardware required for the modification are included in the cost estimates in Section 5.22.

13 The Department recognizes that the estimated cost of the INEL alternative is lower than that of the preferred alternative; however, the uncertainties associated with the estimated cost of the INEL alternative are higher than for the preferred alternative. If the Department decides to proceed with the proposed action, the information presented in the EIS (including the cost data), the operational readiness of facilities, and other programmatic factors will be considered in the final selection of facilities for Mo-99 production.

ON THE
U.S. DEPARTMENT OF ENERGY
DRAFT ENVIRONMENTAL IMPACT STATEMENT
FOR THE
MEDICAL ISOTOPES PRODUCTION PROJECT

PLEASE PRINT CLEARLY

NAME: PRISCILLA TRACY
STREET ADDRESS: 3708 CHERAZ NE
CITY ALBUQUERQUE STATE NM ZIP CODE: 87111
TELEPHONE: (505) 275-6145

1 Your comment form is not designed to contain many comments—there is barely room to write "Molybdenum-99 and Related Isotopes" on it. Also there is no address on the form, no point of contact, no phone nuumber. The form sends a message.

2 What is all this about? Canada is doing fine producing and transporting this nuclear medicine—we should not interfere with their industry. There is no need to spend tax dollars to create a company to give away to some business. The city of Albuquerque has much to lose and nothing to gain by locating a facility like you propose here. See references below:

Reference page 5.1, fourth paragraph of your Draft EIS:
"The effect on economic climate and community resources would also be minimal because of the relatively small number of workers that would be employed in the isotope production project."
Reference page 5.2, fourth paragraph:
"Because the DOE intends to produce Mo-99 even when the Canadian source is supplying MO-99, periods may occur when the DOE is unable to sell the MO-99 that it produces. In this case, the unsold Mo-99 would have to be disposed of as low-level radioactive waste. The disposal of unsold Mo-99, with the other low-level radioactive waste generated during production, is bounded by the analyses in this EIS".

3 The quality and quantity of Albuquerque water is deteriorating. A migrating plume of Trichloroethene (TCE) contamination is already in the acquifer. In addition to contamination, we are also a desert city very short of water. See attached newspaper article--the city will soon begin to sink as the level of the water in the acquifer goes down. As the city sinks, the ground and the structures built on it will crack. Pumping too much water will have a significant environmental impact on this city. Your own phrase "Irreversible and Irretrievable Commitment of Resources" says it all--"when a resource is irreplaceably lost and cannot be replenished." That's what will happen to our water. This is not a good place to locate a water-thirsty industry. DOE wants to use 11,000,000 additional gallons a year for this project in addition to the 1,002,500 hallons already used (page 4.9 EIS & hearing discussions).

4 Whatever happens to Kirtland Air Force Base, happens to the city of Albuquerque. The base and the city actually touch. Many people work on the base besides just DOE employees; some people actually live on the base. This is a big population center. The risks are too great to locate a nuclear facility, store nuclear waste, transport nuclear products and waste.

DOE does not look critically at its own proposals and actions. The Agency is looking at what it wants to do through rose-colored glasses when it ought to remember what happened at Rocky Flats.

The sales pitch for these medical isotopes is that they are important to the world. So is water. If you want to make something wonderful for the world, make water.

Priscilla Tracy Priscilla Tracy Feb 8, 96
3708 Cheraz NE
Albuquerque, NM 87111 Phone: (505) 275-6145

1 atch- newspaper article
NOTE ORIGINAL CONFIRMS FAX OF 9Feb96 - Report of Transmission attached

Heavy water use may sink the city – literally

By Lawrence Spohn
TRIBUNE REPORTER

Some sections of Albuquerque could begin sinking if the city's thirst for underground water isn't quenched soon, a new study says.

Continued heavy water pumping could produce "surface land subsidence" throughout the city, according to the study by William Haneberg of the New Mexico Bureau of Mines and Mineral Resources in Albuquerque.

Haneberg warned today that this could have enormous economic consequences, such as fractured underground utility lines, sinking buildings and streets, and tilting canals and sewers.

It's a problem [illegible] in mining communities, notably those built atop vast coal mines in the East and Midwest where networks of tunnels collapse over time. This undermines the land surface and causes structures above to sink.

In mining communities, court houses or other buildings directly above a mine tunnel may sink several inches or even feet.

But in Albuquerque, major portions of the city sit on top of the aquifer and could experience "widespread land subsidence if heavy groundwater pumping continues," Haneberg cautioned.

Haneberg's study is in the current issue of the scientific journal "New Mexico Geology."

Removing large volumes of water from the vast underground reservoir reduces the "buoyant support for the sand and gravel grains that support the aquifer," he

Please see WATER/A8

WATER *from A1*

explained.

As water is removed, "the aquifer is compacted under its own weight" and the stress of the land above it, he said.

He estimates that the aquifer beneath the city could "be compacted by as much as 10 feet for every 100 feet that the water level falls."

However, subsidence would be closer to 1 or 2 feet, he predicted.

Hydrologists already figure the water level has dropped beneath Albuquerque by about 160 feet.

For now, the magic number for serious consequences appears to be about double that. If water levels dip to about 330 feet below initial elevations, sinking will begin to occur, Haneberg predicts.

However, water levels dipping to as little as 260 feet or as much as 400 feet could trigger subsidence.

"In Albuquerque, we are fortunate because we can anticipate the potential for land subsidence, look at the damage it has caused in other places and have enough time to make decisions before subsidence becomes an issue," he said.

For those who doubt the threat, Haneberg cited "major economic problems in and around cities such as Phoenix, Tucson, Houston and Las Vegas, as well as Deming.

"Heavy groundwater pumping south of Deming is responsible for land subsidence and the occurrence of large cracks, in some cases several hundred yards long, in the ground," he reported.

The study was the result of a cooperative research agreement between the state bureau and the city of Albuquerque. Collaborators included hydrologists and geologists with the U.S. Geological Survey.

Another study reported in the journal concludes that recharging the aquifer might be feasible.

Subsurface injection of treated Albuquerque sewer effluent, as well as Rio Grande surface water "will probably be successful," concludes bureau geologist T.M. Whitworth.

Fax Cover Sheet

Date: Feb 9, 96

To: MR. WADE CARROLL, MIPP EIS DOCUMENT MANAGER

Fax Number: (301) 903-5434
VOICE - (301) 903-7721

From: PRISCILLA TRACY 3708 CHERAZ NE ALBUQUERQUE, NM 87111

Contact Number:

Message: SUBJECT: COMMENTS ON MEDICAL ISOTOPES PRODUCTION PROJECT: MOLYBDENUM-99 AND RELATED MEDICAL ISOTOPES: DRAFT ENVIRONMENTAL IMPACT STATEMENT. COMMENTS MUST BE POSTMARKED TODAY. I AM ALSO FAXING TO ENSURE TIMELY RECEIPT. FOLLOWING ARE COMMENTS AND A NEWSPAPER ARTICLE AS REFERENCE

Total number of pages including this cover sheet: 3

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MB : SEND TO MAILBOX PG : POLLING A REMOTE MP : MULTI-POLLING RM : RECEIVE TO MEMORY

Responses to Comment Letter C059

1 For the convenience of the public, the Department provided a form for individuals who wished to submit comments while attending the public hearings. Because the form was intended to be turned in at the hearings, mailing information was not provided on it. Individuals who wished to submit comments by mail had access to the Department's project address through other materials distributed at the hearings, including the Draft EIS and an informational brochure. Additionally, the mailing address was printed in all public notices.

With regard to the amount of writing space on the form, it should be noted that the Department placed no limitation on the number of forms that could be used for any comment. Individuals had the option of continuing comments on multiple forms or other sheets of paper.

2 If the decision is made to pursue this project, the Department would act as a backup to the existing Canadian supplier. The goal of the proposed project is to ensure that a reliable supply of Mo-99 is available to the U.S. medical community, not to produce Mo-99 for export and to compete in the worldwide market for Mo-99.

The Department would prefer that the private sector assume responsibility for ensuring that a reliable supply of Mo-99 is available to the U.S. medical community; however, private industry has thus far been unwilling to do so. Therefore, DOE has proposed to conduct the Medical Isotopes Production Project. If private industry is able to ensure a reliable supply of Mo-99 on its own, the Department could phase out its production activities.

If DOE decides to pursue this project, private industry may wish to privatize some or all of the production activities. If a private company makes such a proposal, the Department will thoroughly evaluate the costs and benefits of such a proposal, including the effect privatization would have on other isotope production ventures.

3 The impact of EIS proposed actions on water use in the Albuquerque region is considered in this document. SNL/NM obtains its water from onsite wells at Kirtland Air Force Base (KAFB) and supplements it with water purchased from the Albuquerque municipal water system. The total water use from operation of the Annular Core Research Reactor at SNL/NM would increase from the current average of 5000 gal/day to 29,000 gal/day (Section 5.13), compared with total water use at SNL/NM of 1,000,000 gal/day (Section 4.1.13) or total water use in the Albuquerque region of 90,000,000 gal/day. This represents less than a 3% increase in water use at SNL/NM, or 0.03% increase in water use for the region, and would not be expected to substantially impact local geology or availability and quality of water in the aquifer.

4 The concerns expressed in the comment regarding risks associated with medical isotope production are noted; however, the risks associated with any alternative considered in the EIS are low. The risks as well as the benefits to the public associated with producing and transporting medical isotopes will be taken into account by DOE in its final decision on whether to implement the project, and at which site, if any, it should be located.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

February 5, 1996

Mr. Wade Carroll, EIS Project Manager
Medical Isotopes Production Project (NE-70)
U. S. Department of Energy
19901 Germantown Road
Germantown, Maryland 20874-1290

Dear Mr. Carroll:

I am responding to the letter dated December 13, 1995, from Ms. Carol M. Borgstrom, Director, Office of NEPA Policy and Assistance to Mr. Robert Bernero, requesting comments on the Department of Energy's document, "Medical Isotopes Production Project: Molybdenum-99 and Related Isotopes, Draft Environmental Impact Statement".

1 In a cursory staff review of the document, we are in agreement with the
overall conclusions of the report and in the necessity for a domestic supply
of molybdenum-99 (Mo-99). One issue identified by my staff is in the
2 evaluation of the environmental consequences of the transportation of the
Mo-99, to the radiopharmaceutical companies for processing. Consideration of
the existing and comparable shipments from Canada to these same companies may
result in a finding of no increase in risk\impact over that of current
transportation practices.

Thank you for the opportunity to review this document.

Sincerely,

Donald A. Cool, Director
Division of Industrial and
Medical Nuclear Safety
Office of Nuclear Material Safety
and Safeguards

Responses to Comment Letter C060

1 Comment noted

2 If the Department decides to ship Mo-99 to Nordion for final product testing and distribution, then the transportation impacts of shipments from the DOE facility, as discussed in Section 5.11, would essentially be additive to the impacts of Nordion's current transportation activities. If the Department decides to ship Mo-99 directly to the radiopharmaceutical companies, then the transportation impacts of DOE shipments would essentially supplant the impacts of part or all of Nordion's transportation activities.

GLEN DARNELL
318 Bainbridge Drive
Tetonia, Idaho 83452

February 8, 1996

Mr. Wade Carroll, MIPP-EIS Document Manager
U.S. Department of Energy
19901 Germantown Road
Germantown, Maryland 20874

Dear Mr. Carroll:

I would like to make my input on the draft environmental impact statement for the MIPP-EIS.

1 It should be a MUST that the Molly-99 production facility be capable of sustained production of at least 100% of America's medical needs. To do less when the capability exists would be a waste of taxpayer funding.

2 The current "preferred alternative" is the Annular Core Research Reactor (ACRR) at Sandia National Laboratory in New Mexico. As I understand it, the ACRR would require extensive modification to produce even 75% of America's Molly-99 needs. I assume that the modification would require additional EIS development, related documentation, etc. (A costly effort.)

3 The Power Burst Facility (PBF) at the Idaho National Engineering Laboratory can produce approximately 150% of America's needs for Molly-99 without modification. Since this is to be a commercial venture, it is logical to provide profit incentive to potential investors by offering the capability to meet not only America's needs, but Canada's as well. Especially when the PBF is less expensive than the ACRR at the outset.

4 If logic transcends politics, the PBF will prevail, especially when the Boron Neutron Capture Therapy capability is added to the commercialization equation. In tern, America's (and the world's) medical proficiency will be enhanced while the taxpayer is rewarded.

Sincerely,

Glen Darnell

Glen Darnell

Responses to Comment Letter C061

1 All of the reasonable alternatives would (after necessary modifications) have the capability to produce at least 100% of the U.S. demand for Mo-99.

2 The modifications required to produce 100% of the U.S. demand for Mo-99 using the Annular Core Research Reactor (ACRR) are detailed in Section 3.3.1.9 of the EIS.

3 As discussed in Section 3.3.4.9, several modifications to the Power Burst Facility (PBF) would be required. Besides modifying the central cavity, which is a significant modification, the reactor control system would need to be modified for a continued steady state, non-pulse mode. The transient rods would need to be removed and fixtures for target irradiation placed in the vacant locations. Cooling flow to the central cavity would need to be appropriately established, along with the normal core cooling flow in lieu of the contained loop that currently exists. Flow balance valves for the central irradiation cavity would have to be designed and installed to assure that appropriate target cooling flow is established without flow-induced vibration of the targets occurring. The core would need to be redesigned to supply a hardened spectrum of neutrons to the central irradiation cavity. Concentration of the power to the core center would be needed to establish the appropriate flux levels without needing to operate the reactor above 10 MW to make the facility competitive regarding fuel utilization.

The intent of the proposed project is to act as a backup to the existing Canadian supplier of Mo-99 in case that source of supply becomes unavailable. The Department is not proposing to compete in the worldwide market for Mo-99.

4 The Idaho Brain Tumor Center (IBTC) has informed DOE of its interest in coordinating its efforts with those of DOE; however, IBTC has not submitted any plans for coordinating reactor conversion activities, nor has it made a formal proposal to DOE. In addition, the Department understands that IBTC is investigating the possibility of using other facilities for boron neutron capture therapy (BNCT) and that other reactors under consideration for this project may be usable for BNCT. If the Department decides to proceed with a production alternative for this proposed project, it would welcome a proposal from IBTC for dual use of the reactor facility selected.

FAX

U.S. Citizen
1405 Glennbrier
Idaho Falls, ID 83401
H: (208) 523-9219

Date 02/06/96

Number of pages including cover sheet ____

To:

Wade Carroll, MIPP-EIS
Document Manager

Phone 301-903-7731
Fax Phone 301-903-5434
CC:

From:

Bentley J. Harwood
US Citizen
MS Nuclear Engineering

Phone 208-523-9219
Fax Phone

REMARKS:

☐ Urgent ☐ For your review ☐ Reply ASAP ☒ Please comment

I would appreciate a written response to the following comments. Please call me prior to faxing so that I may activate my fax machine.

5.15.4.2 The first paragraph states that the Omega West Reactor is similar to the Power Burst Facility. Although this may be true, later in the same paragraph, the EIS states that "In all cases, the design basis accident described in the Omega West Reactor SAR bounded the consequences, and thus qualitative description from the Omega West Reactor SAR were used in developing..." The problem that needs to be corrected is the fact that fuel elements in these two cores are totally different. Omega is aluminum alloy while the Power Burst is stainless steel oxide. Core melting temperatures are likewise vastly different. This then leads me to believe that source terms from these scenarios should be completely different. The melting of aluminum takes place over a small temperature range while stainless steel oxide does not. Further, other components of either reactor would likely melt and
1 shutdown at different points prior to any type of release.

The Power Burst Facility used to perform experiments on utility fuels up to and including their destruction while retaining the Power Burst Facility reactor core integrity. It, in my opinion, is extremely unlikely that a fuel melt would occur under any conditions at the PBF. A more probable scenario is likely to be more along the lines of the Sandia aircraft crash or natural phenomena resulting in fuel cladding breach but certainly not fuel melting.

This scenario needs to be re-evaluated to at least recognize the above described differences.

5.15.4.2 Table 5-41 lists a dose to a public access location 1000 m to the South. This road or whatever this is does not exist. The closest public access is the highway to the South much further than 1000m. There is no turnoff, parking, or road where this calculation indicates people will be. From USGS maps, the approximate distance from the PBF to Highway
2 20 is just short of 4 miles. All access to the PBF is controlled (the public cannot routinely enter the area) and Highway 20 can be closed very quickly in an emergency. Note that Highway 20 actually crosses the Southern boundary of the INEL site. That is, the INEL site boundary is around 7.7 mi. from the PBF. The distance used for this calculation is in error as well as the source term.

The other tables in section 5.15.4 also have the same problems just described. These calculations must be corrected before this EIS is issued as final.

4.1.2.3 This section states that the shortest distance between the Albuquerque city limits and the reactor area is 2 km (1.2 mi.). Why do the
3 consequence calculations in section 5.7.1 use 5.4 km (3.4 mi.)? I believe the MEI is a person that lives at the closest boundary. Justification is required to make this argument stick.

4.4.7.2 The first paragraph discusses INEL operations related to sources of
radioactive emissions. The Navy training reactors referred to have been
4 shut down and no longer have emissions. Spent nuclear fuel testing is
no longer conducted. Nuclear fuel stabilization consists of repackaging
and results in nearly unmeasurable releases. This paragraph should be
corrected to reflect current operations.

4.4.7.2 The third paragraph discusses the emission of noble gases and various
other products. Where are these coming from? Most facilities that
would produce these products have not been operational for many
years. The largest error in this paragraph is the discussion of Krypton-
5 85 releases due to fuel reprocessing at the ICPP. This operation has
not run since before 1991. The reference used here is incorrect. The
EIS must reflect current conditions. Lastly, only one reactor remains
operational. The statement that refers to "reactor operations release ..."
should be corrected to indicate that it is not many reactors, but only one.

4.4.8.1 The statement that PBF is 1 km (0.6 mi.) from the Big Lost River
channel is in error. This number more closely reflects the Idaho
Chemical Processing Plant. The PBF is around 3.5 mi. from the
channel.

4.4.9.2 The first paragraph indicates that the PBF site may not be acceptable
because of the close proximity of the river channel. The second data
indicates that no data is available concerning aquatic live in the river.
6 Both are incorrect. The Big Lost River channel is around 3.5 mi. from
the channel. Second, data does exist, see the INEL EIS. Further the
Big Lost River does not flow onto the site except in years of exceptional
runoff. Therefore, there is no aquatic life during normal years because
there is no water in the river channel. These paragraphs need to be
corrected.

4.4.9.2 The birch creek playas are only "in the general vicinity of Argonne
National Laboratory-West" if you consider the INEL the general vicinity.
These playas are around 3 to 4 miles from Test Area North and about
17 mi. from the PBF area and 15 mi. from ANL-W. Please correct the
wording and the implications.

5.7.4 The discussion here indicates that 620 Ci of Argon-41 would be
released primarily due to target processing. However, previous
discussions stated that the processing facility would be located at the
7 PBF. That is, the processing facility would have to be built. Why is the
release quantity so large then? This facility would never be built if it
worked so badly. This source term needs further explanation.

8 3.5 Table 3.1 needs to be reworked based on the chapter 3 comments. Consequences due to a processing facility seem to be off. This conclusion is based on primarily the fact that Sandia is very close to a major population center and the INEL is many miles (42 mi.) from the nearest large population center, but the MEI consequences for target irradiation are lower for Sandia than for the PBF. In a similar vain, the consequences for the target processing facility are nearly equal. These numbers look extremely fake.

In addition, consequences to a collocated worker are higher for a facility that has to be built at the INEL than for a facility that exists or partly exists at Sandia. Again, these number look fake. Further discussion and/or description is necessary to add credibility to the numbers in this table.

9 5.14.4 Near the middle of the first paragraph states the fuel elements would be transferred to the Irradiated Fuel Storage Facility for dry or wet storage. This facility is strictly a dry storage facility. Another facility may be available for wet storage. Please correct.

Responses to Comment Letter C062

1 The technical basis of the comment is substantially correct. The EIS attempted, to the extent possible, to utilize existing safety documentation and other analyses in developing accident scenarios that would represent the design basis accidents for facilities considered in the Medical Isotopes Production Project. However, the Power Burst Facility (PBF) safety analysis report (SAR) is outdated and does not contain sufficient information on radiological emissions associated with the design basis accidents evaluated in the document. Based on information contained in the PBF SAR, a coolant flow blockage in the core leading to overheating and fuel element damage was included as a credible design basis accident. This is similar to the type of accident evaluated for the Omega West Reactor (OWR) and for which a radionuclide release estimate was available. Therefore, the OWR release estimate was used to evaluate a similar accident at PBF and also at the Oak Ridge Research Reactor (ORRR) in the absence of more recent analyses specific to those facilities. The release estimates were combined with site- and facility-specific information (stack parameters, meteorology, and location with respect to potential receptors) to estimate the consequences to workers and the public from these accidents.

In addition, the estimated radionuclide releases for fuel damage scenarios (from whatever cause) at OWR and the Annular Core Research Reactor (ACRR) were similar, and use of the OWR scenario to represent emissions from an accident at PBF should bound the consequences of a design basis accident at that facility. Assuming a lower release or accident frequency based on the thermal characteristics of PBF fuel might result in a lower risk estimate; however, this would not likely change the conclusions reached in the EIS because the accident risk associated with operation of any of the facilities is low.

2 The access point assumed for PBF facilities is actually a thermal luminescent dosimetry (TLD) monitoring station at the area boundary. In the absence of more detailed information, it was assumed for purposes of the analysis that a member of the public could gain access to this location. The analyses presented in the EIS for consequences at the public access location following accidents at PBF are therefore more conservative (i.e., estimate a higher dose) than if the highway location were chosen. However, this would not likely change the conclusions reached in the EIS because the accident risk associated with operation of any of the facilities is low.

3 The distance used for the offsite receptor evaluation at SNL/NM represents the location of a full-time resident who receives the highest potential exposure to facility emissions. In some cases, meteorological conditions result in this location being other than the nearest possible access point. Also, other locations to which the public has access are not residential areas, and the exposures at these locations would be substantially lower than at a permanent residence because they are not continuously occupied.

4 The radiological air quality section is based primarily on information in the Spent Nuclear Fuel Programmatic Environmental Impact Statement (SNF PEIS) (DOE 1995b), which reflects site operations in 1991 with updates for some facilities that were expected to begin operation during 1995. The third sentence in the third paragraph of Section 4.4.7.2 was changed to read, "Historically, the radionuclide with the highest emission rate is the noble gas krypton-85, which was released primarily by the chemical reprocessing of spent nuclear fuel at the Idaho Chemical Processing Plant."

Radionuclide emissions from the INEL during 1994 included about 550 Ci of tritium, 2100 Ci of noble gases, less than 1 microcurie of transuranics, and about 10 Ci of other mixed fission and activation products (see 1994 INEL air emissions report to EPA [DOE 1995q]). Emissions from the PBF and the surrounding area amounted to less than 1 microcurie of mixed fission products during that time. The change in status for facilities noted in the comment is acknowledged; however, this information would not affect analyses or conclusions reached in the EIS.

5 Please see response to comment C062-4 above.

6 Sections 4.4.8.1 and 4.4.9.2 of the EIS have been changed to correctly describe the environment.

7 The emissions of argon-41 referred to in the comment would result from operation of the PBF to irradiate targets rather than from target processing. These emissions result from neutron activation of stable argon in the reactor cooling system. Noble gas emissions from either the reactor or target processing facility would not be affected by the type or extent of filtration systems installed in the facility exhaust because of their unreactive nature. Similar emissions were estimated for the reactors associated with other alternatives as well. The emission control systems at any facility utilized for the project would be upgraded as necessary so that they meet all Federal and state standards before operations begin.

8 The consequences of radionuclide releases from a particular facility are a result of the release conditions, the quantity released, meteorological conditions, and the location of receptors relative to the release point. The differences noted in the comment are a result of combining all these factors to determine radiation dose to individuals and populations. Section 5.7 and Appendix C of the EIS contain additional information about the assumptions used to estimate consequences of facility operation.

Because the emissions from medical isotope production facilities consist mainly of noble gases, which are not held up by particulate filters or other typical effluent control systems, the type of filtration system installed in the facility would have only a minimal effect on consequences to workers and the public. The emission control systems at any facility utilized for the project would be upgraded as necessary so that they meet all Federal and state standards before operations begin.

9 Section 5.14.4 was revised to eliminate the confusion. The Irradiated Fuel Storage Facility is a dry storage facility: other facilities at the Idaho Chemical Processing Plant could be available for wet (CPP-666) or dry (CPP-749) storage.

Mr. Wade Carroll
EIS Project Manager
Office of Nuclear Energy, Science and Technology (NE-70)
U.S. Department of Energy
19901 Germantown Rd.
Germantown, MD 20874-1290

January 1, 1996

Dear Mr. Carroll,

I have received a draft EIS for the Medical Isotopes Production Project: Molybdenum-99 and Related Isotopes. I have read all the portions related to Sandia and Los Alamos. I find that the draft EIS <u>**more than adequately**</u> addresses any concerns I have. I think it is an accurate and in-depth document, which has been thoughtfully and carefully prepared. I do however, have some comments in regards to the draft EIS which I would like to be considered.

I would first like to make clear that I am completely in favor of MIPP, and
I believe that medical isotopes (specifically Tc-99) helped to save my son's life.
1 From my point of view, this is a vitally important project, and must go forward in
some fashion regardless to the location selected. I find that the **NO ACTION**
ALTERNATIVE is **COMPLETELY UNACCEPTABLE,** and if possible, should be
2 removed from the EIS as an alternative course of action. The no action
alternative does not **protect the interests of the people of the United States.** At a previous MIPP EIS meeting I heard comments related to the possibility of producing Tc-99 (and other isotopes) in other countries, and using these sources for our domestic needs. The countries mentioned were Belgium and Russia. I immediately recalled the 1973 Arab oil embargo, and the effect it had on fuel availability and price. While we may be able to count on Belgium as a friend, the political climate there is subject to change, which could preclude the manufacture of these necessary isotopes. Russia is again leaning towards communism, and they are a recent fair weather friend at best. If we leave the hard choices to people overseas, we will end up as a nation of burger flippers, dependent on imported beef and spatulas.

Once again I would like to state that I am entirely in favor of MIPP, but I would like to point out some social factors about New Mexico that could possibly be used to speed this project along. If SNL/NM is chosen for the irradiation portion of the project you may see some opposition from the pseudo-environmentalists and nimby's in the Albuquerque area. Most New Mexicans are completely unaware that there any nuclear reactors in New Mexico. A few years ago SNL wanted to dump 50,000 gallons of slightly radioactive water into the Rio Grande. The water was reported to be less radioactive than ordinary milk. When the general public learned of the plan, the opposition was tremendous, and the objections raised we so strong that the water had to be disposed of in some by some other (much more expensive) means, after about six months of haggling.

Since I began writing this letter, recent protests confirm this perception. Anti-nuclear activists (pseudo-environmentalists) protested the MIPP plan to irradiate the targets at SNL on 1/29/96 in Albuquerque, NM. A spokesperson for the activists charged that it was a pork barrel project designed to keep secret N weapon research going, and that we could purchase our Tc-99 from Canada. You, I, and the DOE know that this is a big lie, and that this project is vitally important to our nation. When you get the comments from Los Alamos regarding this project I am sure that you will seethat there is no opposition from the people who will have this project in their backyard (I can see the LLW dump from the roof of my house, it's about 700 yards away!)

I will attend the Los Alamos meeting on 2/1/96, and I am confident that the discussions I will hear **FROM THE PEOPLE OF LOS ALAMOS COUNTY** will be as before, not whether to produce these vital medicines, but as to what method to use. I implore you to proceed with this project at one of the selected locations, just do it. If some other more efficient method (linear accelerator, liquid reactor etc.) comes along, well this is America, and we will change to the most cost effective method. But for now we must push ahead, and do it. **I WOULD PREFER LOS ALAMOS, AND IT IS IN MY BACKYARD, BUT IF ANOTHER SITE IS CHOSEN, FINE! FINE! FINE! FINE! JUST DO IT!!!! DON'T LET US (UNITED STATES) RUN OUT OF THIS MEDICINE!!! MY SON MIGHT NEED IT AGAIN!! YOUR CHILD MIGHT NEED IT!!!**

Sincerely,

Michael A. Dempsey

Michael A. Dempsey
300 Connie Ave.
White Rock, NM 87544

(505) 672-3726

Responses to Comment Letter C063

1 Comment noted.

2 Comment noted. The no action alternative is required to be analyzed under the Council of Environmental Quality's regulations implementing NEPA.

COMMENTS ON DOE/EIS-0249D
MEDICAL ISOTOPES PRODUCTION PROJECT:
MOLYBDENUM-99 AND RELATED ISOTOPES

Kent L. Brinker
755 E. 1600 N
Shelley Idaho 83274

Page 3.23 ACRR has to have new fuel made for the Mo-99 production, has the safety analysis been performed or will this be an extra cost?

1 Has the cost of new fuel construction and procurement been added into the costs for ACRR?

Page 3.24 Has all the safety analysis and engineering been performed for replacement of most of the reactor control systems and safety systems? It appears that almost the entire reactor controls will be redone including rod drives, instrumentation, and safety systems. Are these costs included in the startup estimates?

2 If the closest approach of the city limits is 1.2 miles why is 3.7 miles used in the accident and release estimates.

3 I do not see where the increased shipments of waste to the Nevada Test Site for ACRR and ORNL is totally addressed for safety and accidents during shipment. Only LANL and INEL have total capacity for cradle to grave waste disposal/handling. The same for target production and isotope separation.

4 The INEL has sufficient fuel stored at ICPP that no fuel would have to be shipped for manufacturing the targets.

5 Page 3.51 second paragraph: reference to Highway 26 is incorrect. The Highway is Idaho route 33. This can be closed for a shipment to TAN.

How can PBF's stainless steel clad ceramic fuel be comparable in a loss of flow accident to the aluminum clad metallic fuel of Omega West MTR type fuel? PBF FSAR allows over 2000 degrees C for fuel centerline temperature and the core/fuel is designed to reach over 1 gigawatt in a natural burst and sustain no damage. For its power PBF is probably one the safest fuels/cores ever
6 designed and operated.

PBF has a 36" active core and a test space of 8.25" allowing use of very close to the original size of the Cintichem 16" targets. The targets can be doubled end to end in the PBF core and the test space can physically contain at least 27 targets. Were these facts taken into account for the Mo-99 production capacity of PBF?

Page viii: The statement is that no private company is available in the near term to take on Mo-99 production

The Idaho Brain Tumor Center IBTC has a lease on the Power Burst Facility (PBF) for Boron Neutron
7 Capture Therapy (BNCT). IBTC is a private company. The operation of PBF for both cancer treatment and Mo-99 production is compatible. IBTC would be part of privatization from the start at PBF.

In a time of fiscal restraint, if all the reactors are considered to be equal in capacity and time to full
8 production, what is the reason for ACRR to be the preferred choice when PBF would be the least costly alternative for modification and operation?

For a long-term solution to domestic Mo-99 supply, PBF should chosen for modification. The 12 million dollars/year for Annular Core Research Reactor (ACRR) operation would be saved. The cost for modifying PBF is millions less than the ACRR. PBF is capable of supplying much more of the amount of Mo-99 isotope needed for U.S. consumption. Using the EIS figures, ACRR costs for 5 years would be approximately 89 million dollars (including modifications). Over a period of 5 years PBF would cost the taxpayers 59 million dollars (including modifications) without IBTC participation. With IBTC participating and developing BNCT along with Mo-99 production, PBF operation/modification would cost the taxpayers approximately 33 million dollars. The difference in cost to taxpayers, 30 million/57 million dollars. These savings do not include the reduction/payback from BNCT fees to
9 DOE. After modification/start-up of 2 years, DOE/taxpayers would have minimal or 0 costs for domestic Mo-99 production as it would be by a private company. Once BNCT is in place and patient treatment started, DOE would receive income from the fees agreed to in the long-term lease agreement with IBTC. This could possibly total up to 3 million dollars/year. DOE could utilize this income to help fund other projects such as cleanup of various sites. DOE headquarters has issued orders that all operations that are appropriate for privatization should be privatized. This project would be a perfect illustration of this principle. Not only is PBF the better choice in terms of cost to DOE/taxpayers for Mo-99, a cancer treatment facility for one of the most violent and deadly forms of cancer would be created at the same time at no additional cost to DOE/taxpayer. From an economic and technical standpoint the PBF option is the best, let alone on a humanitarian basis.

If a short-term small production supply is paramount, then according to the EIS information the ACRR can start to production 10-30% of the Mo-99 in a 6 month period with the removal of its experiment dry hole and fabrication of a target holder. ACRR could provide a small temporary supply while PBF is
10 coming up to full production. No purchase of new fuel, change out of the present fuel, or replacement of controls systems would be required for this small amount of production. The existing hot cells can perform the processing for 10-30% level of operation. The funds to complete full modifications for ACRR 100% production would be saved. This option would supply Mo-99 for a minimum cost for the short-term. If there is a shutdown of Nordion supplies during the next 22 months none of the sites could produce 100% of the needed U.S. supply anyway.

Responses to Comment Letter C064

1 The calculations regarding the new fuel and core design have been performed, but these future changes are not adequately addressed in the current safety analysis report (SAR). The SAR will need to be updated before the core change is made. The cost of the change is factored into the SNL/NM budget. New fuel procurement has been factored into the annual operating cost of the SNL/NM facility. Costs of the modified control system have been included in the startup estimate. The safety analysis and engineering design has been completed for the control system modifications.

2 The distance used for the offsite receptor evaluation at SNL/NM represents the location of a full-time resident who receives the highest potential exposure to facility emissions. In some cases, meteorological conditions result in this location being other than the nearest possible access point. Also, other locations to which the public has access may not be residential areas, and the exposures at these locations would be substantially lower than at a permanent residence because they are not continuously occupied. The analysis also considers exposure to onsite workers and to members of the public at a non-residential location to which there is unrestricted access.

3 As described in the EIS, some transportation of Mo-99 and small quantities of low-level waste would be required at any of the alternatives considered. For some of the alternatives this transportation would take place almost exclusively onsite, while others would require use of public roads. The ORNL alternative and the preferred alternative both would require periodic shipments of low-level waste to the Nevada Test Site (NTS). An analysis of the transportation of low-level waste, irradiated targets, and finished isotopes is provided in Section 5.11 of the EIS. This analysis includes the effects of accidents during transportation of low-level waste to NTS.

4 The statement regarding INEL is true. It is also true for every alternative other than the option of target fabrication at SNL/NM.

5 Section 3.3.4.9 of the EIS has been corrected to identify the proper route.

6 The Power Burst Facility (PBF) does not have a current SAR based on DOE Order 5480.23. Since the existing SAR does not contain the accident analysis needed for the EIS, it was assumed that the bounding fission product release accident would be the total flow blockage of one bundle. The source term was then calculated based on the fission product inventory in one fuel bundle. The LANL Omega West reactor has a prepared SAR based on DOE Order 5480.23, and a similar accident was described there. In this aspect, that of the bounding reactor accident being a flow blockage, the two facilities are similar.

Twenty-seven targets will not arrange well uniformly in a circle. One can arrange 19 well, but the next step is 37. Uniform thermalization of the flux is the objective. Stuffing targets so they fit would not be beneficial in that several would run at very high powers and several would run at low powers. Further, with a higher metal-to-water ratio, the targets will operate at lower powers because less thermalization will take place and fewer fissions will occur. Going from a 19-target configuration to a 37-target configuration requires about 1.3 times as many targets to produce a given quantity of Mo-99 because of less thermalization. Lower power targets cause greater specific waste (waste volume per curie of Mo-99 produced). Nineteen targets is likely to work well in PBF.

Stacking the targets is not prudent because it would generate more waste. Waste generation would be higher because flux at the edge of the core is lower; the lower flux at the edge of the core means that the target ends would have low fission rates. Stacking reduces the production per target and increases the number of targets required for full production, which increases the waste produced. Nineteen targets in the center, plus a total of six in the transient rod locations, should be satisfactory for full production.

Long targets are not necessarily prudent either. Their curie content would make hot cell work difficult. A 20-inch target at a fission rate designed to yield 20 kW per target possesses 35,000 curies after a 6-day irradiation and a 6-hour cooling period. A 30-inch target would possess over 50,000 curies. While the larger target could be made to work, it is not a clear advantage. Also, it will not fit in a 55-gallon drum.

7 The Idaho Brain Tumor Center (IBTC) has informed DOE of its interest in coordinating its efforts with those of DOE. The Department is aware of this potential for the INEL alternative, but IBTC has not made a formal proposal to the Department regarding the dual use of the PBF. Although the potential for privatization of the proposed action in this EIS is important, the process for privatization is not part of this proposed action. Each of the production alternatives has potential for privatization. DOE has solicited expressions of interest from the industrial community for the privatization of any isotope production activity conducted by DOE, including the proposed Medical Isotopes Production Project. If promising concepts are received, the Department would seek privatization proposals on a competitive basis.

8 The reasons for identifying the preferred alternative are stated in Section 3.3.1.1.

The Department recognizes that the estimated cost of the INEL alternative is lower than that of the preferred alternative; however, the uncertainties associated with the estimated cost of the INEL alternative are higher than for the preferred alternative. If the Department decides to proceed with the proposed action, the information presented in the EIS (including the cost data), the operational readiness of facilities, and other programmatic factors will be considered in the final selection of facilities for Mo-99 production.

9 Please see responses to comments C064-7 and C064-8 above.

10 Comment noted.

R.U.C.A. ANTI-*NUCLEAR* WASTE

(Ruidoso Upper Canyon Association)
Dedicated to Preserving Quality of Life

P.O. Box 3553
Ruidoso, NM 88345

378-8383
301 Hwy. 70
Plaza D'Oros

Feb. 6, 1996

Mr. Wade Carroll
EIS Project Manager
Office of Nuclear Energy, Science & Technology (NE-70)
U.S. Dept. of Energy
19901 Germantown Road
Germantown, Maryland 20874-1290

Dear Mr. Carroll,

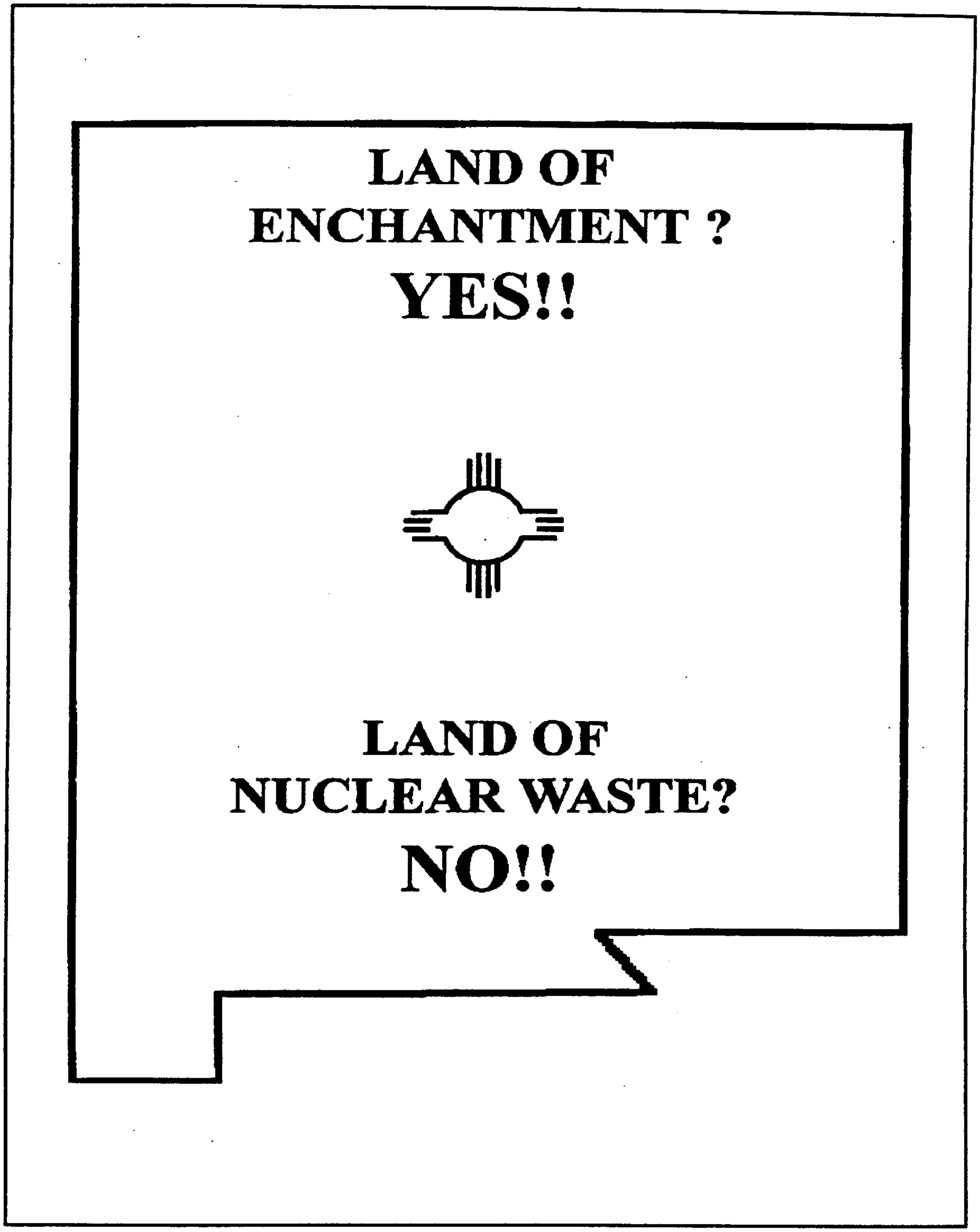
Attached please find resolutions which have been passed by the governing bodies of all towns in Southern New Mexico. I did not bother to obtain the resolutions from the rest of the State but they are there.

1 As you can see the citizens of New Mexico strongly object to any further storage of either hi-level or low-level nuclear waste. It is obvious that we are the dumping grounds for all of this junk which the Eastern and Middle States do not want. WE HAVE HAD ENOUGH AND WILL FURTHER PHYSICALLY PROTEST THIS LATEST ATTEMPT TO ADD TO THE CONTAMINATION WHICH WE ALREADY HAVE.

The attached poster explains our position very well and we feel that is is time that the D.O.E. quit acting like the 3 monkey fable with their attitude of "SEE NO EVIL, SPEAK NO EVIL, HEAR NO EVIL" when it comes to nuclear waste.

RUCA anti-nuclear waste campaign
Hazel C. Haynsworth-Chairman

Copies: All N.M. Congressional Delegates


LAND OF
ENCHANTMENT ?
YES!!
LAND OF
NUCLEAR WASTE?
NO!!

VILLAGE OF RUIDOSO

RESOLUTION 92-37

A RESOLUTION CALLING UPON THE UNITED STATES CONGRESS TO AVOID THE WASTEFUL EXPENDITURE OF FUNDS FOR MONITORED RETRIEVABLE STORAGE OF HIGH LEVEL NUCLEAR WASTES, REQUESTING THE CONGRESS TO CONVENE AND CONDUCT HEARINGS AND INVESTIGATION OF THE NUCLEAR WASTE MANAGEMENT PROGRAM OF THE UNITED STATES DEPARTMENT OF ENERGY, AND FURTHER REQUESTING THE HONORABLE BRUCE KING, GOVERNOR OF THE STATE OF NEW MEXICO, TO JOIN IN THIS REQUEST.

PREAMBLE

A. The United States Department of Energy and Office of Nuclear Waste Negotiator have funded throughout the country twenty (20) "feasibility studies" of Monitored Retrievable Storage of "spent" fuel from commercial power reactors and other high level radioactive wastes. Each study grantee initially received $100,000., awarded mostly to Native American tribes and a few County government jurisdictions. The Mescalero Apache Tribe requested and received federal funds ($300,000.) to study the feasibility of a Monitored Retrievable Storage (MRS) facility, on or near their reservation, located adjacent to the Village of Ruidoso, New Mexico. Documented expenditures for these studies, to date, amounts to $2.2

million.

B. Congress' own MRS Review Commission, along with the General Accounting Office and other agencies have concluded that an MRS will not contribute significantly to, nor will it reduce costs of the Department of Energy's plans to dispose of spent fuel and other high level radioactive wastes, compared to storage of these wastes at or near the generating facility. When costs of construction and manning the MRS itself, and additional costs of infrastructure development (roadways and rail lines, including rights of way; emergency response teams, facilities and equipment; etc.) are considered, the proposed MRS represents an unacceptable level of cost to taxpayers and utility ratepayers in the billions of dollars.

C. Waste of additional millions of dollars of taxpayers' money can be stopped by the United States Department of Energy and the Office of Nuclear Waste Negotiator ceasing activities promoting and "studying" the MRS concept.

D. Funds saved by cessation of MRS siting and promotional activities, as well as by not constructing a costly but needless "temporary" MRS facility, may be allocated for achieving a safe, economical and environmentally sound system of permanent disposal of spent fuel and other high level radioactive wastes, as well as for other national priorities.

E. The Governing Body of the Village of Ruidoso finds and determines that pursuit of an MRS facility is an unacceptable and unnecessary expense to taxpayers and ratepayers. The potential location of an MRS facility within 100 miles of the Village of Ruidoso would be seriously detrimental to the tourist-based economy of the Village; location of an MRS anywhere within the state would be seriously detrimental to the economy of New Mexico.

F. The Governing Body of the Village of Ruidoso further finds and determines that the incoming Congress of the United States has a unique opportunity to save billions of ratepayers' and taxpayers' dollars by refusing to appropriate additional funds for the study or pursuit of MRS facilities. Upon careful review and revision of current policies, the new Congress also may save large sums of money by redirecting the United States Department of Energy's expenditures and efforts toward development of acceptable permanent disposal technologies.

NOW THEREFORE BE IT RESOLVED BY THE GOVERNING BODY OF THE VILLAGE OF RUIDOSO THAT:

1. The Congress of the United State is respectfully requested to refuse any further appropriations or funding for study of siting Monitored Retrievable Storage facilities, thereby saving taxpayers and ratepayers billions of dollars;

2. The Congress direct the United States Department of Energy and Office of Nuclear Waste Negotiator to adopt recommendations of Congress' Monitored Retrievable Storage Review Commission as those agencies' spent fuel management policies; and,

3. The Congress convene hearings and conduct investigation of the radioactive waste disposal and management plans of the United State Department of Energy, especially examining the manner in which that agency expends and managers appropriated funds, as well as money deposited in and drawn from the Nuclear Waste Fund. The purpose of such hearings and investigation would be to redirect the Department of Energy's efforts and expenditures to devising permanent, safe and economically acceptable solutions to the nation's radioactive waste problems; rather than pursuing costly "temporary" solutions which merely delay and avoid addressing core issues of nuclear waste disposal.

BE IT FURTHER RESOLVED that the Governor of the State of New Mexico, the Honorable Bruce King, is respectfully requested to join in this petition to the United States Congress because of the potential statewide detrimental economic effects of an MRS facility.

the United State Department of Energy, especially

PASSED, ADOPTED AND APPROVED this 15th day of December 1992.

managers appropriated funds, as well as money deposited

Victor M. Alonso, Mayor

SEAL
ATTEST:

Tammie J. Maddox, Village Clerk

PASSED, ADOPTED AND APPROVED this 15th day of December 1992, and

STATE OF NEW MEXICO'S POSITION ON MONITORED RETRIEVABLE STORAGE (MRS)

PRESENTED TO

RADIOACTIVE AND HAZARDOUS MATERIALS COMMITTEE
NEW MEXICO STATE LEGISLATURE

JUNE 24, 1994
SANTA FE, NEW MEXICO

BY

KATHLEEN SISNEROS, DIRECTOR
WATER AND WASTE MANAGEMENT DIVISION
NEW MEXICO ENVIRONMENT DEPARTMENT

AND

CHRIS WENTZ, CO-COORDINATOR
RADIOACTIVE WASTE CONSULTATION TASK FORCE
STATE OF NEW MEXICO

COMMISSION/ADMINISTRATION
(505) 437-7427

DATA PROCESSING
(505) 434-4246

INDIGENT
(505) 434-4033

ROAD/GEOGRAPHIC
INFORMATION SYSTEM
(505) 437-7636

FAX (505) 437-6542

1000 NEW YORK AVE., RM 101
ALAMOGORDO, NM 88310-6935

State of New Mexico

County of Otero

RESOLUTION NO. 80-34

RE: Location of an MRS site in Otero County on or near the Mescalero Apache Reservation

WHEREAS, The Board of County Commissioners has received input from the citizens of Otero County, demonstrating a high level of concern and opposition regarding the location of an MRS site on or near the Mescalero Reservation; and

WHEREAS, The Board of County Commissioners recognizes the sovereignty of the Mescalero Indian Nation when it is conducting Tribal affairs on Tribal lands; and

WHEREAS, The Board of County Commissioners nevertheless recognizes the fact that the actions of the Tribal Council with respect to the location of an MRS site on or near Tribal lands within Otero County impact the interests and concerns of both Tribal members and their neighbors, all of whom are citizens of this County; and

WHEREAS, As a result of the concerns and opposition that have been voiced to this Commission, several areas of common interest have come to light which warrant a request for additional information. Some immediate concerns are:

1) site safety;
2) transportation systems safety;
3) emergency response capability;
4) medical treatment facility status;
5) sanitation and sewer facility requirements;
6) funding mechanisms for any of the above;
7) funding mechanisms for necessary infrastructure development and maintenance outside the Reservation boundaries;
8) health risks posed by the site location under normal operation;
9) health risks posed by the site location in the event of a catastrophic failure on-site or in transportation of materials;
10) economic impact of site location in this tourism industry region;
11) economic benefits to be derived outside of the reservation boundaries by location of the site on or near the Mescalero Reservation;

12) a full environmental assessment which addresses all of the concerns expressed herein;
13) the effect of site location on the population growth of the region;

NOW THEREFORE, BE IT HEREBY RESOLVED BY THE BOARD OF COUNTY COMMISSIONERS OF OTERO COUNTY that this Resolution be presented to the Mescalero Tribal Council and the Department of Energy as a request that either one or both of these entities provide Otero County with any and all information currently in their possession or which may come into their possession in the future with respect to the possible location of an MRS site on or near the Mescalero Reservation which addresses any of the concerns expressed herein.

In addition, the Board of County Commissioners requests that any further study for possible sites to locate an MRS facility on or near the Mescalero Reservation addresses all of the concerns expressed herein and that the Board of County Commissioners have an opportunity to provide input and information in all areas of concern that impact the delivery of services to the public.

BOARD OF COUNTY COMMISSIONERS
Otero County, New Mexico

Robert Ortiz, Chairman

Richard L. Zierlein, Member

Dorothy H. Mills, Member

ATTEST:

Dianna Duran
Otero County Clerk

2

SUMMARY OF MAJOR POINTS

- THE STATE OF NEW MEXICO HAS A SINCERE AND LONG-STANDING RESPECT FOR INDIAN TRIBAL SOVEREIGNTY

- THE STATE OF NEW MEXICO OPPOSES THE SITING OF AN MRS FACILITY ANYWHERE WITHIN ITS BORDERS
  - OPPOSITION IN NEW MEXICO IS STRONG AND BROAD-BASED
  - REASONS ARE MANY AND VARIED

- THE STATE OF NEW MEXICO BELIEVES A RE-EVALUATION OF THE NATION'S CURRENT PROGRAM FOR STORAGE AND DISPOSAL OF SPENT NUCLEAR FUEL IS NEEDED
  - DEVELOPMENT OF A PRIVATE MRS FACILITY WILL ONLY COMPLICATE AND IMPEDE PROGRESS ON RESOLUTION OF THE PROBLEM

1

OPPOSITION IN NEW MEXICO TO AN MRS IS STRONG AND BROAD-BASED

- THE FOLLOWING ELECTED STATE OFFICIALS ALL OPPOSE SITING OF AN MRS FACILITY ANYWHERE IN NEW MEXICO:

  GOVERNOR BRUCE KING[1]
  U.S. SENATOR JEFF BINGAMAN (D-NM)
  U.S. SENATOR PETE V. DOMENICI (R-NM)
  U.S. CONGRESSMAN STEVEN SCHIFF (R-NM)
  U.S. CONGRESSMAN JOSEPH R. SKEEN (R-NM)[2]
  U.S. CONGRESSMAN BILL RICHARDSON (D-NM)

- THE NEW MEXICO SENATE PASSED A MEMORIAL (SENATE MEMORIAL 4, 41st LEGISLATURE, FIRST SESSION, 1993) OPPOSING ESTABLISHMENT OF AN MRS IN THE STATE OF NEW MEXICO

- THE NEW MEXICO HOUSE OF REPRESENTATIVES PASSED A MEMORIAL (HOUSE MEMORIAL 66, 40th LEGISLATURE, SECOND SESSION, 1992) OPPOSING ESTABLISHMENT OF AN MRS IN NEW MEXICO

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[1] See Governor's Office News Advisory of February 3, 1994; and Governor King's Congressional Testimony of March 17, 1994 (attached)

[2] The Mescalero Apache Reservation is located in Representative Skeen's congressional district.

3

NEW MEXICO OPPOSITION TO THE MRS PREDATES MESCALERO TRIBE INVOLVEMENT

- FORMER NEW MEXICO GOVERNOR GARREY CARRUTHERS VOTED IN SUPPORT OF AN MRS RESOLUTION PASSED UNANIMOUSLY BY THE WESTERN GOVERNORS' ASSOCIATION (WGA) IN 1989

- CURRENT NEW MEXICO GOVERNOR BRUCE KING VOTED IN SUPPORT OF THE READOPTION OF THIS SAME RESOLUTION IN 1993

- THIS WGA RESOLUTION (RESOLUTION #89-024) STATES THAT THE WESTERN GOVERNORS:

  -- SUPPORT THE NATIONAL POLICY OF SAFE, PERMANENT, GEOLOGIC DISPOSAL

  -- ENDORSE AT-REACTOR DRY STORAGE, WHERE STORAGE IS PERMISSIBLE UNDER STATE LAW

  -- OPPOSE THE SITING OF ANY MRS WITHIN THE GEOGRAPHIC BOUNDARIES OF A STATE WITHOUT THE WRITTEN CONSENT OF ITS GOVERNOR

5

- SITING AN MRS IN NEW MEXICO IS INEQUITABLE
  - THERE ARE NO COMMERCIAL NUCLEAR REACTORS LOCATED IN THE STATE OF NEW MEXICO
  - STATES THAT HAVE REACTORS AND HAVE THEREFORE BENEFITTED FROM THE GENERATION OF COMMERCIAL NUCLEAR POWER MUST CONTINUE TO TAKE RESPONSIBILITY FOR THEIR OWN WASTES UNTIL PERMANENT DISPOSAL CAPACITY IS AVAILABLE
- NEW MEXICO HAS DONE ITS SHARE, MAKING SIGNIFICANT CONTRIBUTIONS TO BOTH THE ENERGY AND DEFENSE SECURITY OF THE UNITED STATES BY:
  - HOSTING AND MAINTAINING TWO OF THE FEDERAL GOVERNMENT'S NUCLEAR WEAPONS RESEARCH, DEVELOPMENT AND TESTING FACILITIES FOR OVER 50 YEARS
  - SERVING AS A POTENTIAL SITE FOR THE PERMANENT DISPOSAL OF DEFENSE TRANSURANIC RADIOACTIVE WASTE AT WIPP
  - PROVIDING THE VAST MAJORITY OF U.S. URANIUM MINING AND MILLING CAPACITY
- NEW MEXICO HAS REAPED BENEFITS FROM THESE U.S. NUCLEAR PROGRAMS, BUT ALSO BEARS THE LEGACY OF REAL/PERCEIVED ADVERSE IMPACTS ASSOCIATED WITH THESE ACTIVITIES

7

PRIVATE MRS COMPLICATES AND CONFLICTS WITH THE FEDERAL PROGRAM

- THERE IS LEGITIMATE AND PRUDENT NATIONAL INTEREST IN THE FEDERAL GOVERNMENT ' S RETENTION OF SPENT FUEL MANAGEMENT
  - CRITICAL LINKAGES TO REPOSITORY PROGRAM
  - TRANSPORTATION SAFEGUARDS
  - PUBLIC INVOLVEMENT
- SITING OF A PRIVATE MRS DOES NOT CONSIDER:
  - OPTIMIZATION OF TOTAL WASTE SYSTEM
  - RISK AVOIDANCE OR MINIMIZATION
  - COST-EFFECTIVENESS
- HOST OF A PRIVATE MRS LARGELY DETERMINES CONFIGURATION AND SCOPE OF OPERATIONS
  - LIMITED SYSTEM INTEGRATION
  - NO REPACKAGING OR SHIPMENT "STAGING" BENEFITS

9

THERE ARE SERIOUS CONCERNS RELATED TO THE SITING AND OPERATION OF AN MRS FACILITY IN NEW MEXICO

- THESE CONCERNS INCLUDE POTENTIAL IMPACTS ON:
  - -- PUBLIC HEALTH AND SAFETY
  - -- ENVIRONMENT
  - -- ECONOMY

- THE PROPOSED MESCALERO SITE POSES UNIQUE PROBLEMS:
  - -- LIMITED INFRASTRUCTURE CAPACITY
  - -- LIMITED EMERGENCY RESPONSE CAPABILITY
  - -- NO RAIL ACCESS
  - -- FRAGILE ENVIRONMENT
  - -- TOURISM-BASED ECONOMY

11

OFFICE OF THE GOVERNOR
STATE CAPITOL
SANTA FE, NEW MEXICO 87503

BRUCE KING
GOVERNOR

505 827-3000

TESTIMONY OF GOV. BRUCE KING OF NEW MEXICO
TO THE U.S. HOUSE OF REPRESENTATIVES'
SUBCOMMITTEES ON ENERGY AND MINERAL RESOURCES
AND OVERSIGHT AND INVESTIGATIONS
OF THE COMMITTEE ON NATURAL RESOURCES

March 17, 1994
9:30 a.m., 1324 Longworth House Office Building

Thank you, Chairman Miller, Chairman Lehman, and Representatives, for giving me the opportunity to express my views to you on the possible construction of a Monitored Retrievable Storage (MRS) facility for nuclear waste on the Mescalero Apache Reservation in New Mexico.

I have been notified that the Mescalero Apache tribe and Northern States Power Company of Minnesota have entered an agreement to consider such a facility and that discussions are being held with other utility companies about the project.

Representatives of the Mescalero Tribe first approached me in October of 1991 about a study of an MRS facility on their lands. I told them that I respected their self-governing treaty status and their right to conduct these kinds of discussions. I also told them that I was adamantly opposed to an MRS facility in New Mexico and would do whatever I could as Governor to prevent the construction of such a facility in our state.

Since then, both houses of the New Mexico Legislature have passed memorials opposing an MRS and many of the local governments in the vicinity of the Mescalero Reservation have taken similar action. Furthermore, the Western Governors' Association has adopted two policy resolutions which, among other things, call for a demonstration of the safety and cost advantage of an MRS facility before the construction of any such facility, endorse at-reactor dry storage, and oppose the siting of any MRS within the geographic boundaries of a state without the consent of that state's Governor.

Because the health and safety of all New Mexicans might be affected by an MRS project, I do not believe the state and its citizens should be left out of the process of selecting sites and establishing conditions.

OFFICE OF THE GOVERNOR
STATE CAPITOL
SANTA FE, NEW MEXICO 87503

BRUCE KING
GOVERNOR

(505) 827-3000

June 1, 1994

Honorable William J. Clinton
President of the United States
The White House
Washington, D. C. 20202

RE: National Nuclear Waste Management Policy

Dear Mr. President:

I am deeply concerned about the Nation's policy regarding the management of spent nuclear fuel generated by commercial reactors, especially as it relates to the interim storage of this waste. The Nation needs your leadership on this issue.

You are aware a private spent nuclear fuel storage facility is being proposed by the nuclear utility industry and the Mescalero Apache Tribe for construction and operation on the reservation lands in south-central New Mexico. Such a proposal is the direct result of the lack of an effective National policy for the management of spent nuclear fuel. While I have the greatest respect for the sovereignty of the Mescalero Tribe, the siting of such a facility in New Mexico will pose undue risks for the citizens of New Mexico. I strongly oppose the siting of a spent fuel storage facility anywhere in the State of New Mexico.

I urge your Administration to clarify its policies and effectively address the following issues.

- **A National Nuclear Waste Management Policy is Needed.** I do not believe that an away-from-reactor interim storage facility, especially as proposed by the Mescaleros, will have cost and safety advantages over continued at-reactor storage (or other options yet to be considered). I question whether such a facility will even alleviate short-term storage needs. No comprehensive comparative risk (or cost) analyses have been conducted to date on the soundness of such a facility, and its contribution to an integrated, National waste management system. These issues must be examined and a National integrated waste lands, many other federal agencies must also be involved in the development and implementation of a National policy on this issue. For far too long there has been an absence of coordination at the federal level regarding the management of the Nation's nuclear waste. The lack of an effective program calls into question the federal government's trust and credibility with respect to achieving progress on a pressing National concern: permanent disposal of nuclear waste.

I encourage your Cabinet to put forth a coordinated position to respond to the mandates Congress has given the Executive branch. I strongly urge your Administration to work with Congress to place a moratorium on actions related to this issue until an effective National policy for management of spent fuel is in place.

Sincerely,

Bruce King
Governor

cc:
- United States Senator Jeff Bingaman
- United States Senator Pete V. Domenici
- United States Congressman Steven Schiff
- United States Congressman Joe R. Skeen
- United States Congressman Bill Richardson
- Senator Max Baucus, Chairman, Senate Environment and Public Works Committee
- Congressman George Miller, Chairman, House Natural Resources Committee
- Secretary Hazel O'Leary, U.S. Department of Energy
- Administrator Carol Browner, U.S. Environmental Protection Agency
- Ivan Selin, Chairman, Nuclear Regulatory Commission

VILLAGE OF RUIDOSO

RESOLUTION 92-2

A RESOLUTION REQUESTING THE LEGISLATURE OF THE STATE OF NEW MEXICO TO ADOPT A RESOLUTION OPPOSING THE SITING OF MONITORED RETRIEVABLE STORAGE (MRS) OF HIGH LEVEL NUCLEAR WASTE.

WHEREAS, the Mescalero Apache Indian Tribe has received a $100,000 grant from the U.S. Department of Energy to study the feasibility of the siting of a Monitored Retrievable Storage (MRS) facility for the storage of high-level nuclear waste; and

WHEREAS, the Mescalero Apache Indian Tribe is actively undertaking the activities outlined in Phase 1 of the grant from the federal government; and

WHEREAS, published reports have identified three (3) sites that the Tribe is considering for placement of the Monitored Retrievable Storage (MRS), all of which are within relatively close proximity to the Village of Ruidoso; and

WHEREAS, it is anticipated that the formal decision by the Mescalero Apache Tribal Council as to whether or not the Tribe will pursue Phase 2 of the (MRS) process will be made this month; and

WHEREAS, the Village of Ruidoso is extremely concerned about the potential socio-economic and environmental impact that the siting of a (MRS) facility would have on the Village; and

WHEREAS, Governor King has denied the Village of Ruidoso's request to apply for a federal grant to assess the potential detrimental effects that a (MRS) would have on the Village, but has stated that he would give his wholehearted support to a resolution of the legislature opposing high-level nuclear waste storage as well as committing the full resources of his administration in-lieu-of the grant.

NOW, THEREFORE, BE IT RESOLVED by the Village Council of the Village of Ruidoso that the State Legislature adopt a resolution opposing the siting of a Monitored Retrievable Storage (MRS), in New Mexico and allocate any resources necessary to assess the detrimental effects of the placement of a (MRS), in New Mexico.

PASSED, ADOPTED AND APPROVED this 14th day of January, 1992.

Victor M. Alonso, Mayor

ATTEST: Tammie J. Maddox, Village Clerk

RESOLUTION NO. 1992- 11

A RESOLUTION OPPOSING THE ESTABLISHMENT, LOCATION OR SITING OF A MONITORED RETRIEVABLE STORAGE FACILITY IN SOUTHERN NEW MEXICO

WHEREAS, the United States Department of Energy has encouraged Indian tribes in the United States to act as hosts for the storage of high-level nuclear waste materials;

WHEREAS, the United States Department of Energy has offered attractive financial incentives to Indian tribes in the United States which apply as to act as hosts for the storage of high-level nuclear waste materials and which agree to establish, locate or site the above-ground storage facilities [known as Monitored Retrievable Storage facilities] on Indian-owned or Indian-leased lands;

WHEREAS, the Mescalero Apache Tribe has applied for, and received, grants from the United States Department of Energy to study the possibility of hosting a Monitored Retrievable Storage facility;

WHEREAS, the governing body of the City of Alamogordo, New Mexico, recognizes and respects the right of the Mescalero Apache Tribe to study the possibility of hosting a Monitored Retrievable Storage facility and to wisely use lands and natural resources;

WHEREAS, the governing body of the City of Alamogordo, New Mexico shares the concerns which prompted its counterparts in the Villages of Ruidoso and Ruidoso Downs, the Town of Carrizozo and the Counties of Lincoln and Chavez to express opposition to the establishment, location or siting of a Monitored Retrievable Storage facility in Southern New Mexico;

WHEREAS, the governing body of the City of Alamogordo, New Mexico is deeply concerned that the prospect of the establishment, location or siting of a Monitored Retrievable Storage facility in Southern New Mexico may have a negative effect on economic development in the City of Alamogordo, New Mexico; and

WHEREAS, the governing body of the City of Alamogordo, New Mexico, based on its current understanding, believes that the establishment, location or siting of a Monitored Retrievable Storage facility in Southern New Mexico presents the possibility of damage to the environment and the potential of adverse impact upon tourism and recreation.

NOW THEREFORE, BE IT RESOLVED BY THE GOVERNING BODY OF THE CITY OF ALAMOGORDO, NEW MEXICO that it opposes the establishment, location or siting of a Monitored Retrievable Storage facility in Southern New Mexico;

NOW THEREFORE, BE IT FURTHER RESOLVED BY THE GOVERNING BODY OF THE CITY OF ALAMOGORDO, NEW MEXICO that it welcomes ongoing dialogue between the City of Alamogordo, New Mexico and the Mescalero Apache Tribe regarding development of the Monitored Retrievable Storage facility.

NOW THEREFORE, BE IT FURTHER RESOLVED BY THE GOVERNING BODY OF THE CITY OF ALAMOGORDO, NEW MEXICO that copies of this Resolution be transmitted to the elected officials of the Mescalero Apache Tribe, to all elected officials of all municipal and county governments in Southern New Mexico, to the Governor of New Mexico,

2

to the New Mexico Congressional Delegation, to the Office of the Federal Waste Negotiator, to the Secretary of the United States Department of Energy and to the President of the United States.

PASSED, APPROVED AND ADOPTED THIS 28 day of April, 19 92.

CITY OF ALAMOGORDO, NEW MEXICO,
a New Mexico municipal corporation

By: ____________
Daniel R. King
Mayor

ATTEST:

____
Angie J. Rahn
City Clerk

APPROVED AS TO FORM:

____
John Paul Weber
City Attorney

ors1.res

3

TOWN OF CARRIZOZO
RESOLUTION 92-01

WHEREAS, the Mescalero Apache Tribe has expressed in interest in determining the advisability of hosting a Monitored Retrievable Storage (M.R.S.) Facility through obtaining funds for a feasibility study from the U. S. Department of Energy; and

WHEREAS, the Board of Trustees of the Town of Carrizozo recognizes and respects the sovereignty of the Mescalero Apache Tribe and their right to self-determination through the wise use of their own resources; and

WHEREAS, the Mescalero Apache Tribe is actively undertaking the activities outlined in Phase 1 of the grant from the federal government; and

WHEREAS, published reports have identified three (3) sites that the Tribe is considering for placement of the M.R.S., all of which are within relatively close proximity to the Town of Carrizozo; and

WHEREAS, it is anticipated that the formal decision by the Mescalero Apache Tribal Council as to whether or not the Tribe will pursue Phase 2 of the M.R.S. process will be made this month; and

WHEREAS, the Board of Trustees of the Town of Carrizozo has determined that both the feasibility study and the prospect of housing nuclear waste on the Mescalero Reservation or surrounding environs will have a chilling effect on the prospect of economic development in Lincoln County; and

WHEREAS, the Board of Trustees of the Town of Carrizozo had determined that the prospect of housing nuclear waste on the Mescalero Apache Reservation or surrounding environs has a potential disastrous effect on the environment of this area.

NOW THEREFORE BE IS RESOLVED by the Board of Trustees of the

Town of Carrizozo to oppose the further study and any other action leading up to the establishment of a Monitored Retrievable Storage Facility on the Mescalero Reservation; and

BE IT FURTHER RESOLVED that the State Legislature adopt a resolution opposing the siting of a Monitored Retrievable Storage (M.R.S.) and allocate any resources necessary to assess the detrimental effects of the placement of an M.R.S. in the State of New Mexico; and

BE IT FURTHER RESOLVED that a copy of this Resolution be sent to the Mescalero Tribe, New Mexico's Congressional Delegation, and the Governor of the State of New Mexico expressing such opposition.

Cecilia Kuhnel, Mayor

Carol Schlarb, Village Clerk

APPROVED AS TO FORM:

J. Robert Beauvais
Village Attorney

Village of Capitan
RESOLUTION 92-2

WHEREAS, the Mescalero Apache Tribe has expressed in interest in determining the advisability of hosting a Monitored Retrievable Storage (M.R.S.) Facility through obtaining funds for a feasibility st dy from the U. S. Department of Energy; and

WHEREAS, the Board of Trustees of the Village of Capitan recognizes and respects the sovereignty of the Mescalero Apache Tribe and their right to self-determination through the wise use of their own resources; and

WHEREAS, the Mescalero Apache Tribe is actively undertaking the activities outlined in Phase 1 of the grant from the federal government; and

WHEREAS, published reports have identified three (3) sites that the Tribe is considering for placement of the M.R.S., all of which are within relatively close proximity to the Village of Capitan; and

WHEREAS, it is anticipated that the formal decision by the Mescalero Apache Tribal Council as to whether or not the Tribe will pursue Phase 2 of the M.R.S. process will be made this month; and

WHEREAS, the Board of Trustees of the Village of Capitan has determined that both the feasibility study and the prospect of housing nuclear waste on the Mescalero Reservation or surrounding environs will have a chilling effect on the prospect of economic development in Lincoln County; and

WHEREAS, the Board of Trustees of the Village of Capitan had determined that the prospect of housing nuclear waste on the Mescalero Apache Reservation or surrounding environs has a potential disastrous effect on the environment of this area.

NOW THEREFORE BE IS RESOLVED by the Board of Trustees of the

Village of Capitan to oppose the further study and any other action leading up to the establishment of a Monitored Retrievable Storage Facility on the Mescalero Reservation; and

BE IT FURTHER RESOLVED that the State Legislature adopt a resolution opposing the siting of a Monitored Retrievable Storage (M.R.S.) and allocate any resources necessary to assess the detrimental effects of the placement of an M.R.S. in the State of New Mexico; and

BE IT FURTHER RESOLVED that a copy of this Resolution be sent to the Mescalero Tribe, New Mexico's Congressional Delegation, and the Governor of the State of New Mexico expressing such opposition.

Frank Warth, Mayor

Jan Starnes, Village Clerk

APPROVED AS TO FORM:

J. Robert Beauvais
Village Attorney

RESOLUTION NO. 80-39

WHEREAS, the Lincoln County Board of Commissioners has a long tradition of protecting and preserving the natural resources, as well as the cultural, historical and economic values of Lincoln County; and

WHEREAS, a primary responsibility of County Government is to promote the economic development of the County through establishment of policies regarding the highest and best use of private and public lands, other natural resources and the human resources represented by the citizenry of Lincoln County; and

WHEREAS, the Lincoln County Board of Commissioners is embodied with wide ranging authority through its inherent police powers to protect the health, welfare and safety of its citizenry; and

WHEREAS, the Lincoln County Board of Commissioners recognizes and respects the sovereignty of the Mescalero Apache Tribe and their right to self-determination through the wise use of their own resources; and

WHEREAS, the Mescalero Apache Tribe has expressed an interest in determining the advisability of hosting a Monitored Retrievable Storage (M.R.S.) Facility through obtaining funds for a feasibility study from the U. S. Department of Energy; and

WHEREAS, the Lincoln County Board of Commissioners has determined that both the feasibility study and the prospect of housing nuclear waste on the Mescalero Reservation or surrounding environs will have a chilling effect on the prospect of economic and cultural development in Lincoln County.

NOW THEREFORE BE IT RESOLVED by the Lincoln County Board of Commissioners to oppose any action leading up to the establishment of a Monitored Retrievable Storage Facility on the Mescalero Reservation or Mescalero tribal lands in/or adjacent to Lincoln County; and

BE IT FURTHER RESOLVED that a copy of this Resolution be sent to the Mescalero Tribe, New Mexico's Congressional Delegation, and the Governor of the State of New Mexico expressing such opposition.

BOARD OF COMMISSIONERS
OF LINCOLN COUNTY

Stirling Spencer
CHAIRMAN

Bill Elliott
Member

BY: Chief Deputy Clerk
MARTHA MCKNIGHT PROCTOR
Lincoln County Clerk

APPROVED AS TO LEGAL FORM AND SUFFICIENCY:

J. Robert Beauvais
Lincoln County Attorney

Date: December 17, 1991

Responses to Comment Letter C065

Please note that the attachment received by DOE titled "State of New Mexico's Position on Monitored Retrievable Storage" contained only the odd-numbered pages of the presentation.

1 The quantity of waste generated by the Mo-99 program at any of the alternatives is presented in Section 5.14 and is considered to be small. The storage and disposal of the low-level waste will take place at the Nevada Test Site for the SNL/NM and ORNL alternatives. The LANL and INEL alternatives would dispose of the low-level waste onsite in existing DOE-approved facilities. All the alternatives have on-going laboratory-wide waste management and minimization programs.

As discussed in Section 5.14, all alternatives considered have onsite capabilities sufficient to store spent nuclear fuel (SNF) generated in operating at 100% U.S. demand for at least 5 years. Long-term storage and disposal of the Department's SNF will be conducted in accordance with the Department's Record of Decision for the Spent Nuclear Fuel Programmatic Environmental Impact Statement (DOE 1995b).

STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
NASHVILLE, TENNESSEE 37243-0435

DON SUNDQUIST
GOVERNOR

DON DILLS
COMMISSIONER

February 9, 1996

Mr. Wade Carroll, MIPP-EIS Document Manager
US Department of Energy
Office of Isotope Production and Distribution, NE-70
199901 Germantown Road
Germantown, Maryland 20874

Dear Mr. Carroll:

As the Lead Contact for National Environmental Policy Act (NEPA) state reviews, I am responding on behalf of the State of Tennessee to the *Draft Medical Isotopes Production Project: Molybdenum-99 and Related Medical Isotopes, Environmental Impact Statement, DOE/EIS-0249D, dated December 1995.*

The enclosed comments provided by our Division for DOE Oversight constitute the concerns, observations and policy positions on behalf of the State of Tennessee.

1 Please make special note of our belief that the Oak Ridge alternative is a much more viable alternative than indicated by DOE's initial preferences and evaluation. At a minimum, the final EIS should address more specific and objective reasons, benefits and tradeoff's for locating this facility at sites other than Oak Ridge.

Your consideration of the interests of the State of Tennessee is greatly appreciated.

Sincerely,

Don Dills by [signature]

Don Dills

Enclosures

c: The Honorable Congressman Zach Wamp, Third District *(each with enclosures)*
Commissioner William A. Dunavant, Jr.
Leonard Bradley, Governor's Office
Ken Bunting, Administrator
Earl Leming, DOE-Oversight
Dodd Galbreath (NEPA coordination file)
LET-DOE.DOC
02/09/96

STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
DOE OVERSIGHT DIVISION
761 EMORY VALLEY ROAD
OAK RIDGE, TENNESSEE 37830-7072

January 29, 1996

Mr. Don Dills, Commissioner
Tennessee Department of Environment and Conservation
c/o Tennessee Environmental Policy Office
14th Floor L&C Tower
401 Church Street
Nashville, Tennessee 37243 - 1553

Dear Commissioner Dills

Document NEPA Review -- Draft Medical Isotopes Production Project: Molybdenum-99 and Related Medical Isotopes Environmental Impact Statement, DOE/EIS-0249D, dated December 1995.

The Tennessee Department of Environment and Conservation, DOE Oversight Division has reviewed the above document for your concurrence and transmittal to the following DOE office:

Mr. Wade Carroll, MIPP-EIS Document Manager
U.S. Department of Energy
Office of Isotope Production and Distribution, NE-70
199901 Germantown Road
Germantown, Maryland 20874

Our office review was conducted in accordance with the requirements of the National Environmental Policy Act (NEPA) and implementing regulations 40 CFR 1500 - 1508 and 10 CFR 1021.

2 After review and research, the Division recommends DOE reconsider the Oak Ridge Research Reactor for this project preferred alternative. The technical and economic considerations combined with ORNL's 50 year history of medical isotope production experience, and additional benefits of the experimental facilities at the Oak Ridge Research Reactor should be completely evaluated.

Commissioner Dills
Page Two
January 29, 1996

Also, we request the attached comments on the above document be given full consideration in the preparation of the Final Environmental Impact Statement for Medical Isotopes Production Project: Molybdenum-99 and Related Isotopes.

If you have any questions, please contact Dale Rector at (423) 481-0995 or Steve Nisley at (423) 481-0163.

Sincerely

Earl C. Leming, Director

Attachment

cl0194.99

Tennessee Department of Environment and Conservation/DOE Oversight Division

Comments on Draft Environmental Impact Statement, DOE/EIS-0249D, December 1995, "Medical Isotopes Production Project: Molybdenum-99 and Related Medical Isotopes."

GENERAL COMMENTS

ORNL must be considered a strong contender for the medical isotope project. Information throughout the document states ORNL not only is cost competitive, but has more years
3 experience in isotope and medical isotope production than any other candidate site. Most importantly, the Oak Ridge Research Reactor could continuously supply the needed isotopes during times of national emergency.

DOE should weigh into it's decisionmaking the additional benefits of the Oak Ridge Research
4 Reactor for experimental uses, and that operational costs would be offset from users of the experimental facilities. Restart would extend the useful life, avoid the estimated $500.000 to $700.000 per year environmental restoration mortgage payments to maintain the shutdown facility. It is unlikely that decontamination will occur before 2020.

Based on the technical information, discussion, and the comparison of alternatives tables provided in the document, Oak Ridge facilities appear to be the viable candidate both from the point of
5 operating and maintaining a plant specializing in the production of isotopes as well as technical know-how that could accommodate other isotopes if needed. It has the potential to meet 100% use requirements of the isotope in the United States with a twenty-percent increase in the production for any emergencies. Also, ORNL is an officially Food and Drug Administration
6 certified "drug establishment."

The production unit should be centrally located to minimize the travel time and distance to
7 destination and the ideal candidate would be the one with the least distance. Oak ridge National Laboratory seems to have ideal location for dispatching the finished products by its proximity to the airport as well as the time and distance considerations. The truck transportation accident
8 impact to the public is reported at .03 person -rem versus .05 person-rem for LANL and SNL/NM alternatives.

Information provided in the document for the four candidate sites is not consistent in evaluations.
9 If the document is to be properly evaluated for the most suitable site, information needs to be provided using the same reference criterion. Two examples in Section 4 are the total mass of spent nuclear fuel and volume of low-level generated wastes cumulative to 1993.

10 Provide a life cycle cost evaluation for the construction and operation for all the alternatives.

11 Los Alamos National Laboratory and Sandia National Laboratories are cited as DOE's preferred alternatives. The reasoning for this is not very clear from the document.

1

12 Under air quality, data for different sites in different years cumulative and average releases of uranium over the period of similar use or production experience would be more meaningful for site assessment.

13 DOE should make clear that the Annular Core Research Reactor can only operate at 10% production after becoming operational within 6 months from the Record of Decision. It should be noted that production would remain at 10% at the Annular Core Research Reactor until 28 months for full production. This is within two months of the time needed for full production at the Oak Ridge Research Reactor.

Specific Comments

14 1. <u>Page 4.20 and Page 4.46</u>

Provide the total mass of spent nuclear fuel at SNL/NM and LANL in the same manner as described for ORNL on Page 4.70, Section 4.3.14.1

15 2. <u>Page 3.22 Required Modification at LANL and Page 3.45 Required Modification at Oak Ridge</u>

The two sites parallel each other, yet the schedule for modification lists Oak Ridge requiring thirty months for operation of the facility versus LANL and SNL which have a 20 and 28 month time specified for full production. Since SNL is not certified by the Food and Drug Administration as a Drug Establishment, and certification takes time, the schedule time as tabulated in Table 3-2 is misleading. Also, the breakdown of the events leading to the production phase should be presented for every candidate site. Please provide this information for ORNL.

16 3. <u>Page 3.26, Conversion of Annular Core Research Reactor to Support Defense Program Mission</u>

Please provide information on the current program jurisdiction of the Annular Core Research Reactor. Detail a contingency plan for isotope production should the reactor be called to service for the Office of Defense Programs. If the Office of Defense Programs has the same type of retained rights (as the Annular Core Research Reactor) at the other candidate sites, please state the effected reactors or indicate this is unique to the SNL/NM site.

17 4. <u>Page 3.45, Oak Ridge Research Reactor Modifications</u>

Please provide information on if the proposed project will require upgrades to the Oak Ridge Research Reactor low-level waste piping system, as waste lines currently do not meet standards.

2

5. Page 4.70, Section 4.3.14.2

18 The Oak Ridge Reservation has all three sites (K-25, Y-12, and ORNL) included for the total cumulative volume of low-level waste disposed of through 1993. Provide the same information for SNL/NM.

6. Page 3.70, Table 3-2

19 The "Schedule Comparison Category" for SNL/NM, LANL, and INEL lists time frames from Record of Decision to initial target irradiation, reactor operation, Moly-99 production, and initial production. Please provide the same type of information for ORNL.

7. Page 5.100, Paragraph 1

20 Please identify those facilities that would have decommissioning costs funded by the Department of Defense programs for all alternative sites.

8. Page 5.100, Table 5-52 Comparison of Estimated Project Cost at Candidate Sites

21 Please provide estimated operational costs offset at ORNL due to the usage of the experimental facilities at the Oak Ridge Research Reactor.

3

Responses to Comment Letter C066

1 The EIS was prepared to analyze the environmental impacts of reasonable alternatives for conducting the proposed action. The Department will compare the environmental impacts and other factors related to the alternatives and will issue a Record of Decision, which will document the basis for the Department's eventual selection of an alternative.

2 Comment noted. The Department recognizes that ORNL, LANL, and INEL have significant isotope production experience.

3 As stated in Section 5.22, the estimated cost of restarting and operating the Oak Ridge Research Reactor is the highest of the alternatives analyzed. ORNL, LANL, and INEL all have significant isotope production and distribution experience. All of the reactors evaluated as reasonable alternatives for the proposed project would (after necessary modifications) have the ability to produce at least 100% of the U.S. demand for Mo-99.

4 The EIS presents cost information only for the proposed Medical Isotopes Production Project at each of the alternatives. The Department recognizes that facilities proposed for use in all of the alternatives under consideration could conduct other cost-sharing activities; however, these other cost-share activities and their impacts are outside the scope of the EIS and therefore are not considered in the EIS.

5 As stated above, all of the reactors evaluated as reasonable alternatives for the proposed project would (after necessary modifications) have the ability to produce at least 100% of the U.S. demand for Mo-99.

6 Both ORNL and LANL are FDA-certified "drug establishments."

7 Location and proximity to an airport would have an effect on the environmental impacts of the proposed project, especially with respect to transportation impacts. However, the environmental impacts of all the reasonable alternatives analyzed in the EIS were found to be low.

8 This comment correctly notes that truck transportation impacts for the ORNL alternative are expected to be lower than those for the SNL/NM or LANL alternatives.

9 The Department utilized the best data available and has attempted to provide comparable data wherever possible. In regards to the specific example, the EIS in Section 5.14 provides total spent nuclear fuel and hazardous waste volumes for each of the alternative sites (summarized in Table 5-19).

10 The costs for the modification of facilities and facility operations are presented in Table 5-1 and Table 5-52. Since each alternative proposes the use of existing facilities and the Department is already responsible for facility-related costs, such as facility decommissioning, an incremental cost analysis (rather than a life-cycle cost analysis) was considered appropriate information for the decision-making process for the proposed project.

11 The Chemistry and Metallurgy Research Facility at LANL is the preferred alternative for Mo-99 target fabrication, and the Annular Core Research Reactor/Hot Cell Facility (ACRR/HCF) combination at SNL/NM is the preferred alternative for target irradiation and processing for the reasons stated in Section 3.3.1.1.

12 The radiological air quality sections for the affected environment address uranium emissions in conjunction with other radionuclides released from the sites in recent years. Additional information specifying historical uranium releases would add little value to the EIS because such emissions are not expected to be a major environmental consequence of producing medical radioisotopes.

13 As discussed in Section 3.3.1, the ACRR could operate at 10% of U.S. demand after initially becoming operational. ACRR could potentially supply up to 30% of U.S. demand for a short period of time in this configuration in case of an emergency. The commentor is correct in stating that the ACRR would (under non-emergency conditions) only be able to produce about 10% of U.S. demand until all necessary modifications are complete.

14 This information has been added to Section 4 and Table 5-19 in Section 5.14.

15 It should be noted that the radiopharmaceutical companies, not DOE, would be required to obtain FDA approval for the Mo-99 produced by DOE. Each site would have the same requirement to provide a series of samples of the Mo-99 product to radiopharmaceutical companies so that these companies could obtain FDA approval of their products using the DOE-supplied Mo-99. The time required to obtain this approval is included in the estimated time requirements in Table 3-1. The FDA approval process could be initiated at different times for each of the alternatives because full power operation would not be required to begin the process.

16 The Office of Defense Programs has no current or foreseeable need for the ACRR. That Office has requested that, if the ACRR is selected for this mission, the capability of the reactor to perform defense experiments be retained in case of an emergency. The reason that the possible diversion of the ACRR for defense use is highlighted in the EIS is that, in an emergency, the ACRR is more likely than the other reactors considered in the EIS to be used for defense purposes. However, the Department has determined that the probability of needing the ACRR for defense purposes is sufficiently low to preclude disqualifying the reactor from consideration.

17 The low-level waste piping would require an upgrade. This upgrade is included in the cost estimate for the reactor facility upgrades in Section 5.22.

18 The EIS presents the total site generation volume in Section 5.14 for all the alternatives.

19 The scheduling information listed in Table 3-2 is time from the Record of Decision. The ORNL alternative is in column 5. Similar information is provided for each alternative.

20 All facilities are Department of Energy facilities and would be decommissioned by DOE.

21 Please see response to comment C066-4 above.

LOC INC
Oak Ridge Reservation Local Oversight Committee

February 8, 1996

Mr. Wade Carroll
MIPP-EIS Document Manager
19901 Germantown Road
Germantown, Maryland 20874

RE: **Medical Isotopes Production Project: Molybdenum-99 and Related Isotopes Draft Environmental Impact Statement (DOE/EIS-0249D, December 1995)**

Dear Mr. Carroll:

The Oak Ridge Reservation Local Oversight Committee (LOC) is an independent, non-profit organization comprised of local elected officials and citizens from the City of Oak Ridge and six counties impacted by activities at the Oak Ridge Reservation.

After extensive review, the LOC submits the attached resolution as comment on the Draft EIS. The LOC disagrees with the DOE's proposed alternative, and considers the analysis incomplete in several areas.

The LOC appreciates the opportunity to provide input into DOE's medical isotopes project. Feel free to contact me at (423) 483-1333 if you have any questions.

Sincerely,

Amy S. Fitzgerald

Amy S. Fitzgerald, Ph.D.
Executive Director

cc with attachment:

Earl Leming, Tennessee Department of Environment and Conservation, DOE Oversight Division
Brian Kelly, Governor's Policy Office

Anderson • Meigs • Rhea • Roane • City of Oak Ridge • Knox • Loudon

136 S. Illinois Avenue, Suite 208 • Oak Ridge, Tennessee 37830 • Phone (615) 483-1333 • Fax (615) 482-6572

RESOLUTION **NUMBER 96-1**

WHEREAS, the Oak Ridge Reservation Local Oversight Committee (LOC), being comprised of elected officials and citizen representatives of Anderson, Knox, Loudon, Meigs, Rhea, and Roane Counties and the City of Oak Ridge, was created in part to provide local input into decisions affecting the continued operation of the U.S. Department of Energy's (DOE) Oak Ridge Reservation; and

WHEREAS, the U.S. medical community has been dependent entirely on a Canadian firm to supply Molybdenum-99, a radioactive isotope that has broad applications in the area of medical diagnostic procedures; and

WHEREAS, the U.S. Department of Energy (DOE) proposes to establish, as soon as practicable, a domestic capability to produce a continuous supply of molybdenum-99 and related medical isotopes for the U.S. medical community; and

WHEREAS, the DOE proposes to modify an existing research reactor and hot cells to produce and process Molybdenum-99 and related medical isotopes; and

WHEREAS, the DOE has prepared a Draft Environmental Impact Statement to evaluate facilities that have passed the preliminary technical screening criteria for Molybdenum-99 generation and processing; and

WHEREAS, the Oak Ridge Research Reactor/Radioisotope Development Laboratory at the Oak Ridge National Laboratory is one of four facilities under consideration by the DOE; and

WHEREAS, the DOE has selected the Annular Core Research Reactor at the Sandia National Laboratory as the preferred alternative; and

1 **WHEREAS**, the DOE's analysis of the preferred alternative is the most expensive of the four capable of meeting the DOE's goals as stated; and

2 **WHEREAS**, the Oak Ridge National Laboratory has had a long history of experience and expertise in the development of such isotopes; and

3 **WHEREAS**, the DOE's analysis of the environmental consequences, schedule, and technology does not justify the selection of the preferred alternative; and

4 **WHEREAS**, the Oak Ridge alternative is best suited on the basis of being designed to meet the necessary specifications, with all the needed production facilities in close proximity and a reactor designed to operate in a continuous mode; and

5 **WHEREAS**, the citizens of LOC jurisdictions are entitled to assurances that the socioeconomic impacts and life-cycle costs associated with the DOE's alternatives are thoroughly analyzed; therefore, be it

6 **RESOLVED**, that this Committee supports the selection of the Oak Ridge Research Reactor as the preferred alternative for the production of Molybdenum-99 and related medical isotopes.

BE IT FURTHER RESOLVED, that this resolution shall be submitted to the U.S. Department of Energy for consideration in its preparation of the Medical Isotopes Production Project Environmental Impact Statement, and that the Executive Director send a copy of this resolution to the Tennessee Congressional delegation and other relevant federal and state officials.

This, the 1st day of February 1996.

Edmund A. Nephew

Edmund A. Nephew, Chairman
City of Oak Ridge

Amy S. Fitzgerald

Amy S. Fitzgerald, Ph.D.
Executive Director

Responses to Comment Letter C067

1 As discussed in Section 5.22, the estimated modifications costs of the preferred alternative are the second lowest, and the estimated annual operating cost of the preferred alternative is the highest.

2 As presented in Table 3-2, ORNL, LANL, and INEL all have significant isotope production experience.

3 The Chemistry and Metallurgy Research facility at LANL is the preferred alternative for Mo-99 target fabrication, and the Annular Core Research Reactor/Hot Cell Facility combination at SNL/NM is the preferred alternative for target irradiation and processing for the reasons stated in Section 3.3.1.1.

4 As discussed in Section 3.3, all of the alternatives will (after necessary modifications) have the capability to satisfy the purpose of the proposed action.

5 The socioeconomic impacts of the proposed project are discussed in Section 5.3 of the EIS. The costs for the modification of facilities and facility operations are presented in Table 5-1 and Table 5-22. An analysis of these costs and the projected revenues specific to this proposed project will be evaluated for each alternative as information for the Record of Decision process. Since each alternative proposes the use of existing facilities and the Department is already responsible for facility-related costs, such as facility decommissioning, an incremental cost analysis (rather than a life-cycle cost analysis) was considered appropriate information for the decision-making process for the proposed project.

6 Comment noted.

A Tradition of Excellence
1946–1996

NORDION
INTERNATIONAL INC.

February 8, 1996

Mr. Wade Carroll
MIPP-EIS Document Manager
U.S. Department of Energy
Office of Isotope Production and Distribution, NE-70
19901 Germantown Road
Germantown, Maryland 20874

Dear Mr. Carroll:

This letter constitutes the comments of Nordion International Inc. regarding the Draft Environmental Impact Statement (EIS), and we respectfully request that this document be made part of the public record. It is our sincere hope that you will view these comments as helpful, taking them into account as you assemble the final EIS.

<u>Nordion's Plans to Secure Supply</u>

Nordion is a private North American-based company owned by MDS Health Group Limited with operations in Canada, Asia and Europe. We have a 50 year history of reliably providing raw materials for radiopharmaceutical products to our customers for the enhancement of human life and health. In fact, there has never been a serious interruption of supply to our customers for any of our products in that entire time. While we do acknowledge that new reactors to produce molybdenum-99 must be completed to prepare for the next century, we do not expect this record of reliability to change. We have moved aggressively to ensure this will remain the case--securing back-up capability and making a major investment in building two new reactors and a processing facility.

1 Nordion has made several attempts to work with DOE to provide additional security of supply for the short term--prior to Mallinckrodt being in full production and prior to the Maple I start up. The United States Department of Energy (DOE) has remained focused on a long-term plan, which in our view does not meet the requirements of the Nuclear Medicine Community. In January 1995 representatives from the DOE, U.S. radiopharmaceutical producers, Nordion and research reactor operators from the United States and Canada, met in Albuquerque to generate an emergency response plan for molybdenum-99. In the ensuing report from the meeting, prepared by Bobby Savoie, the group concluded that the preferred option was a collaboration between the DOE and Nordion. Furthermore, the report concluded that a DOE program at Sandia for independent production would not meet the needs of the industry from a timing perspective. (report attached)

447 March Road, Kanata, Ontario, Canada K2K 1X8 Tel.: (613) 592-2790 Fax: (613) 592-6937

-2-

Nordion has very specific plans to address the security of supply for molybdenum-99. These plans have been widely communicated to the Nuclear Medicine Community in the United States, including informal communications with DOE representatives. There has been widespread endorsement of Nordion's plan as reflected in various communications printed in the Journal of Nuclear Medicine, Newsline, November 1995 - January 1996 (attached).

1 Although Nordion has communicated its plans to the Nuclear Medicine Community, these plans are not accurately reflected in the Draft EIS. We therefore state for the official record that Nordion <u>will</u> provide the funding for two new reactors and a processing facility, all dedicated solely to isotope production. These facilities will be known, and are hereafter referenced, as Maple I and Maple II. The timing of the formal announcement with respect to this project has nothing to do with the commitment of funding, as implied in the Draft EIS Summary (page v). An issue related to the tax treatment of reactors in the private sector, which we expect to be resolved in the near future, is the only major item delaying the formal announcement. We anticipate construction of Nordion's new processing facility and the Maple I & II reactors will resume this spring.

<u>Timing</u>

2 The Draft EIS (page v) inaccurately describes the timing associated with Nordion's plan to develop a secure, continuing private-sector supply of molybdenum-99. The Maple I will yield product within 36 months, not 42 months as described. Maple II will be available one year later. Both of these reactors will be dedicated to isotope production. Each reactor alone will be able to meet the world's full requirement for molybdenum-99 for the next twenty years.

<u>Nuclear Waste</u>

3 The Draft EIS summary (page xii) states that the process to be used by the DOE would generate "primarily low-level radioactive waste." Based on Nordion's technical knowledge of the Cintichem process and information in the body of the Draft EIS, we believe this statement to be inconsistent with the facts.

While the Draft EIS understates the nature of the waste generated by the Cintichem process, it exaggerates the level of waste generated by the Nordion process. In its summary (page v) and in section 2.2 the Draft EIS makes reference to the Nordion process as generating substantially greater quantities of liquid waste. This is not consistent with later statements acknowledging that the process Nordion will employ in its new facility will generate comparable levels of waste to Cintichem process that the Draft EIS currently contemplates. Nordion urges that its strong commitment to reducing the levels of waste it generates should be clearly stated for the public record.

-3-

Private-Sector Sources of Supply

The Draft EIS (pages vi and viii) makes reference to the absence of private companies in
molybdenum-99 production. In fact, Nordion is a private company in North America with a fully
4 integrated production and distribution network. Our service and commitment to the U.S. Nuclear
Medicine Community is unquestioned.

The Draft EIS assessment of back-up capability (page v) is severely understated. While it is developing the industry's long-term solution to a secure private-sector supply of molybdenum-99, Nordion has taken independent action to assure short-term back-up supply. Nordion has secured back-up capacity from the IRE reactor in Belgium and can guarantee a large portion of the required back-up. It is also anticipated that when Mallinckrodt completes development of its production capability in 1996/97 it will be able to supply the balance of what is required. In addition, molybdenum-99 from a South African reactor is in the process of being validated by U.S. radiopharmaceutical manufacturers. Together, Nordion, Mallinckrodt and South Africa offer a sound, back-up supply until the Maple I reactor is fully commissioned.

5 Even if one gives credence to the Draft EIS concern (page v) that overseas sources are not able to meet the U.S. demand fully, we cannot envision a scenario, under any circumstances, in which the DOE would be required to furnish 100 percent of the U.S demand. Therefore, we believe it is unwarranted to assert that any U.S. reactor not capable of supplying 100 percent of the U.S. demand should be removed from consideration.

While Nordion agrees with the statements attributed to the DOE's consultants (page 2.3) Savoie and Singh, that "European capacity can only supply a portion of the U.S. demand," we have studied this issue and determined that European sources can be configured quickly to achieve sufficient back-up supply faster than the DOE would be able to establish a new, subsidized source of supply.

The idea that U.S. reactors capable of supplying only a portion of the U.S. demand should remain
under consideration becomes increasingly meaningful in light of Nordion's repeated offers to the
DOE to work collaboratively on a short-term back-up supply for North America. These offers
include partial processing at a DOE facility prior to final processing and distribution by Nordion.
6 Nordion's expertise and established distribution network, not addressed in the Draft EIS, remain
available to the DOE should it wish to pursue a collaborative effort with the private sector. With
this in mind, the University of Missouri, Missouri Research Reactor Center, discarded as an
option (page xi, table S-1), could provide a solution which could be put in place more quickly
than the preferred option being proposed.

-4-

Page vii of the Draft EIS sets a DOE target for specific activity of 10,000 curies/g which, based on Nordion's own customer needs, exceeds specific activity requirements. Therefore, eliminating the Missouri reactor from consideration based on specific activity (pages 3.59 and 3.60) is, in our view, not valid as the assumed needs of the customers are overstated.

6 In addition to more quickly meeting the need for back-up capability, the Missouri reactor would be more cost-effective and could be activated only as required--also resulting in less costs. The "preferred option" as currently stated would require routine operation even when no product is required. Unless it is DOE's intention to market this product in direct competition with the private sector (in direct contradiction to DOE's stated objective), the current configuration for proposed back-up supply is wasteful and unnecessary.

7 Further, section 3.3.1.10 on page 3.28 describes a 28 month timetable for DOE production capability. By this time, the private sector options will be well-established and Nordion will be on the verge of having Maple 1 fully operational.

8 Options which allow the private sector to fully or partially participate in the short-term supply solution are in keeping with the DOE's stated mission of not competing with the private sector. In addition, these options directly address the concerns expressed by the North American Nuclear Medicine Community. The Society of Nuclear Medicine (SNM) and the American College of Nuclear Physicians (ACNP) have both urged the DOE to ensure that there was a reliable back-up source of molybdenum-99 as quickly as possible. These groups have never specifically asked for DOE to become that source. This view was recently made clear at the SNM Isotope Availability Committee meeting in Puerto Rico in January 1996 and further supported by statements in the January 1996 Journal of Nuclear Medicine Newsline (attached).

Thank you, in advance, for your consideration of Nordion's comments. Working together, we are confident that the DOE, Nordion and the Nuclear Medicine Community can move forward with a solution that quickly and cost-effectively achieves an increased short-term capability. Please let us know if you require additional information or assistance.

Respectfully submitted,

Dr. Iain Trevena
Vice-President
Isotope Products

/dh
Attachments

Date: January 20, 1995

To: All Mo-99 Emergency Response Workshop Participants

Subject: Initial Review Draft of the Emergency Response Plan

Enclosed as promised is the initial review draft of the Emergency Response Plan for Molybdenum-99 Production. The document has come together well, but still requires substantial refinement. It is, however, at a point where seeking your comments is both appropriate and valuable. Please review the enclosed documents and fax comments to me at (504) 834-5890 by the close of business on Tuesday, January 24, 1995.

As a side note, I met with Terry Lash, Director of Nuclear Energy at the Department of Energy on Thursday, January 19, 1995. It is clear that funding will be an extremely tough issue which will require further thought. We'll be working on that one and hopefully will have a better picture soon.

Please do not hesitate to call me as needed at (504) 834-5878.

Respectfully,

Bobby Savoie
President, CEO

111 VETERANS BLVD. / SUITE 900 / METAIRIE, LA 70005 / 504-834-5878 / FAX 504-834-5890

EMERGENCY RESPONSE PLAN

FOR

MOLYBDENUM-99 PRODUCTION

INITIAL REVIEW DRAFT
JANUARY 20, 1994

EXECUTIVE SUMMARY

The U.S. Department of Energy (DOE) is pursuing the development of a production source for Molybdenum-99 (Mo-99) at the Sandia National Laboratory (SNL). This action was precipitated by the current reliance on a single Canadian source, the NRU reactor at Chalk River, to meet the U.S. demand for Mo-99, which serves as the parent for the most commonly used medical isotope, Tc-99^m. The current SNL program would use the Annular Core Research Reactor (ACRR) with its adjacent hot cell facilities to provide a second supply source in approximately 18-24 months.

The U.S. nuclear medicine community and radiopharmaceutical manufacturers have expressed concern that the current DOE program, although valid, will not address the near term risk of an interruption in the supply of Mo-99. In response to these concerns the DOE held a workshop at SNL with the specific purpose of developing an emergency response option which could quickly be made operational. This workshop was broadly attended by representatives from industry, government, national laboratories, universities and Canada.

The workshop identified the parameters within which an emergency response option must function along with the criteria against which to evaluate options. Various options were identified and discussed. Several preferred options emerged for detailed evaluation, resulting in a single option, expedited production of "raw" Mo-99 at SNL for subsequent refinement by Nordion, being unanimously chosen for implementation if all assumptions hold. A detailed discussion of the objectives of this option was developed. An action plan was developed for the preliminary steps which must be taken to initiate this option.

The single biggest hurdle to implementing any emergency response option is funding. The Isotope Production and Distribution Program (IPDP) has very limited funds available during the current fiscal year. Furthermore, the overall atmosphere of budget reductions throughout the federal government and particularly to DOE may prohibit the redirection of funds from other programs. This issue, along with several others pertaining to throughput, sales and schedule must be resolved before a "go-no-go" decision can be made.

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1.0 INTRODUCTION AND PURPOSE

This document presents an emergency response plan for the development of a reliable, cost effective mechanism to keep Mo-99 flowing in the pipeline to patients if there is a supply interruption. It was developed under the direction of the DOE in concert with industry, universities, and national laboratories.

The most widely used isotope in nuclear medicine is $Tc\text{-}99^m$ (approx 40,000 U.S. procedures per day). It is the daughter product of Mo-99. The short half lives of both of these isotopes precludes stockpiling of supplies. As such, a consistent stable, daily supply of Mo-99 is critical to the U.S. nuclear medicine programs. The Mo-99 Production and Distribution Chain is depicted in Figure 1.0.

Currently the largest supplier of Mo-99 on a worldwide basis is the NRU reactor in Canada. If this reactor were no longer available or the Mo-99 processing facilities were no longer available, a shortage of Tc-99 would be evident in two weeks.

The other suppliers, primarily in Europe, could increase production for a limited time period only. Transportation distance and production capabilities in Europe would preclude meeting the North American supply for long periods.

A reliable backup capability in North America that could replace the current Canadian supply system during an interruption would better support the continued supply of $Tc\text{-}99^m$ to North America than other identifiable solutions.

This plan begins by presenting the parameters of an emergency response option - those specifics which must be addressed in order for an option to be considered viable. This is followed by the parameters to be used in comparing/evaluating options. The various options offered at the workshop are then discussed in terms of their "terminal objectives" - the specific end points to be achieved for each specific option. Finally, an action plan is presented for achieving the chosen option - production of "raw" Mo-99 at SNL for shipment to Nordion in Canada.

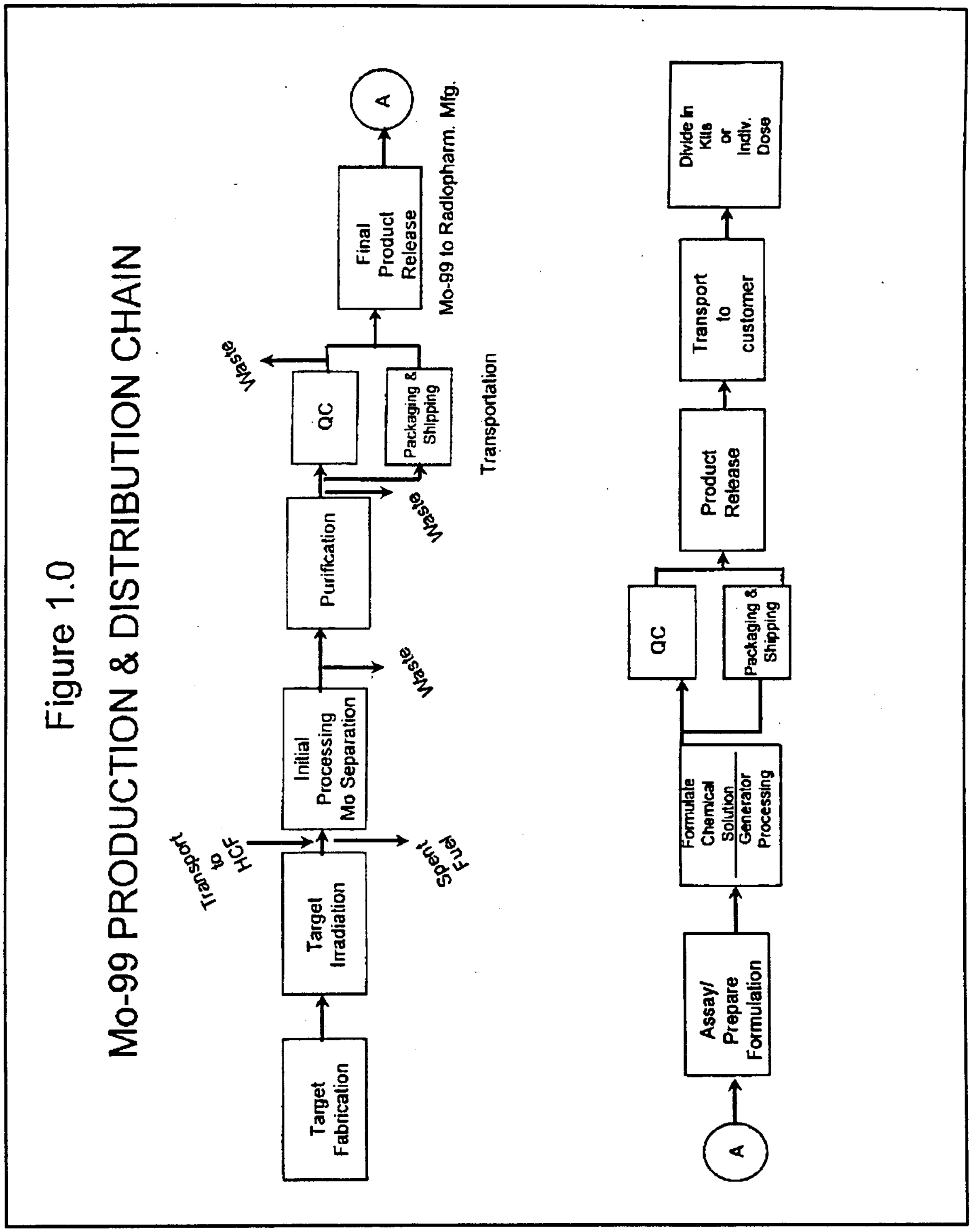
Figure 1.0
Mo-99 PRODUCTION & DISTRIBUTION CHAIN
Target Fabrication
Target Irradiation
Transport to HCF
Spent Fuel
Initial Processing Mo Separation
Waste
Purification
Waste
QC
Packaging & Shipping
Waste
Transportation
Final Product Release
Mo-99 to Radiopharm. Mfg.
A
A
Assay/ Prepare Formulation
Formulate Chemical Solution
Generator Processing
QC
Packaging & Shipping
Product Release
Transport to customer
Divide in Kits or Indiv. Dose

2.0 PARAMETERS OF THE EMERGENCY RESPONSE PLAN

Any emergency response option must meet certain parameters if it is to fulfill its primary purpose of ensuring a reliable, cost effective mechanism to keep Mo-99 flowing in the pipeline to patients. This section delineates these specifics or parameters which the emergency response option must address. The plan must define the applicable requirements of each parameter and specify steps that are necessary to meet these requirements.

2.1 FDA Approval

The FDA approval process will involve amendments to the Drug Master applications filed by the radiopharmaceutical manufacturers and approved by FDA. This process will require that the Drug Master file (DMF) defines the Moly-99 production source and process; production site and procedures are approved, if required; and that the end customers (radiopharmaceutical manufacturers) have validated 3 production lots (trial runs of the emergency plan). If the final processing (refinement) step is accomplished by Nordion under its existing DMF this approval process may be greatly simplified.

2.2 Funding

The incremental funding required to create and implement an Emergency Preparedness Program is estimated to be an additional $5 million in FY 1995. Some of these funds were planned for expenditure in FY 1996, but must be expedited to support the emergency response option. Obviously the program cannot be implemented unless the funding is available. It is critical that this funding include training personnel and developing support systems. The funding for this program is not currently available. Changing IPDP priorities, reprogramming DOE budgets or seeking other agencies support are the only possible government sources. These options must be evaluated and exercised immediately.

2.3 Quantity

The emergency response capability must be able to provide enough Mo-99 to support 100% of the North American requirements. This value is approximately 3000 6-day curies per week, or equivalent to 13,600 Ci per week at the pharmaceutical companys' docks. The amount of power required in targets to meet this demand is 400 kW. The reactor operation will be required for essentially 24 hrs/day, 7 days/week. If raw moly were shipped to Nordion, the production at the source must be increased accordingly.

2.4 **Quality**

The process and product will need to be validated (qualified) to the level required by the Radiopharmaceutical Manufacturers. Concentration, purity and specific activity are included in the customer's product specification. A DMF must be written and submitted to the FDA so that customers may refer to it when applying to use the material. Good manufacturing practices must be followed throughout the process.

2.5 **Time to Prepare Emergency Response Mechanism**

The time required for the emergency response capability to be prepared for implementation must be as short as realistically possible since the supply is currently vulnerable. Implementation of the plan within six months of the issuance date is acceptable.

2.6 **Cost for Preparing and Maintaining Plan**

The cost required to prepare the emergency response plan and maintain it in a standby mode must be affordable, and the cost of the product, if the plan is initiated must be reasonable. Although this is a national priority issue, the cost must be within parameters which can be absorbed by the market or the U.S. taxpayer or a combination thereof.

2.7 **Operational**

Conduct of operation mentality appropriate to reliable continuous operation must be adopted by the facility and applied to all activities therein. Additional redundancy and reliability may be needed through equipment and procedural changes to ensure state of readiness. A complete compliment of trained staff and infrastructure necessary for all phases of operation in continuous 24hr/day operation must be maintained in readiness and be immediately available.

2.8 **Time to Engage**

In the event of an interruption in supply from existing sources, the plan should seek the initiation of Mo-99 production by alternate means within one calendar week, with final FDA - acceptable product being delivered to radiopharmaceutical manufacturers - within 2-3 weeks from the date when the interruption occurred. The entire North American demand should be met from week 3 onwards.

2.9 Waste

The facility must have adequate waste management resources and must be capable of controlling gaseous emissions (I-131 & Xe-133 in particular), be able to either discharge liquid waste (including SLFP and possibly U-235) to a central waste handling facility on site or be able to solidify such waste for disposal with other solid radioactive wastes. It should be noted that the disposal of enriched U-235 must be considered carefully in order to prevent critically problem in the future and separation of U-235 may be necessary.

2.10 Other Regulations

Various regulations will effect the production and preparation of the product for shipment to the purifier and wholesale marketer. Specific regulations to consider include:

1. Target preparation - regulations concerning access to highly enriched uranium (Dept of State and NRC)
2. Reactor Operation - NRC or DOE approval of targets in reactor
3. Processing/Separation of Mo-99, handling of radioactive materials - NRC, DOE, or agreement state regulations
4. If transportation is involved between irradiation and processing - NRC, DOT plus International regulations, and State transportation regulations
5. Company, agency, organizational rules and regulations, within company facilities and controlled areas.
6. EPA and State regulations
7. For Government related operation - the NEPA process.

2.11 Staffing

The appropriate level of fully trained and available staff will be required for implementation of the plan. Staffing actions must consider documented training, overtime, and back-ups. Staffing plans should be driven by the short time required for implementation. Consideration should be given to temporary assistance from sources of existing expertise within the industry and appropriate agreements put in place.

2.12 <u>Target Availability</u>

The emergency response plan for Mo-99 requires a sufficient supply of targets to be available that are approved for irradiation in the selected reactor. The targets must be in a form that can be processed at an approved site. The inventory and product capability should be at least sufficient to supply the North American need for Mo-99 for 1 year. To the extent possible, the inventory should be at the reactor site. A fabricator for the backup targets must be available.

2.13 <u>Target Processing</u>

The relatively short half-life of the Mo-99 radioisotope (66 hrs) requires that the processing time (the time interval from removal of the targets from the reactor until the final product is delivered to the customer) be as short as possible. Under normal circumstances the target processing facilities have been at the reactor site or very close, in transport time, to the reactor.

The gross fission-product radioactivity contained in the uranium targets after irradiation for Mo-99 production is typically 25 times the Mo-99 radioactivity and must be shielded during the transfer of the targets to the processing facility. This gross radioactive inventory can amount to 10,000 to 100,000 Ci's per target depending upon the irradiation capabilities of the reactor.

The emergency response plan must provide a delivery system to enable the irradiation and processing of targets in the same time interval (1 to 3 days depending upon the option chosen) as is done in the routine normal production scheme. This maximum and minimum production time will depend on the starting Mo-99 inventory in the post irradiation target. The Mo-99 produced in the emergency response scheme must be equal in quality to the normal supply.

The target irradiation and Mo-99 separation process is technically complex and requires a highly trained staff of professional and technician level personnel in reactor operations, hot cell operation, radio-chemical processing, packaging, transportation and health physics. It would be extremely difficult, if not impossible to assemble a proficient team to accomplish an instant start-up. The available options for implementing the emergency plan should address this consideration.

2.14 Transportation

One parameter required for a successful emergency Mo-99 response plan deals with transportation. Transportation will be required to take the Mo-99 product from the reactor to the process facility and then from the process facility to the customer. Due to the short half-life of the material it is necessary that all transportation time be minimized and scheduled commensurate with the anticipated target specific activity. The maximum and minimum transportation times will be determined by the curie content of targets. The capability to complete material transport must remain in place in order to support immediate startup of the process in an emergency.

By locating the process facility geographically close to the production reactor the first phase of transportation is simplified somewhat. Location of the process facility at the same site as the rector could alleviate the need for using a certified licensed container for the movement. Locating the process facility close to the reactor could have the added benefit of minimizing transport time and the resultant decay of the product material. If the process facility is designed to produce a bulk Mo-99 product (i.e. not final form) transportation would be required, using certified container, to the final process facility (such as Nordion). If no processing capability exists near the reactor, transportation of thermally hot targets to a distant processing facility would be required. Pre-approved containers and plans to transport these "hot-targets" would be required.

The necessity of prompt delivery of Mo-99 to the customer requires that distribution logistics be addressed. The final process facility should be located such that it has ready access to air transportation (i.e. charter or military aircraft). These would have to be certified licensed containers and a sufficient number of these containers would be required to ensure that continuous "round-robin" deliveries could be completed. Additionally, the final processing facility must have the capability to complete rapid container decontamination to support shipment schedules.

2.15 Management

The management of the Mo-99 emergency response mechanism must be organized with a clear chain of responsibility and specific duties and authorities at every level. There must be a single individual with responsibility, accountability and authority to assure that the all parties and facilities are ready at all times to perform their function if the need arises. A single telephone call should be sufficient to implement the emergency plan.

The manager of each facility or operation involved in the emergency response plan must be fully responsible and accountable for the current and timely implementation of his/her part of the plan, and for the quality, quantity and cost of the product to be produced.

All functions and necessary actions of the plan must be documented and tested, and the documents must be available to every person who has a need to know.

The responsible manager(s) must periodically review developments in technologies and new discoveries in the associated fields to update information and documents used in the emergency response plan. All parties who might be affected must be notified of any changes on a timely basis, and training classes or exercises must be conducted where needed to implement changes.

2.16 General

Cooperative agreements between existing suppliers and the backup suppliers are paramount to a successful plan. DOE, Nordion and AECL have already held informal discussions on cooperative arrangements, and believe that within the context of providing backup support capabilities such agreements could be achieved without undue delay or difficulty. Agreements may also be required with national laboratories and customers.

3.0 PARAMETERS FOR EVALUATING OPTIONS

In addition to the parameters of the emergency response plan discussed in the previous section, parameters were developed for evaluating/comparing options. These are obviously similar to those presented in section 2.0 but have a completely different purpose and are therefore distinct.

3.1 FDA Approval

Obtaining FDA approval requires understanding and implementing appropriate FDA guidelines. This includes establishing GMP (Good Manufacturing Procedures) procedures and facility operational specifications including final validations on site.

The steps involved in FDA approval will include one or more of the following:

1. Placing procedures and validation protocol in place and testing them, and getting data package ready for FDA approval
2. FDA review of data package
3. Complete and adequate response to all FDA questions
4. Customer validation of approved product

It should be noted that raw material may not require FDA involvement. The option must be evaluated to determine the extent of required FDA involvement and associated time for compliance with FDA requirements.

3.2 Management & Infrastructure

The DOE laboratories are not structured to facilitate the kind of production management required to implement a successful Mo-99 enterprise. Neither the experienced personnel nor the support systems are in place. This means that extensive training with substantial outside support should be undertaken immediately. The required culture change to go from a research-based to a customer-oriented production environment is a major undertaking. Without top management's strong support and appropriate resource allocation this program has little chance of success despite any technological accomplishments. The time and resources required to establish the required management and infrastructure must be compared for each option considered.

3.3 <u>Cost and Economic Feasibility</u>

All phases of cost must be considered for each option. These include startup, standby, operation (including target production and transportation), and post operation (including waste handling). Other considerations include capital, training, licensing, and overhead. The standby costs must be reasonable. The source of funding to cover these costs, whether government or customers, must be identified for each option.

3.4 <u>Time to Get Ready and Time to Start Up in an Emergency</u>

The amount of time required to implement, an option must be considered. There are two considerations, 1) the time required for the plan to be implemented, and 2) the time required for the plan to take effect when called upon. Six month may be on overly ambitious goal for a production backup to be established; one year or less may be more reasonable. When called upon to operate, ideally full production should be established within one week to ten days.

The minimum time to design, purchase, and install equipment in existing facilities; hire and train operators; obtain target supplies and be ready to produce and process Mo-99 is on the order of six months.

Administrative processes (NEPA, procurement, regulatory requirements of DOE, NRC, DOT, FDA) are additional time constraints that would extend the time to get ready. It is theoretically possible to obtain waivers of these administrative requirements such that additional time is not necessary.

Three major independent parallel activities are required. Preparation of a reactor, preparation of processing facilities, and preparation of a supply of targets. Each of the three major activities would require about six months of time for completion. Additionally, casks for transportation of irradiated materials, if required, would need to be made available.

3.5 **Transportation Feasibility**

Transportation of the moly to the required destination must be feasible. Current approved shipping containers and methods of shipment must be considered as the most simplistic approach. New container certification requirements may be prohibitive. The containers must be currently certified, and enough must be available to meet the delivery requirements. The customer/supplier logistics must be considered. Delays and transportation times must be factored into the selection.

3.6 **Complete Solution**

The option must be complete. The option must fulfill the purpose of the emergency response. It must be a start to finish option dealing with all aspects of the problem, from raw materials, though waste management. The overall system must be optimized. The solution may require more flexibility in the supply chain. The solution must be able to produce raw and/or purified moly.

3.7 **Public Support**

The public and political support is essential for the funding and success of the program. Each option must be evaluated from this perspective to minimize public and political opposition.

3.8 **Difficulty to Implement**

The emergency response concept involves the almost instantaneous start up of a highly technical and complex operation to compensate for the unplanned interruption of the supply chain. The operations involved are normally closely regulated by government license or some other specific approval.

The emergency response plan should employ facilities or resources that are technically capable or allowable by license or permit to perform the necessary operations. The options must be evaluated in terms of establishing a capability which can be available in a "stand-by" condition of readiness.

3.9 Waste Management

Waste parameters include disposition of liquid, solid, and high-level waste. The facility selected to complete Mo-99 processing must have the capability to safely handle and store liquid waste. Additional consideration should be given to subsequent solidification and long term storage of the waste products. Management of the waste products includes plans for routine, continuous handling of waste, waste minimization in the process, and plans for final waste disposition. The options must be evaluated on the capability to manage waste for the required length of time.

3.10 Product Quantity

Production quantity must be sufficient to meet U.S./North American needs in an emergency. Ideally it might be desirable to meet worldwide need to avoid allocations to/from European Sources. Any proposed plan must be evaluated as to its potential to meet these levels of production.

The test runs are required to confirm that adequate quantities will be available. If test runs indicate a shortfall, changes in irradiation/target/process will be made to correct the problem and re-testing will be performed.

3.11 Product Quality

The processing facility must have adequate analytical facilities and procedures to assure meeting the required product specifications prior to shipping. The specifications are well known and the analytical facilities must be able to detect the levels of impurities as noted in the product specifications.

3.12 Degree of Control

While the plan should include U.S. resources as much as possible, the use of AECL & Nordion resources for fluid processing and the use of European sources to help meet the shortfall should not be ignored. A clear definition of responsibility and ownership for the plan is required for effective initiation and management. This plan does not assure U.S. Independence in the market but shows a cooperative effort between Canada and the U.S. is needed in order to avoid a shortfall of Mo-99. The critical point is that all aspects of implementation be within the control of those parties responsible for implementation.

3.13 Sustainable Production

Production of Mo-99 and delivery to the radiopharmaceutical companies must be sustainable for at least a two year period except for unpredictable factors such as strikes, "Acts of God," etc. It is preferred that there be no significant cost increase (e.g., greater than 10 %). The Emergency Response Plan must consider and evaluate potential disruptions in supplies of raw materials, transportation routes, equipment and/or facilities, and provide for alternate means of ensuring the supply if difficulties in any of these areas arise.

3.14 Reliability/Risk

The emergency supply pipeline for Mo-99 must use facilities and technology that can demonstrate the capability to perform their respective function reliably within the required response time and for the required time interval. This means that the needed staffing, infrastructure, management, and proper operational culture must be either in place or could be established.

3.15 Consistency with Long Term Solution

If the nature of the emergency is such be that viable commercial supply is interrupted for a long period, the emergency response mechanism shall be able to provide the basis for a long term supply option. However, the emergency response plan should not negatively impact the re-establishment of existing commercial supplier(s), nor impede the development of a new domestic supplier that may chose to pursue Mo-99 sales on a commercial basis.

3.16 <u>Consistency with Current Supply Chain</u>

The emergency response plan preparation should not create changes in the current market system that would adversely affect any participant - producers, suppliers, distributors, users (patients). The plan, when and if it needs to be implemented should have as a goal, the ability to fill the production void fully and in a timely manner, with as little impact on the current participants as possible.

Organizations mobilized, as part of the emergency plan, must be willing participants, and need to be appropriately compensated. The emergency plan should integrate easily within the overall current supply chain. It is desirable, to the extent possible, that the commercial entities, currently involved in the supply chain, also be the implementers of the emergency response. The government should serve primarily as a helper, or facilitator, if necessary. It is inappropriate for the government to impose a system that causes any of the current participants to be a "loser". However, it is appropriate that all of the current participants take a role in effectively implementing an emergency response.

3.17 <u>Impact on Existing Programs</u>

Backup reactors or processing facility must be dedicated or prepared (and willing) to provide the production immediately following notification. Other program activities may piggy back during latent periods but must disengage without impeding Mo-99 production when required. Conduct of operation appropriate to Mo-99 production must be adopted by piggy back programs. Any programs, whose required disengagement, would delay initiation of production are precluded.

Backup process must be exercised periodically or continuously at low level (which may reduce time available to other programs), so as to periodically validate emergency readiness.

3.18 Categories of Evaluation Criteria

Although each of the parameters for evaluation options discussed previously must be considered, they are not all of equal importance. The parameters (now evaluation criteria) for the options were divided into four categories as listed below:

Go-No-Go

1. The option must offer a complete solution
2. The option must be able to produce the required quality of the product
3. The option must adequately address the management of the waste generated
4. The transportation required to implement the option must be currently feasible

Very Important

5. The quantity of Moly-99 produced
6. The time to start up in an emergency
7. Time to get ready to implement the option
8. Reliability/Risk (This includes ability to sustain production)
9. Consistency with current supply chain (including FDA status)

Important

10. Public and political support
11. Cost and economic feasibility
12. Difficulty to implement
13. Management and infrastructure

<u>Not Very Important</u>

14. Consistent with long term solution
15. Impact on existing programs

Based on the Go-No-Go Criteria certain options were dismissed. Based on other criteria, the team agreed on the preferred options discussed later in the report.

4.0 EMERGENCY RESPONSE OPTIONS

This section provides a brief description of the ten options discussed in the workshop and evaluation criteria for the options.

4.1 ACRR Raw Moly

This option requires the irradiation of targets in the ACRR. The targets could be either Cintichem targets commercially produced by Babcock and Wilcox or by LANL, or AECL targets shipped from Canada. The first stage processing of the targets would be performed in the Gamma Irradiation Facility (GIF) located next to ACRR in the same building or in the Hot Cell Facility (HCF) located in a building adjacent to but outside the ACRR building. The crude Mo-99 obtained from first stage processing would be shipped to Nordion for final purification, QC verification, and distribution to radiopharmaceutical companies.

Major issues discussed relative to this option included modifications required to the ACRR facilities and training of personnel. Although these requirements will essentially be the same as that for the current SNL Mo-99 program, this option will not require the establishment of a QC laboratory. There will be additional funds ($5 to $6 million) required for this option which are not currently available. There will be additional regulatory issues that will have to be dealt with. It was stated that this option will take approximately six months to implement.

4.2 AECL Targets to U.S. Reactors

This option requires that AECL targets be irradiated in a U.S. reactor such as University of Missouri, McMaster, ATR, or ACRR and irradiated targets be sent to AECL for processing. As an alternate the irradiated targets could be processed at INEL or LANL. In either case, Nordion would receive the same crude moly-99 as they currently receive from AECL and would perform the same steps as they currently perform, i.e., final purification, QC verification, and distribution to radiopharmaceutical companies.

The major issues discussed relative to this option were the required evaluation of U.S. reactors to irradiate AECL targets to the extent required for the emergency, the apparat lack of adequate shipping casks to accomplish the task, and the time required for shipment.

4.3 MURR

This option requires that spent fuel from the MURR reactor at University of Missouri be shipped to AECL. AECL would process the fuel to extract crude moly-99 which would be sent to Nordion for final purification and distribution.

The major issues involved evaluation of processing capability and willingness on the part of AECL (who was not represented at the meeting), the modifications required at AECL, and the extent of FDA involvement due to a revised process. It was stated that this option will take approximately 1 year to implement not counting the time required to obtain FDA approval.

4.4 Expedite Current SNL Mo-99 Program

This option requires that the current program at the SNL be expedited by using targets from B&W and by obtaining certain exemptions to the NEPA process. It was estimated that this would require additional funds and will take approximately 13 months to implement.

4.5 Multiple U.S. Reactors

This option required fabrication of the Cintichem targets by B&W, irradiation in more than one U.S. reactors including DOE and University reactors and transport of the irradiated targets to AECL for raw processing and finally shipment of raw moly-99 from AECL to Nordion for purification and distribution. The issues involved with this option are similar to those associated with the option described in 4.2 above.

4.6 SNL-LANL

This option required the targets (Cintichem) to be fabricated at LANL, irradiated at ACRR and shipped back to LANL for processing in their CMR facility. The processing at LANL could be the first stage processing to produce raw moly-99 which could be shipped to Nordion for purification and distribution; or LANL could perform the entire processing, including purification and QC verification and shipment to radiopharmaceutical companies.

It was stated that this option would take at least one year to implement and would require approximately 1.3 million dollars.

4.7 Commercial U.S. Reactors

This option required the irradiation of Cintichem targets in a commercial reactor and transport of irradiated targets to either AECL or SNL for processing to obtain raw moly-99 which could be shipped to Nordion. The commercial reactors would be compensated for the loss of power generated.

Major issues associated with this option are the required modifications to commercial reactors, the apparat lack of adequate shipping casks to accomplish the task, the time required for shipment, and potentially huge costs associated with loss of power generated.

4.8 ATR

This option required irradiation of Cintichem targets (fabricated by B&W) in ATR, processing of the irradiated targets at INEL to produce raw moly-99, and shipment of this product to Nordion for final purification and distribution. Although, ATR has previously irradiated Cintichem targets, the major impediment to this option was identified as the operating cycle of ATR and its inability to transfer targets during operation.

4.9 B&W Aqueous Reactor

This option required using the B&W aqueous reactor previously used at LANL (SUPO) in a hot cell at the CMR to produce raw moly-99 which could be shipped to Nordion for final purification and distribution.

4.10 McMaster Reactor

This option is similar to the MURR option described in 4.3 above except that the McMaster reactor will be used in lieu of the University of Missouri reactor.

5.0 DISCUSSION OF PREFERRED OPTION(S)

The previous section described each potential option for providing a Mo-99 emergency response mechanism. Figure 5.1 depicts each option in a blank matrix format versus the evaluation criteria presented previously in section 3.0. Each option was evaluated against the evaluation criteria by all workshop participants. The first step was to eliminate those options which did not meet the "go-no-go" criteria. The participants agreed that the options of "Irradiating AECL targets in U.S. Reactors" and "Using Commercial U.S. Reactors" could be eliminated. This left eight (8) options to be ranked/evaluated against the evaluation criteria. The results of this exercise are depicted in Figure 5.2.

Based on the rankings shown in Figure 5.2 four primary options were chosen for further evaluation as follows:

Option 1 - ACRR produce raw Mo-99 for processing by Nordion

Option 2 - ACRR/LANL/Nordion cooperative venture

Option 3 - Expedite the current SNL ACRR Program

Option 4 - Ship MURR fuel rods to AECL/Nordion

Further analysis showed that the time required to prepare Option 3 was unacceptable and provided little advantage over the current program. Therefore, Option 3 was eliminated from consideration. This left 3 primary options for consideration. These options were analyzed in terms of "terminal objectives" - the "end state" that option must achieve to be prepared to serve as an emergency response mechanism. Many of the terminal objectives are common between the options and interrelated. Besides defining the end-point for each option, the terminal objectives drive the action plan for implementing a particular option. The remainder of this section further describes each of the three preferred options in terms of terminal objectives and time to prepare for implementation.

Figure 5.1
Evaluation Criteria Matrix

Criteria / Options	Public/ Political Support	Cost & Economic Feasibility	Time to Get Ready	Time to Start Up in an Emergency	Waste Management	Transportation Feasibility	Consistency with Long Term	Difficulty to Implement	Complete Solution?	Impact on Existing Programs	Degree of Control	FDA Status	Production Quantity	Reliability	Product Quality	Management & Infrastructure	Consistency with Current Supply Chain
ACRR HAW HQ																	
APS Targets in U.S. Reactors																	
MURR																	
Expedite Current SNL Prog																	
Multiple U.S. Reactors																	
SNL/LANL																	
Commercial U.S. Reactor																	
AIR																	
New Aqueous Reactor																	
Molecular																	

Figure b 2
Vote Count and Rank of Options

Options \ Ranks	1	2	3	4	5	6	7	8
ACRR NAW MO	8	5	2	1	1	0	0	0
MURR	4	0	3	3	3	2	2	1
Expedite Current SNL Prog.	2	9	3	0	1	2	1	0
Multiple U.S. Reactors	0	1	0	3	2	2	2	4
SNL-LANL	3	2	7	6	1	0	0	0
ATR	0	0	2	3	4	3	4	1
B&W Aqueous Reactor	0	0	0	2	0	6	3	8
McMaster	1	2	1	2	5	3	2	2

5.1 **Option 1 - ACRR Produce Raw Mo-99 for shipment to Nordion**

5.1.1 Targets Available and Qualified for Processing Irradiation

Having targets available and qualified for processing in the ACRR requires the following steps:

1. Target Specifications and Test criteria to be mutually agreed to among B&W, Sandia and DOE.

2. Purchase agreement between B&W & SNL - Detailed purchase order can follow

3. B&W procure any equipment and raw material (fittings, stainless tubing) not in inventory and install process equipment

4. Manufacturing process flow chart established

5. Shipping arrangements - Uranium to Lynchburg/Targets to Albuquerque

6. Pilot run (~5 Targets) completed, tested and shipped

7. SNL Acceptance Test & Irradiation Tests

8. Process Modification, if required

9. Start Production at 40 Targets/Week

10. Ship 40 T/Wk

5.1.2 Sufficient Staff Hired, Trained, & Qualified

The production of Mo-99 requires a very diverse staff, some of whom (radiological protection personnel, security, etc.) will be furnished by the facility independent of the type of work that is to be accomplished. The additional personnel, however, are mission specific and include the following:

1. Hot Cell Technicians trained in the use of manipulators, iodine control, good manufacturing practices, process procedures, decontamination techniques, radiation worker training, and waste handling

2. Reactor Operators trained to operate the ACRR and certified by testing

3. Maintenance personnel trained in the specifics of the facility, in particular the repair of manipulators, replacement of filters (both HEPA and charcoal) and the repair/maintenance of shipping casks

4. Supervision for the operating/maintenance crews

5. Quality Assurance personnel trained to the product specification and available for specific problem situations as they arise

6. Analytical Chemistry personnel, trained and equipped to assay product and process stream to the levels noted in the product specification

7. Facility manager trained to the Tech Specs of the Reactor and to the Operational Safety Requirements of the non-reactor nuclear facilities

8. Shipping and Transportation personnel trained to DOT regulations

9. Customer Services personnel trained to handle customer orders, complaints, problems, and billing

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The staff must be of sufficient size to provide around - the - clock operation, both at the reactor and the processing facility.

5.1.3 ACRR Mods Complete/Uninterrupted Steady State Ops

Reactor Core Reconfiguration

The core must be reconfigured to accept and irradiate targets. The main modifications that must be made are simple and straight forward, requiring only the current staff to accomplish. These activities include removing the cavity liner and offset tubes, adding an attachment grid structure in the central core region to accept 19 to 37 targets, and reconfiguring the bridge. The time required to accomplish these tasks is estimated to be 3 months.

Heat Exchanger Upgrade

With the current 2 MW pool cooling capability, about 70% of the required demand could be met. In order to meet the full 100% demand, ~400 kW of target power is required. To meet this the reactor would have to operate at ~3 MW. The current heat exchanger upgrade design includes dual redundant 4 MW heat exchangers, pumps, and cooling towers. The upgrade of this system is estimated to cost ~1 M. The time required to install would be on the order of 4 months. This would require a parallel path with the EA.

Control Systems/Console

The current control console is located within 30 ft from the top of the reactor tank. Although this could be used for moly production, it is expected that the radiation levels would be too high for continuous 24 hr/day operations. The control console upgrade has been ongoing intermittently for several years. Currently there is a dedicated team working to have the complete system operational by May 1995. The control rod drive motors are also being upgraded.

Ventilation System

At this point in time it is unclear as to what upgrades would have to be performed on the ventilation system. The current system may be adequate or minor modifications may be required.

Analysis for Operations and Safety Evaluation

Much of the calculative work has been performed for both operations and safety evaluation. This work could be finalized within 2 months.

SAR and TSR Change/USQ Addressed

There is a current SAR and TSR documentation. Changing over to moly will require a high degree of responsiveness from the DOE. This is the most uncertain area for achieving the desired goal. The review and approval path must be set up in advance and as much authority at the local level must be given as possible.

Prototype Testing

Targets must be tested after the modification and approval process to determine if the desired power levels of 21 kW per target can be achieved. ~400 kW is required for all targets.

5.1.4 Transportation Issues Resolved/Casks Available

A Transportation Plan must be delivered and subsequently implemented that addresses all of the issues appropriate to providing Nordion the raw Mo-99 product they require in a timely fashion. Shipping and Waste Packages must be certified for use and their licensing must be addressed so that they remain current. The product packages, namely CI-20 WC-2 and - 2A must be approved for shipment to Canada by US authorities and subsequently the Canadian Government must review and approve these packages for use in their country.

A handling and transportation staff must be identified, funded, trained and qualified to package, handle, and transport Mo-99 between production facilities and air charter or freight loading ramps. Air freight and/or charter air companies must be contracted to transport Mo-99 packages from Albuquerque International Airport to Ottawa Canada. The Production Plan will call for daily shipments and a combination of air freight and charter air may be necessary. Regulatory issues concerning all aspects of packaging, and ground and air shipments must be identified and complied with or appropriate waivers or exemptions must be acquired.

Coordination and agreements between SNL and Nordion must be accomplished to identify the required shipment schedule. The point of product acceptance in Canada (Ottawaa ARPT), and the establishment of radio product package turnaround procedures.

Transportation also includes waste shipment to disposal sites or site. Similar to above personnel, packages, and appropriate licensing must be accomplished to support this function. In addition however, waste disposal agreements must be in-place or available to support this emergency production plan.

5.1.5 Hot Cell Facility/GIF Operational

There are several key tasks which must be accomplished to make the Hot Cell Facility or GIF Operational. These include the following:

Hot Cell Modifications

1. Deionizer in GIF Storage Pool
2. Isolate dissolve cell from reactor pool
3. Install pass-through between cells
4. Install adequate ventilation and air filtering equipment (HEPA - Carbon - HEPA) with sufficient decontamination factor
5. Provide product unloading (cask-loading) facilities in GIF
6. Provide fission product waste storage/unloading (cask loading) facilities
7. Provide manipulator handling, maintenance and repair facility

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Processing Equipment

1. - Target dissolver equipment
    - Heater/Rotator spindle
    - Target reentry fittings
    - Vacuum pump
    - Cold Trap

2. - Mo-99 Separation Equipment
    - Raw fission liquor bottle
    - Raw fission waste bottle
    - Precipitate filters
    - Ag/C column
        - Raw Mo 99 product bottle
        - Glassware holding equipment and liquid product transfer fittings, miscellaneous items (syringes, valves, needles, etc.)

3. - Waste packaging/storage equipment

Raw Material Inventory

1. - Target storage facilities (security & criticality)
2. - Warehouse & inventory control system
3. - Process equipment make-up lab

Documentation

1. - Revise SAR for Max credible accident
2. - Process procedures
    - Target handling
    - Dissolution & precipitation of Mo-99

Ag/C Purification of Mo-99
Fission waste processing/solidification
Mo-99 product packaging and shipping
Fission product waste packaging & shipping

3. - Operational Procedures
Hot Cell Maintenance
Manipulator Maintenance
Contamination Control
Ventilation Maintenance
etc.

5.1.6 FDA Approval

There are several key issues concerning FDA approval of this option which must be addressed:

1. Nordion needs to modify their DMF to include Cintichem type Uranium-Oxide targets, irradiated at any reactor as a source of first stage raw Mo-99 and processed to remove the waste material.To do this they need to obtain the product specifications as developed by SNL and sample material to test and run through their final chemical process to show that the final product is equivalent to their current product.

2. Generator manufacturers will need a sample of the SNL irradiated, Nordion processed Mo-99 solution to determine that the Mo-99 does not negatively effect the performance of the generator: Manufacturers may need to add a statement on their annual report to FDA that they have qualified this supply of material. They also need to amend their drug master applications.

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5.1.7 NEPA Issues Resolved/Exemptions

All NEPA issues must be resolved prior to start of Mo-99 production. The current EA (in the review and comment phase) must be amended to include processing in the GIF. Process effluent from any portion of HCF is already included. Process effluent from the GIF stack must be included as well as continuous operation within the high bay area. The EA must also be amended to include shipment of "Raw" Moly to Nordion and transfer of waste from GIF cells to HCF storage and handling area.

5.1.8 Repair and Maintenance Prog

There are several key factors to be addressed in developing a maintenance program for the reactor, Hot Cells, equipment, container, and associated facilities.

1. Adequate maintenance personnel available.
2. Maintenance program in process cell in accordance with GMP.
3. Adequate backup equipment.
   - Shielding window maintenance in place and personnel trained
   - Support systems, hydraulics, ventilation, HVAC, Radiological instrumentation etc., maintenance in place and operational

5.1.9 Nordion Ready to Accept/Process Crude Mo-99

Within the six months implementation window, Nordion must undertake activities required in order to accept and purify the crude Mo-99 stock provided by the first stage DOE process. These activities include:

- Definition of incoming product specifications
- Definition and Implementation of Incoming Product QC
- Facility Modifications as may be required to handle the designated shipping container

The end result is such that Nordion is able to perform validation run(s) at production levels as will be required in support of a change to its existing DMF with the FDA.

5.1.10 Operational Readiness Assessment

DOE orders require an extensive readiness review process to be completed prior to the initiation of a major change in a facility operation. In the case of Mo-99 production this would encompass operation of both the reactor and the hot cells. Furthermore the DOE order is based on a large reactor and the scope would imply evaluations of activities that are not significant to a small research reactor's operation. The SNL must be prepared to undertake the appropriate and necessary level of readiness assessment.

The obstacle to overcome is to establish a "waiver" condition where by the readiness assessment is scoped to the ACRR (not a 500 MW production reactor) and the duplication is reduced. A suggested assessment might include:

a) form the SNL & DOE review teams
b) Have the DOE team review the SNL scope to assure it is sufficient
c) Have DOE team "observe" the conduct of the SNL review
d) Have DOE team identify any specific areas that warrant a separate DOE review
e) DOE team looks at any corrective actions that SNL is performing as a result of the SNL ORR.
f) If satisfied that the SNL review has been sufficient and completed, and that the corrective actions have been taken; the DOE ORR process is completed.

5.1.11 Quality Control Lab Established

A Quality Control lab (facilities & resources) must be established to verify and release bulk Mo-99 for shipment. It must also have the capability to test and accept the raw materials required to complete the first stage process. The analytical services must be able to measure the quantity and quality of the 1st stage product as well as test chemicals and materials to USP specifications (or equivalent). In order to satisfy the requirements of Good Manufacturing Practices, a Quality Program and Quality

Plan for Mo-99 production will need to be established which demonstrates satisfactory levels of control & documentation within operations and QC.

All operational procedures and test methods must be validated prior to delivering useable product to NII and ultimately to the industry. Nordion will have qualified (validated) SNL's first stage Mo-99 prior to this time as well.

5.1.12 Competing Missions Eliminated/Resolved

Once the required schedule is established, negotiations with competing programs must be conducted to eliminate, reschedule or accommodate any activity which impacts the emergency plan terminal objective.

5.1.13 Radiological Monitoring Equip Operational

A key aspect of establishing a Mo-99 operation is proper radiological monitoring. This includes:

- Hot cell processing will have a proven confinement.
- Confinement adapted to remote operations.
- Testable charcoal and HEPA Systems.
- Operating, trained team of Radiological personnel.
- Full coverage of Facility Monitoring equipment for Iodine, particulates and Noble Gases.

5.1.14 Waste Issues Resolved

Provision must be made to transfer process waste from the GIF cells to a transfer container for subsequent movement to HCF Waste Storage and Handling Area.

5.1.15 Industry Agreements in Place

The Emergency Response Plan requires that two distinct agreements being in place:

(a) An agreement between DOE and Nordion covering - management of the supply chain; product specifications; transfer pricing; confidentiality; Nordion concerns about assisting in the development of a competitor

(b) An agreement between the radiopharmaceutical industry and Mo-99 produces covering - Means of allocating product under Emergency Shortage of Supply During Transition Periods; Confidentiality; Emergency Supply situation; Management/Communication; Responsibility & accountability for each step of an emergency process; pricing considerations

5.1.16 Fuel Inventory Available

The available fuel inventory must support six months of steady state full power operation. Fuel fabrication must be available to start supplying additional fuel within four months of modification to start production.

5.1.17 Procedures & Documentation (SAR) complete

All required procedures, at the program level and as required by each facility to be used in the Moly-99 Emergency Response Plan are to be identified and preparations included in the preparations to effect the plan. These shall include, but not be limited to:

Modifications to the facility Safety Analysis Reports

Environmental Assessment(s)

Staff Trained Plans and Procedures

Waste Management Plan(s) and Procedures(s)

Quality Control Plan(s) and Procedures; e.g. process control specifications, test procedures, standard operating procedures, etc.

Change Control Procedures(s)

5.1.18 Management Prepared

Central responsibility of the Moly-99 Emergency Response Plan (ERP) will reside in the Department of Energy (DOE), Office of Nuclear Energy (NE), Isotope Production and Distribution Program (IPDP). A single individual will be identified, who will have the authority to make binding decisions for the ERP within the governing regulations and policies of the DOE, EPA, FDA, etc.

With the approval of the IPDP ERP manager, each participating organization will also identify a single responsible manager to direct and manage the work on the ERP by his/her organization in cooperation with the IPDP ERP manager. An organization chart will be published and distributed, along with a brief description of the duties, responsibilities and authorities of each manager and how they are to interface with each other.

The group of managers shall identify all required documents, plans, procedures, etc. necessary to prepare for and to implement the ERP when and if necessary. Preparation of the documents will be done by the organization most directly affected by each one, subject to review and comment by the other, interfacing organizations, and approval by the IPDP ERP manager.

Under the guidance of the DOE IPDP manager, appropriate readiness reviews shall be conducted to confirm that the various parts of the plan and the associated organizations are properly prepared to perform their respective functions.

The ERP manager shall conduct meetings of the manager group as required to assess and control progress on the preparations, and once the plan is in place, additional meetings as required to ensure that readiness is maintained and changes or new developments are accommodated in the ERP.

5.1.19 DOE Funding

Funding for the Mo-99 emergency plan, because of the timing, must come out of already allocated funds most likely within the DOE IPDP. While this will likely affect other isotope initiatives, there may be a opportunity to seek a higher funding level for the FY '96 IPDP budget.

In order to shift the estimated $5 million needed for the Mo-99 emergency plan from other budget accounts the office of the secretary and the Director of Nuclear Energy must be convinced that it's the right thing to do. This pressure must emphasize the importance of putting an emergency plan in place and the fact that there is consensus within the nuclear community (including industry) and within parts of DOE for the need for an emergency Mo-99 plan.

There are also additional concerns that must be addressed. The first is convincing OMB of the need for Mo-99 program. This will realistically entail stopping OMB from making specific cuts in the Mo-99 program.

The likelihood of success in securing funding within DOE, while not easy is helped by the fact that industry has already begun to bring this issue to the attention of the Secretary's office, and OMB and Congress.

There is still a need to educate some Members of Congress and their staffs on the importance of Mo-99. Nevertheless, support for funding an emergency response plan for Mo-99 will have to overcome the inherent discomfort Congress may have with DOE and the frenzied budget cutting atmosphere.

5.1.20 Production Quantity and Schedule Established

The Sandia hot cell operation needs to be able to respond, in emergency, to a nominal 5 fold increase in normal output. This could be accomplished by:

a) a transition from single shift/5 day week to around the clock operation; one crew to 3 or 4 crews. Crew readiness needs to be maintained; or

b) major automation of the hot cell process, permitting automatic systems to ramp up and increase the output with little increase in manpower.

Option (a) requires higher continued operational costs. Option (b) requires higher initial cost (capitol investment).

5.2 Option 2 - ACRR Irradiate targets - LANL Raw Mo-99 - LANL or Nordion Refinement (8 mos.)

This option entails all those terminal objectives applicable to Option 1 plus those described herein.

5.2.1 Target Transportation to LANL

Target transport to Los Alamos in lots of 1 to 8 targets is potentially available. Two B3 casks have arrived in Los Alamos and are in the beginning stages of inspections by LANL transportation. A fully compliant package will be available within the designated time frame (6 mo). A dedicated trailer will have to be purchased for expeditious shipping.

A inner package will have to be built that may require additional shielding. However the Certificate of Compliance (C of C) for the B-3 allows 9000# of internal shielding.

Transporting of up to 8 irradiated targets per shipment is allowed when the wattage/cask is 400 watts. Calculations show that 6 hours after removal from the reactor, the targets are less than 100 watts each. They could be received well within the 10-12 hour window that was originally planned for LANL processing.

5.2.2 Public Opposition Resolved

Public opposition is not a trivial issue, but can potentially be resolved by a functioning stakeholder office in Los Alamos. Opposition to shipping of Isotopes was minimal in previous public meetings. However, an effective outreach effort is required to keep this from becoming an issue.

5.2.3 Waste Transportation to SNL from LANL

LANL has existing waste facilities that respond to ongoing funded processes. If necessary, the waste will not have to leave Los Alamos. It was suggested that the pipeline for this profile of waste (that SNL will have to establish anyway) be used to eliminate redundant efforts. In the scaled-down mode proposed at Los Alamos to handle emergencies, there is available allowed storage capability of 24 weeks of 3000 ci/wk production.

5.2.4 Completion of CMR upgrades

The upgrades to the Hot Cells within the CMR have been completed in the area designated for Mo-99 production. Radiological equipment and wiring to master control monitors in going on at this time with completion scheduled in the spring.

5.3 Option 3 - Expedite Current SNL Mo-99 Prog. (13 - 15 mos.)

Although this option was originally ranked as a preferred option, the time to implement (13-15 months) was deemed unacceptably long. Therefore, terminal objectives were not developed for this option.

5.4 Option 4 - Ship MURR Spent Fuel Element to AECL/Nordion (12 mos)

The specific terminal objectives necessary to accomplish this option are discussed herein.

5.4.1 Operational Readiness Review

When all other objectives are completed, sufficient number of test runs should be completed to prove operational readiness.

5.4.2 Waste Issue Resolved

AECL needs to be prepared to handle the larger volume of process waste generated per curie of Mo-99 when processing a MURR fuel element.

5.4.3 Industry Agreements in Place

- AECL must agree to accept and process MURR fuel elements
- Nordion must agree to accept and qualify the raw Mo-99 from the process
- B&W must agree to fabricate the additional fuel elements on an emergency demand schedule
- DOE must agree to additional fuel support in case of an emergency
- MURR must commit to weekly shipments of one week fuel element.

5.4.4 Fuel Inventory Available

The available fuel inventory must support six months of steady state full power operation. Fuel fabrication must be available to start supplying additional fuel within four months of notification to start production.

5.4.5 Commitment for Additional Funds by DOE

DOE needs to agree to provide for the additional fuel fabrication cost necessary to support the Emergency Mo-99 plan. Funds may be required to cover modifications at AECL and to support increased waste generation if and when emergency plan is implemented.

DOE needs to fund feasibility review for this option.

Transportation costs need to be covered.

5.4.6 Production Quality & Schedule

Preliminary indications are that a single MURR fuel element run for 1 week and shipped on a weekly basis should meet the specifications required by Nordion, when processed in a similar manner to the NRU targets currently use. This will have to be validated by test runs.

5.4.7 AECL Prepared to Use MURR Fuel Element

AECL must determine what modifications are required to process a MURR fuel element and complete the modifications.

5.4.8 Transportation Issues

Approval must be in place for using an available cask for transporting a MURR fuel element with sufficient Mo-99 inventory from Columbia, Mo to Chalk River, Canada. This requires approval from the NRC for the use of the Cask and route in the U.S. and appropriate approvals for route and cask in Canada. Agreement must be in place to make cask immediately available if Emergency Mo-99 Plan is implemented.

5.4.9 FDA Approval

Raw Mo-99 from processed MURR fuel element must meet specifications set by Nordion to allow amendment of DMF.

5.4.10 Sufficient Staff hired, trained & qualified

Already in place.

5.4.11 Public Opposition (to transportation) Issue

Weekly shipments of a fresh fuel element through four states, across the border and through the province of Ontario will require appropriate understandings in advance with each of the states, and an agreement with the provincial government as well as the Canadian federal government. Public opposition can be mitigated by making two aspects clear in public perception:

a) A single short-decay fuel element has no more activity that the eight long-decay elements that have routinely been shipped across five states, and the fresh fuel decays at a faster rate that the old fuel.

b) The purpose is to supply Moly-99 for medical needs for 36,000 seriously ill patients each day, and many thousands of other laboratory tests.

Making these points clear in advance of discussions with the states, and negotiations with Canadian officials, will result in a more gratuitous response. Also, emphasizing that the requests would only be used in an unlikely emergency will further enhance the probability of quick acceptance and no opposition.

6.0 ACTION PLAN

There are two key phases to implementing an emergency response capability. The first is to complete those initial steps necessary to confirm the feasibility of the emergency response option. These steps, as outlined below, are necessary for a go-no go decision to be made.

DOE

1.	Draft Report to NE-1	2 weeks	1-27-95
2.	Determine funding needs and options (diverting funds, etc.)	2 weeks	1-27-95
3.	Define minimum required throughput & revenue stream required	2 weeks	1-27-95
4.	Initiate Discussions with Nordion & AECL	Now	
5.	Designate a central point of Coordination & Communication	Now	Savoie
6.	Enroll Support from NE-1/Secretary/Etc.	4 weeks	2-10-95
7.	Support MURR interactions with AECL	As Required	

SNL

1.	Develop Resource Driven Schedule	2 weeks	1/27/95

Nordion

1.	Review DMF	2 weeks	1-27-95

CORAR/MEMBERS

1.	Review Regulatory Issues	2 weeks	1-27-95
2.	Meet with DOE on 2-8-95		

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MURR

1.	Meet with AECL to determine feasibility of MURR option	T.B.D.	

LANL

1.	Evaluate Option 2 Issues vs. Option 1	2 weeks	1-27-95

From the desk of . . .

Bobby Savoie

This detailed write-up was completed by Jim Ledbetter (LANL) per the action plan. It has not yet been factored into the report. Please review at your leisure.

Bobby

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FAX. NO: (505) 667-2612
CONFIRMATION NO.: (505) 667-4653

DATE: January 20, 1995 TIME: 11:46

FAX NUMBER: (504-834-5890

TO: Joy St. Romain

FROM: Jim Ledbetter

MESSAGE:

This message consists of 10 Pages, including Cover

M. Edgett, CRM-4, MS A150
MST-5 File

7.) FDA Approval for Mo-99 production at Los Alamos will require little effort.

Because of existing isotope production activities, Los Alamos National Laboratory is registered with the FDA as an approved drug manufacturer. Our existing programs in Good Manufacturing Practices (GMP), required by the FDA, are easily transferred to Mo-99 production. This, combined with production using the existing "Cintichem- Drug Master File" now owned by the DOE, will streamline the FDA approval process. Ultimately, the timeliness of FDA approval will depend on close cooperation and support by the radiopharmaceutical manufacturers.

8.) NEPA Issues at Los Alamos have already been addressed and no exemptions are required.

There are no known environmental issues associated with the processing of targets in the Los Alamos CMR Hot Cells. A NEPA review, performed for the Mo-99 program, resulted in the preparation of an Environmental Assessment. All operations that would be required in the CMR Hot Cells for emergency production were described in the original Environmental Assessment. The Environmental Assessment was under review by DOE Headquarters when the Mo-99 program at Los Alamos was put on hold pending resolution of Omega West Reactor issues. The Environmental Assessment should be reviewed/revised and resubmitted to DOE for approval.

9.) A Repair and maintenance program already exists at Los Alamos.

The facility presently utilizes an in-house capability for repair and maintenance of remote equipment, Hot Cell equipment, and Glovebox related equipment. All permanent service equipment (e.g., cranes, hoists, and etc.) is maintained as part of a laboratory wide program that complies with DOE Order requirements.

10.) The Operational Readiness Review (ORR) is already being planned for at Los Alamos.

Operational Readiness Review (ORR) will be performed jointly by the Laboratory and DOE prior to the production of Mo-99. The local area office has already agreed to support this ORR. Los Alamos had already assembled a team in preparation for completing the Operational Readiness Review for the Mo-99 program. Required programmatic documentation, procedures, etc. were being prepared. We estimate that 4 months will be needed to complete the documentation and the ORR.

11.) All equipment for the Quality Control (QC) Laboratory currently exists in the CMR building. A Quality Assurance (QA) Program is already in place.

As mentioned previously all required activities for FDA approval of Los Alamos, including QC/QA, as a drug manufacturer are in place. Transferring these programmatic requirements to the Mo-99 program can be accomplished well within the time frame required for emergency Mo-99 production. All instrumentation for the QC/QA program currently exists in the CMR building. Additionally, the Laboratory maintains an active QA instrumentation calibration program and a master Quality Assurance Program Plan. The MST-5 group that will operate the CMR Hot Cell facility already has a 5700.6C/10CFR830.120 compliant Quality Assurance Program Plan in place. Furthermore, MST-5 management is formally trained in implementation of ISO 9000/ASI Q90 Quality Standards.

12.) There are no Competing Missions to be eliminated or resolved at Los Alamos.

A the present time there are no competing missions for the facilities proposed for this effort.

13.) All Radiological Monitoring Equipment at Los Alamos (CMR-Wing 9) is operational.

The radiological instrumentation necessary for the Mo-99 program has been procured as part of the Phase I facility upgrades and is in the last stages of installation. This instrumentation includes: particulate, iodine and noble gas monitoring for operating areas and the ventilation stacks. New fixed head monitors, Alpha CAMs, and Beta CAMs are being installed. Installation of these items will be completed by June.

14.) Waste Issues are resolved at Los Alamos.

The waste issues for Mo-99 target fabrication and in-cell material processing and purification were addressed in the Environmental Assessment. Temporary, on-site, storage is acceptable.

15.) Industry Agreements with Los Alamos for Radiopharmaceuticals have been negotiated in the past.

Contracts with various Radiopharmaceutical Companies have previously been negotiated. Radiopharmaceutical manufacturing representatives and members of the Council on Radiopharmaceutical and Radioisotopes (CORAR) are well aware of the Los Alamos capabilities in radioactive material handling and chemical processing . They are well acquainted with our facilities. They have, uniformly, been very complementary of our Hot Cell and Chemical Processing facilities in both the CMR building and at the TA-48 Radiochemistry Site. We believe our facilities and capabilities will lend credibility to the emergency production effort. This would facilitate agreements with industry. Ultimately, industrial agreements would be the joint responsibility of the industry, the supplier to be backed up (Nordion), and the DOE.

17.) Procedures and Documents are well underway at Los Alamos.

Generic procedures for FDA approved isotope production are available from existing production activities currently regulated by the FDA and are readily transferable to Mo-99 production. Specific procedures related to production operations in the CMR building were in preparation when the Los Alamos effort was placed on hold. These efforts could be re-started and completed well within the time frame for emergency production.

18.) Los Alamos Management is prepared to continue its commitment to the Mo-99 Production Program.

Management is committed to the Mo-99 target fabrication program and continues to support accelerator isotope production activities. Los Alamos has always helped in meeting the emergency needs of the Nation.

19.) Target transportation to Los Alamos.

See Response #5 above.

20.) Public Opposition to the transportation of Medical Isotopes and irradiated components has been addressed at several public meetings.

It should be noted that nuclear material transport is already being done, on a regular basis, in compliance with DOT regulations. If a concern were expressed, it should be resolved within a six month time frame. Shipments of materials between Los Alamos and Sandia should not be any more difficult than any other shipments. However, public opinion is subject to change. Public opinion of the emergency backup plan is unknown and should be formally addressed.

21.) Waste transportation to SNL from Los Alamos.

If Los Alamos is a part of a funded program that produces waste, then Los Alamos will provide temporary on-site waste disposition.

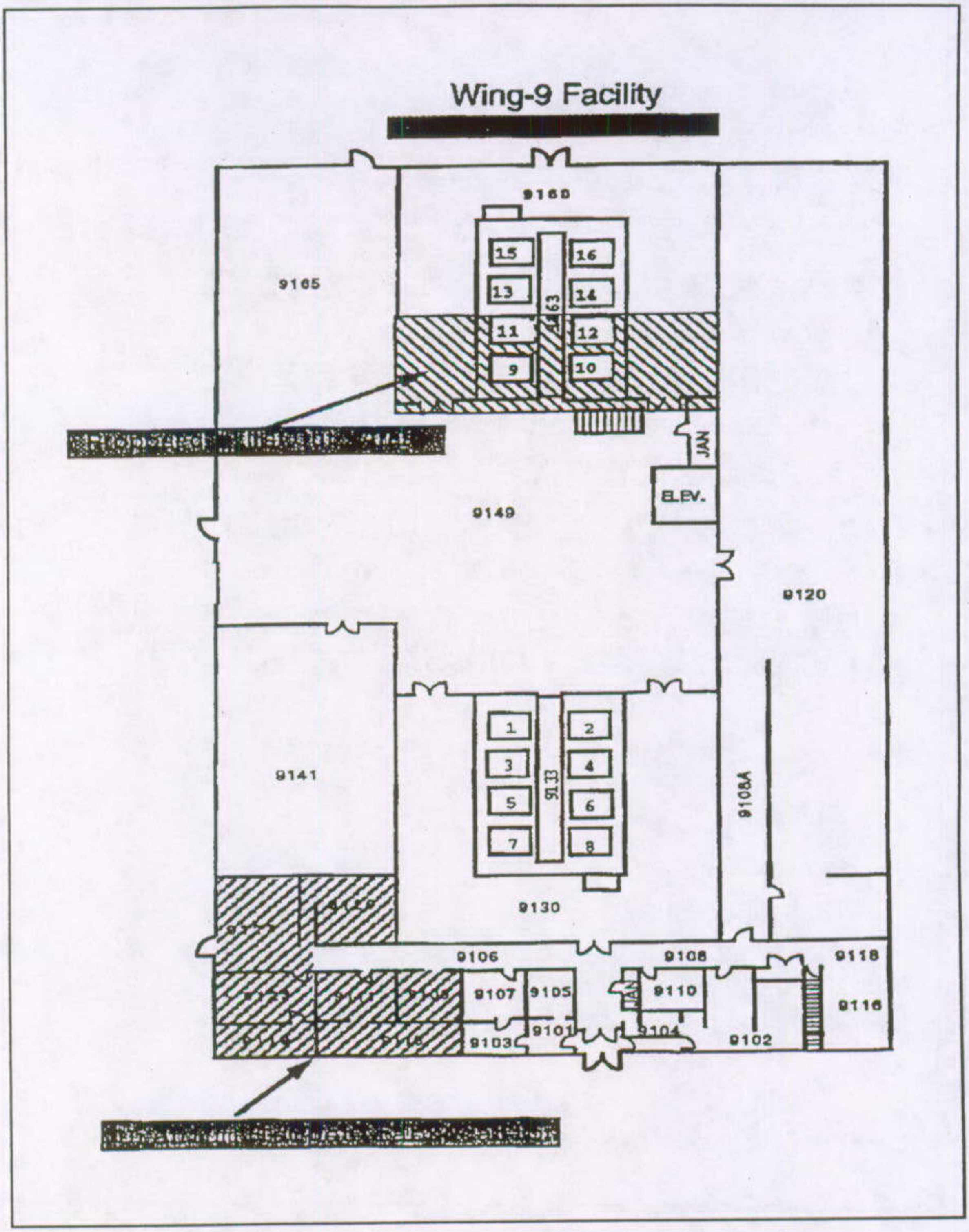
22.) Completion of CMR Upgrades in Wing-9.

The completion of the CMR upgrades in the Hot Cell Facility is proceeding at the present time with Phase I nearing completion. Phase I included the replacement of electrical systems and radiological instrumentation. The radiological instrumentation upgrade has also included the installation of instrumentation for uranium target fabrications and the processing of medical isotopes in the Hot Cells. The Los Alamos Hot Cells Upgrades are 99% complete.

23.) Defense Nuclear Facilities Safety Board (DNFSB) Issues.

Operations at either Los Alamos or Sandia will need to be reviewed and approved be the DNFSB. At Los Alamos, we have a long established baseline for the operation of nuclear facilities and for the chemical processing of Actinides and irradiated materials. Los Alamos has a technically sound approach that, based upon past experience, should be acceptable to the DNFSB.

page -5- Ledbetter, LANL January 20, 1995


Wing-9 Facility
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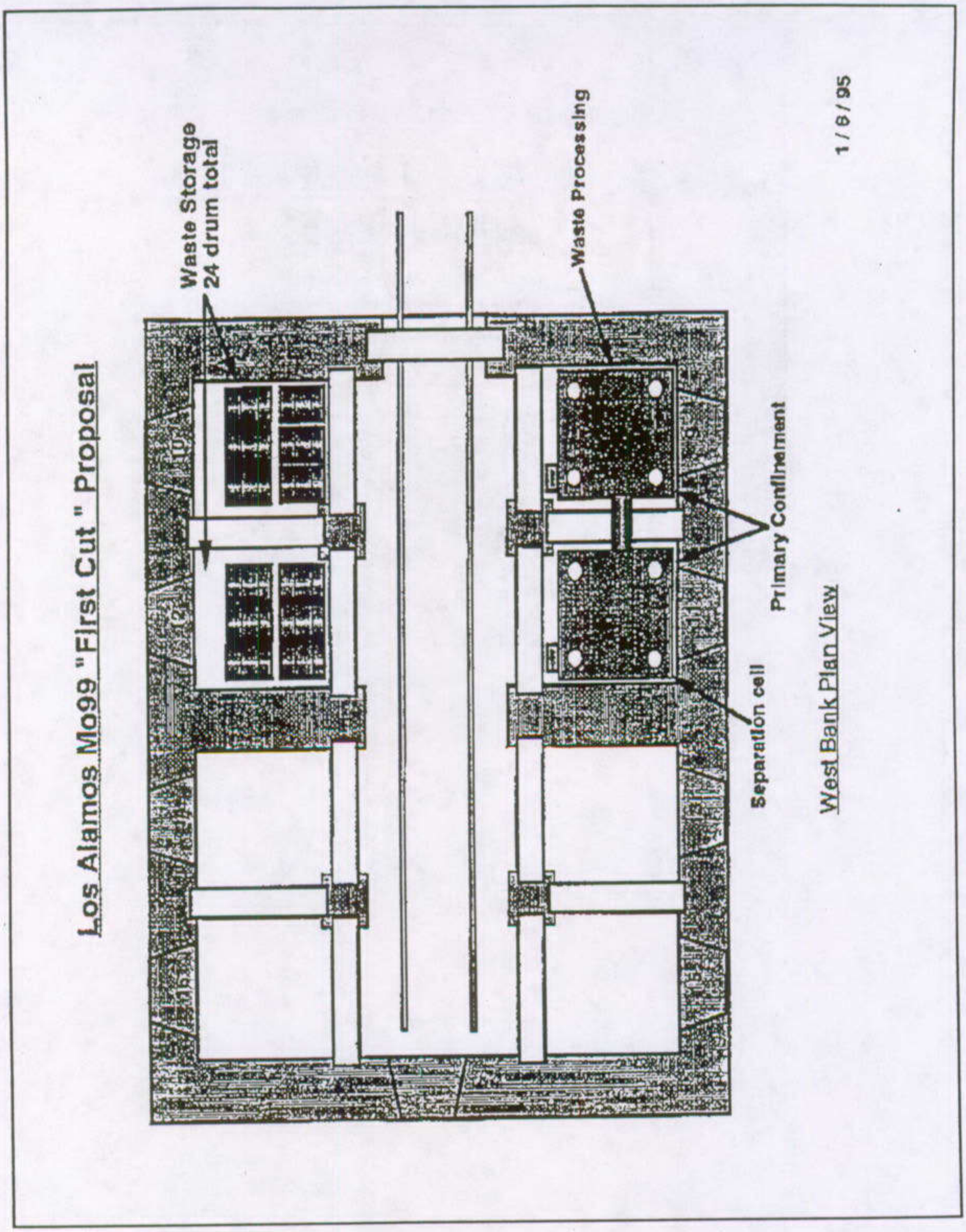
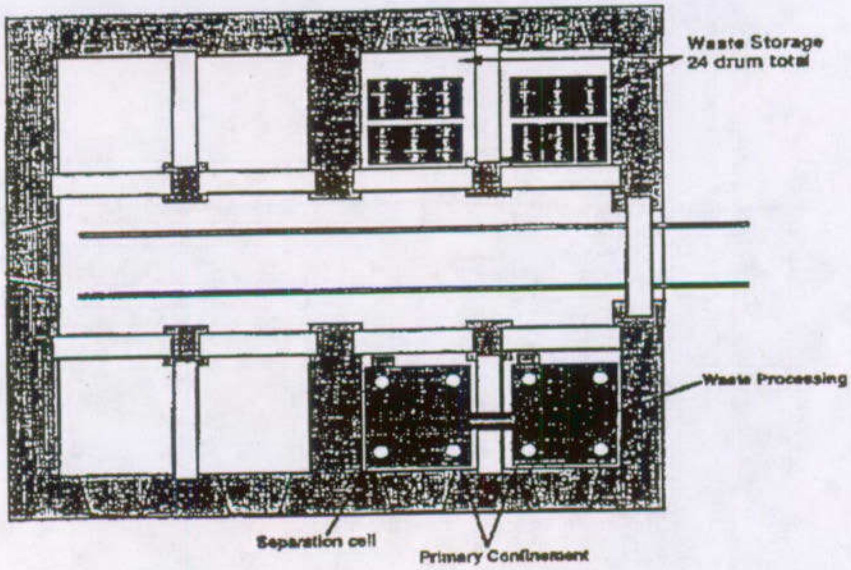
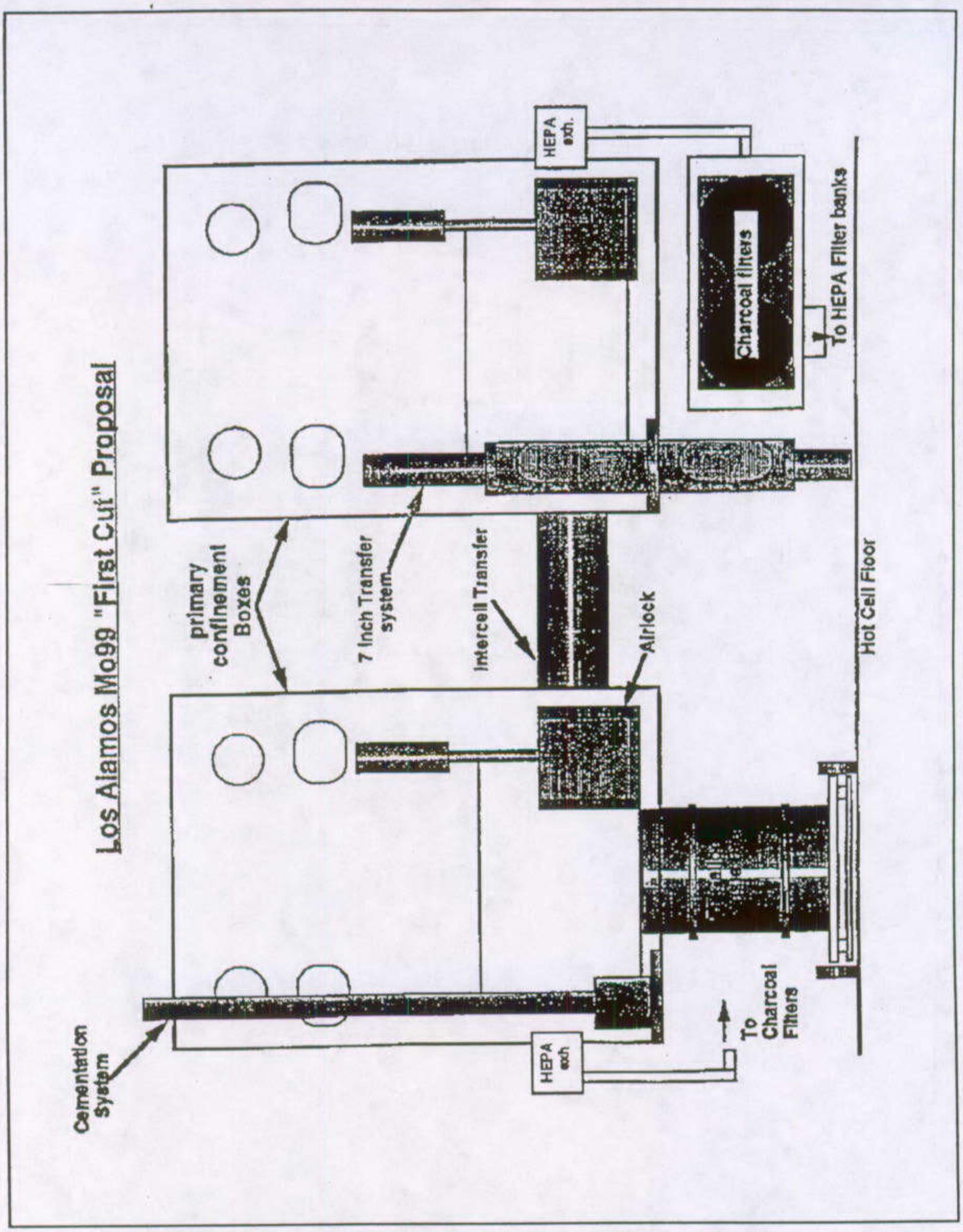

Los Alamos Mo99 "First Cut" Proposal
Waste Storage
24 drum total
Waste Processing
1/8/95
Primary Confinement
Separation cell
West Bank Plan View

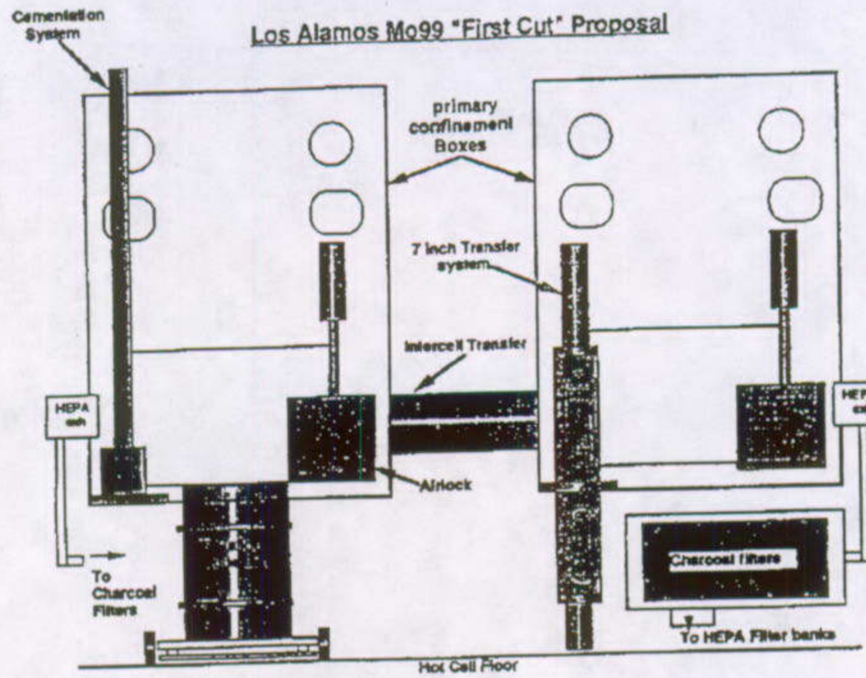
Los Alamos Mo99 "First Cut" Proposal



West Bank Plan View

1/6/95


Los Alamos Mo99 "First Cut" Proposal
primary confinement Boxes
7 Inch Transfer system
Intercell Transfer
Airlock
Hot Cell Floor
HEPA exh.
Charcoal filters
To HEPA Filter banks
To Charcoal Filters
HEPA exh
Cementation System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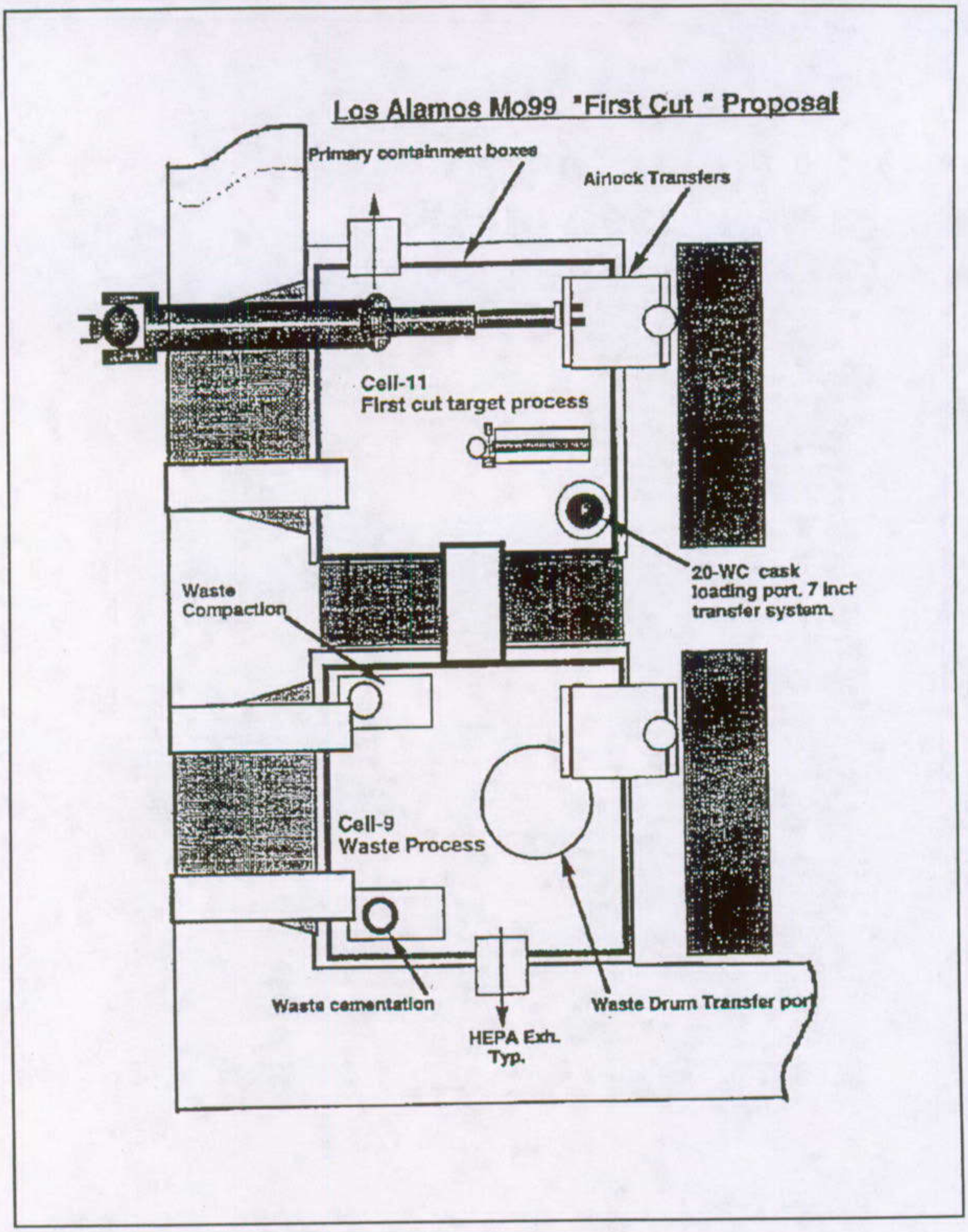

Los Alamos Mo99 "First Cut " Proposal
Primary containment boxes
Airlock Transfers
Cell-11
First cut target process
20-WC cask
loading port. 7 inch
transfer system.
Waste
Compaction
Cell-9
Waste Process
Waste cementation
Waste Drum Transfer port
HEPA Exh.
Typ.

NEWSLINE

The Future Supply of Molybdenum-99

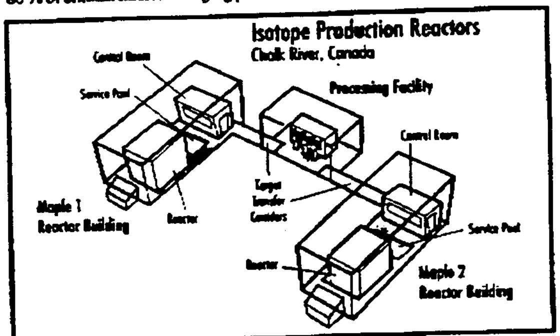
Since 1991, nuclear medicine physicians across the United States and much of the world have relied entirely on one 38-year-old nuclear reactor in Canada for the production of ^{99}Mo, the isotope used in ^{99m}Tc generators. This situation came about quietly in the 1980s as alternate suppliers dropped out of the market, leaving Nordion International Inc. in Kanata, Ontario as the major supplier in the world. While Nordion has managed to maintain a steady supply of the essential material to radiopharmaceutical makers, a series of reactor failures and labor disputes have come close to halting production several times at the facilities that produce isotopes for Nordion in Chalk River, Ontario.

After four years during which nuclear medicine professionals had concerns about the reliability of ^{99}Mo supplies, several major initiatives to bring new production reactors on-line are finally getting off the ground. Nordion officials say they will soon resume construction on two new 10 megawatt reactors that will be dedicated entirely to isotope production. Pharmaceutical giant Mallinckrodt Medical recently obtained a license in The Netherlands to begin upgrading a reactor for ^{99}Mo production for their own supply. Moreover, the U.S. Department of Energy (DOE)—despite severe budget-cutting pressures from Congress and the Clinton Administration—has sustained efforts to convert a reactor formerly used for weapons research into a back-up supplier for ^{99}Mo.

"For now, we're still vulnerable if anything catastrophic happens to Nordion's NRU reactor. But at least there seems to be definite plans on the table," said Wynn Volkert, PhD, chairman of the Society of Nuclear Medicine's committee on radioisotope supply and professor of radiology at the University of Missouri. "There are options now that we didn't have a few years ago."

Representatives from radiopharmaceutical companies are expressing similar optimism tinged with some reservations. They say all of the new initiatives will require at least a year or more before they will result in facilities capable of producing ^{99}Mo. "That means there is still a very significant period of risk for the next couple of years," said William Ehmig, a vice-president with Medi-Physics Inc., a unit of Amersham. Other industry executives point out that the building of any new facility is bound to bring increases in the price of molybdenum. The exact amount of the increase that will come from the proposed plans as well as the pass along increase in cost for technetium generators remains unclear.

Regardless of the current concerns, both radiopharmaceutical manufacturers and nuclear physicians recognize the need for a reliable back-up supply of ^{99}Mo. They know that a steady supply of ^{99}Mo is crucial to the practice of nuclear medicine. In fact, ^{99}Mo/^{99m}Tc generators are used in more than 80% of clinical nuclear imaging procedures. Moreover, the parent isotope has a 67-hour half-life, so it cannot be stockpiled. This is why the nuclear medicine community has for years been pushing for an alternative source of ^{99}Mo in the event that Nordion's supply was ever halted. What follows are updates on the three biggest ^{99}Mo production ventures.



This diagram illustrates Nordion's proposed plans to build a new reactor facility for the production of ^{99}Mo. The site will have two identical reactors and a processing facility.

Nordion's Plans for Maple-X

With plans drawn up to build a new reactor facility, Nordion executives may have felt even more compelled to get their plans off the ground after a glitch occurred in the aging NRU reactor at Chalk River last April. Production was halted for five days when a fuel rod became stuck and could not be readily withdrawn from the reactor. Nordion managed to maintain shipments to generator manufacturers by calling on a back-up agreement with the Institute National des Radioelements (IRE) in Belgium. IRE provided material for use in Europe and supplies were ready for emergency approval

NEWSLINE

POTENTIAL NEW SUPPLIERS OF MOLYBDENUM-99 IN THE FUTURE

Supplier	Reactor	Power	Target date	Project cost	Production capacity
Nordion/AECL *Chalk River, Ontario*	Maple-X (new)	10 MW	~1998	$140 million	Up to 100% world demand
U.S. DOE Sandia National Lab *New Mexico*	ACR (upgrade)	4 MW	mid-1998	>$11.4 million	Up to 70% U.S. demand
Mallinckrodt Medical *The Netherlands*	HFR	45 MW	1996	N/A	About 25% world demand and more if needed

The chart above outlines the three biggest initiatives world wide concerning the production of ^{99}Mo. All aim to assure a reliable supply.

by the Food and Drug Administration in the U.S., but the NRU became functional before this was necessary.

Nordion officials now say they have secured an "agreement in principle" with Atomic Energy of Canada, Ltd. (AECL) and the government of Canada to resume construction of two new reactors at Chalk River. Back in 1993, AECL tried to cancel the Maple-X project and halted construction after spending $40 million on planning and other work. Nordion and its parent company MDS Health Group Ltd. filed a breach of contract lawsuit against AECL. The suit has not gone to court yet, but the parties have been engaged in arbitration hearings where they have forged a tentative agreement. "There are some outstanding details to be worked out," said Nordion spokesman Ian Mumford.

The latest plan, calls for building two, 10 megawatt reactors and a new processing plant committed entirely to isotope production at a projected cost of $140 million.

Constructing and getting the first Maple reactor up to full power will take three years, and no start date has been set for the construction. The second Maple-X reactor will be completed a year later. To finance the project, Nordion officials originally said they would have to raise the price of molybdenum by 40% in October 1995. In September, they announced that the increase would be "something less than 40%" and that the company would delay the increase until January of next year when the agreement with the Canadian government should be finalized. (See *Newsline*, October 1995, p. 32N)

Without firm figures, radiopharmaceutical makers are reluctant to estimate how the increase would affect the cost of generators. Molybdenum accounts for about 30% to 60% of the cost of manufacturing a generator. This will mean an increase in hospital budgets at a time when administrators are being pressured by managed care consultants to cut costs. Nordion's three biggest U.S. customers, Dupont Merck, Amersham and Mallinckrodt, have recently informed their own customers about the possibility of a future increase in the cost of ^{99}Mo/^{99m}Tc generators and ^{99m}Tc unit doses and are awaiting their feedback. Ehrnig acknowledges that the price increase may be a cause for con-

(Continued on page 35N)

The Birth of Technetium—By Mail Order

The reference to ^{99}Mo as the "parent" of ^{99m}Tc makes complete sense, since ^{99m}Tc was literally born from ^{99}Mo. In 1937, Emile Segre and C. Perrier received a small package sent to their Italian laboratory from the Lawrence cyclotron at Berkeley, CA which contained ^{99}Mo targets that the two scientists had previously sent there to be bombarded with deuterons. Segre and Perrier dissolved the target in a solution of one part nitric acid and three parts hydrochloric acid. They then added manganese salts and allowed the resulting metals to precipitate. The result was a new element with a half-life of 6 hours. Since the element had to be manufactured in the laboratory, its creators dubbed it "technetium," which derives from the Greek word technetos, meaning artificial.

Perhaps a more fitting name for ^{99m}Tc would have been "freedomium", since Segre was able to use his discovery as a ticket out of facist Italy to gain entrance into the U.S. Segre persuaded Italian officials to allow him to travel to Berkeley to manufacture vast quantities of the element—which he emphasized was bringing scientific fame to Italian soil. The officials were not aware that Segre was indeed able to produce ^{99m}Tc in his Italian lab by sending shipments back and forth to the Lawrence cyclotron. It was this duplicity that allowed Segre to emigrate in 1938 and enabled him to join his mentor, the Nobel prize winning physicist Enrico Fermi. Fermi had left Italy for the U.S. the previous year, after he convinced the Italian government to allow his family to travel to Stockholm with him as he accepted the Nobel prize.

—Adapted from Marshall Brucer's A Chronology of Nuclear Medicine (St. Louis; Heritage: 1990).

Diatech Receives $10 Million for Peptide Research

In a deal that may signal the beginning of a new trend for radiopharmaceutical start-up companies, Diatech, Inc. in Londonderry, NH, recently announced that it had received a $10 million investment from Hafslund Nycomed, a large company based in Oslo, Norway that makes contrast media products. Under a five-year cooperation pact with an estimated potential value of $50 million to Diatech, Nycomed's initial investment will ensure a 17% stake in Diatech's peptide imaging drugs market.

Diatech currently has six peptide products that are in various stages of clinical trials, including P-280 which is in Phase III trials for the detection of deep vein thrombosis. The other peptides are in Phase I and II stages and are being tested as diagnostic agents for pulmonary embolism, somatostatin receptors in endocrine tumors, atherosclerortic plaque and infections of unknown origin. Diatech has not yet submitted any of its peptide products to the FDA for approval. "Nycomed's investment will significantly underwrite the cost of conducting studies for FDA approval," said Brad Miles, a spokesperson for Diatech.

He said Nycomed will make additional payments if Diatech's products win regulatory approval. "This is a giant company that was never involved in nuclear medicine, and this is their first leap into this area," said Miles. Nycomed executives recognize the promise of an imaging tool that could pinpoint diseases at an earlier stage and illustrate disease progression at a cellular level with greater sophistication than existing technology, including contrast media agents that Nycomed markets for x-rays and ultrasound. ■

Supply of Molybdenum-99
(Continued from page 22N)

cern among nuclear physicians, but he feels the new facility will be worth the extra cost. "My gut feeling is for people using unit doses out of a radiopharmacy the cost increases won't add more than a couple or three percent to their budget," said Ehmig. "And I can't think of a better way to assure a more secure supply."

The DOE's Proposal to Convert Sandia

For years, SNM leaders and other nuclear medicine leaders have been urging the DOE to build a reliable back-up facility for the production of ^{99}Mo. The DOE is currently preparing an environmental impact statement (EIS) on the production of ^{99}Mo. The department's preferred alternative is the annular core research reactor (ARR), a 2-megawatt reactor at Sandia National Laboratories in Albuquerque, New Mexico. By upgrading the Sandia reactor to 4 megawatts and adding processing equipment, Wade Carroll, the EIS Project Manager at DOE, said the DOE could provide 100% of the U.S. demand for molybdenum on a short-term basis. Carroll said the department is not planning to re-enter the market as a competitive supplier. "It would strictly be a back-up at this point," he said.

Given Nordion's plans to build a Maple-X reactor to be used solely as a back-up, the DOE's current plans to ensure a back-up supply may seem duplicative. DOE officials say they are acting on a need expressed in the nuclear medicine community and that the U.S. cannot rely on the Nordion proposal to build the two reactors to assure an adequate U.S. supply in the future. Carroll said that a decision by the DOE is expected early next year on whether or not the department will produce ^{99}Mo and, if so, at what facility. "If Sandia is selected, production of moly could occur by October of next year at the earliest," he said.

Some industry observers remain skeptical of the DOE's effort. They say the project is bound to be delayed for months, if not longer, by the DOE's decision to put together a full-blown EIS. More than a few observers have expressed dismay at what they consider a lack of responsiveness from the federal agency. "We don't feel like they are listening to their customers," said Ehmig. The major concern is that DOE has moved too sluggishly to be of much help. "The DOE has great plans, and I have no doubts about their good intentions, but I do have doubts about their budget," said Peter Vermeeren, general manager of Mallinckrodt's nuclear medicine division.

Mallinckrodt: A New Producer of Moly?

In August, Mallinckrodt received a license from the Dutch nuclear regulatory agency to begin work on medical isotope production at facilities in Petten owned by the Joint Research Center of the European Community, according to Vermeeren. The company started a trial production run in September as a step in gaining approval from the FDA to provide ^{99}Mo for generators marketed in the U.S.

"We expect to produce moly by the beginning of 1996," Vermeeren said. "We will then be able to use our own moly in Europe and in the U.S. when the FDA approves it." Mallinckrodt launched their plans about three years ago in an effort to create a secure supply of ^{99}Mo to ship generators to their customers. Vermeeren said Mallinckrodt is planning to produce only enough molybdenum to supply the company's own needs. Mallinckrodt supplies about 25% of the global market for ^{99m}Tc generators, he said, and about 20% of the U.S. market. "We are not out to conquer the world market for moly production," he said. "We're just trying to create a more stable situation and a more acceptable situation for our customers worldwide." In the event of a sudden shutdown of the NRU reactor in Canada, Vermeeren said, "it would be possible for IRE and Mallinckrodt to crank up production to supply the world."

J. Rojas-Burke

Dear Society Member and Fellow Professional:

Nuclear medicine and industry leaders have been concerned for several years about possible interruptions in the continued reliable supply of ^{99}Mo to the medical community. This concern arose from the realization that the current Nordion production facility, located in Chalk River, Ontario, Canada, is nearing the end of its useful life. At present, Nordion is the principal worldwide supplier of ^{99}Mo, and no other facility is currently capable of producing sufficient amounts of this radionuclide to meet needs on an immediate basis.

We are pleased to report that Nordion, after consultation with the nuclear medicine industry and the profession, has adopted a plan to build two new reactors for ^{99}Mo production that will not only provide a fail-safe system by the constant availability of a standby reactor but also incorporate a new process to better manage radioactive waste. This plan will assure a reliable long-term supply of ^{99}Mo. The reactors will be located on Atomic Energy of Canada, Ltd. (AECL) property, but will be owned and operated by Nordion. It is projected that the two new reactors, to be called Maple I and Maple II, will come-on line by 1998. We support this plan as an essential investment in the future of nuclear medicine.

The cost of building these new reactors is significant. In order to pay for this project, Nordion is constrained to increase the cost of ^{99}Mo to all ^{99m}Tc generator manufacturers. Nordion discussed with the nuclear medicine leadership the price increases that necessarily accompany their comprehensive program for guaranteeing a reliable high-quality supply of ^{99}Mo. While we are concerned about how this cost increase will be passed on to nuclear medicine facilities, third-party payors and patients, the nuclear medicine leadership feels that Nordion has dealt with this important problem in a responsible manner and concedes that a modest price increase is an acceptable alternative to lack of a reliable supply of ^{99}Mo. Since the price of ^{99m}Tc generally contributes a small portion of the overall cost of a clinical nuclear medicine study, the total increase in procedure costs is expected to be modest.

Peter T. Kirchner, MD, President
Society of Nuclear Medicine

Robert F. Carretta, MD, President
American College of Nuclear Physicians

Responses to Comment Letter C068

1 The Department of Energy's proposed action in this environmental impact statement addresses the near-term requirements of a backup supply of Mo-99. It does not focus on a long-term plan. Regarding the emergency response plan cited in the comment, this plan was developed as a predecisional draft by a consultant to the Department, but was never formalized or adopted by the Department. Section 3.2.2 of the EIS has been modified to reflect the comments on the current status of Nordion's proposed actions.

2 At the time of this writing, Nordion still had not formally announced that they were going to resume construction of the Maple reactor complex. Nordion has informed the Department that construction and commissioning of Maple I would be completed about 3 years after an announcement is made and that FDA approval of Nordion's new Mo-99 production process is expected to be accomplished within that same time frame. The Department's estimate of 42 months was based on Maple I and the new processing facility reaching full production capability rather than an initial yield of product. Section 3.2.2 has been revised to more accurately reflect Nordion's stated position.

3 The Department believes that the discussion of the waste generation in the EIS is accurate. The waste generated during target processing is stored and allowed to cool for 6 months to a year before processing or disposition, at which time it meets the requirements of 10 CFR 61.54 to be categorized as "Class-C" low-level waste and meets the suitability requirements for near-surface disposal.

Further, DOE does not believe the waste generated is understated in the EIS. Calculations have been made to confirm the amounts of the fission products that would be produced from the targets. It should be noted that the volumes given are typically compacted and/or crushed volumes.

After the Maple I and II facilities and the new separation facility are built and in operation, appropriate waste figures can be attributed to that operation. Until then, the current process used by Nordion/National Research Univeral is waste-intensive compared with the Cintichem process. The Department acknowledges Nordion's strong commitment to waste minimization as evidenced by Nordion's plans to employ in its proposed facilities a process similar to the Cintichem process (see Section 3.2.2).

4 The summary has been revised to clarify that the passages in question refer to production of Mo-99 by domestic (U.S.) private companies.

5 The Department is aware of the actions Nordion has taken in an attempt to narrow the window of vulnerability, and Section 3.2.2 has been updated to reflect the current world supply situation. The Department appreciates and welcomes these actions. However, even with these efforts, it is still the Department's view (as well as the view of the U.S. medical community) that there continues to be an inadequate backup foreign supply capability to meet U.S. demand for Mo-99 should the current source become unavailable for any extended period of time.

The Department understands that if Nordion's current source for Mo-99 were to become unavailable, Nordion has arrangements with other sources that could supply a portion of the U.S. demand. However, these sources are not capable of supplying more than about half of the current U.S. demand.

6 The Department believes that it is prudent to establish a production capability that could supply 100% of the U.S. demand in case of a Mo-99 supply shortage. Regarding the offer of cooperation, the Department

has kept Nordion apprised of the status of the Department's NEPA process and has been in contact with Nordion regarding plans for Mo-99 production. The option of shipping Mo-99 to Nordion for final product testing and distribution has been discussed with Nordion, is presented in the Summary, and is evaluated in Section 5.11 and in Appendix B of the EIS.

The EIS project team contacted radiopharmaceutical companies and asked the specific activity required when the product reached their loading dock. The companies provided an answer "in the range of 10,000 curies/gm." Further, when SNL/NM was preparing its environmental assessment, SNL/NM contacted the customers and asked the same question. The answer was the same, "in the range of 10,000 curies/gm." Pursuing a more definitive figure from the customers did not yield a more definitive answer.

The Missouri option was also eliminated from consideration because of the schedule on which it could deliver Mo-99. Missouri, irradiating one bundle per week, cannot supply the current market demand on a continuous basis. It can supply the pharmaceutical houses with more than 3000 six-day curies in one single lump delivery, but it cannot supply 3000 six-day curies with the deliveries spread evenly over five days. Without a significant upheaval in the way the medical community currently conducts business or without a fuel design change, Missouri cannot meet the industry demand. This analysis is given in Section 3.4.2.1.

7 The Department is aware of the proposed Nordion plans for new reactors. Discussions and press releases regarding these reactors have been issued for some time. Cost estimates for these reactors approach $140 million dollars. Uncertainty has surrounded the ability to secure this funding and to reach construction agreements with Atomic Energy of Canada Ltd. It is the Department's understanding that Nordion is now in disagreement with the Canadian government regarding the tax treatment of the new reactors. These factors, combined with the Department's position that the U.S. is currently in a window of vulnerability, continue to require progress toward developing a backup capability to Nordion's current sources of Mo-99.

8 The Department believes that, as stated in the Jupiter report, Mo-99 production in the long-term should be conducted by the private sector. As stated in the EIS, the Department encourages private sector production of Mo-99, and if the private sector begins reliably producing Mo-99 in the U.S., the Department would phase out its production. The Department has simply proposed to establish a production capability to act as a backup to the existing Canadian supplier. The intent is not to compete with Nordion.

1581 Golden Gate
Pocatello, ID 83201
February 04, 1996

Mr. Wade Carroll, MIPP-EIS Document Manager
U.S. Department of Energy
Officer of Isotope Production and Distribution, NE-70
19901 Germantown Road
Germantown, Maryland 20874

Dear Mr. Carroll

This letter requests an extension of the February 9, 1996, deadline for comments on the Medical Isotopes Production Project: Molybdenum-99 and Related Isotopes Draft Environmental Impact Statement. Specifically, I request that you consider my comments that will be submitted by February 30, 1996. I was late to identify the Moly 99 project had an alternative that could potentially affect the area in which I live. My preliminary review raises the following concerns.

1 • Section 2.1 (Purpose and Need) states the long term goal is that production of Mo-99 in the U.S. should be conducted by the private sector. In selecting their preferred alternative, it appears that DOE has not put enough weight on the fact that the INEL is the only alternative that the private sector has expressed interest in participating. As stated in the Draft EIS, there is a lease agreement with the Idaho Brain Tumor Center to perform boron neutron capture therapy at PBF. Additionally, Idaho Brain Tumor Center has expressed interest in a shared cost venture. To meet DOE's long term goal of privatization, it appears that the INEL alternative is a more logical choice.

2 • It appears that DOE selected the preferred alternative before triggering the NEPA process. The problem DOE is attempting to solve is an unreliable supply of Mo-99. Selecting Sandia as the solution to the problem appears to violate the spirit of NEPA.

I need more time to review the Draft EIS and fully research the above concerns. A response to my request would be appreciated.

Sincerely,

Brad L. Swanson

Responses to Comment Letter C069

1 Private U.S. production of Mo-99 could be accomplished by privatization of a DOE operation or by a separate initiative by the private sector. The process of privatization is not part of this proposed action. The Department published a Notice for Expression of Interest in the *Federal Register* in December 1995 to solicit concepts from private industry for privatization of DOE isotope activities. Businesses interested in pursuing Mo-99 production have been invited to respond to this solicitation. If the Department decides to implement the action proposed in this EIS and if concepts on privatization of Mo-99 production received from the private sector are promising, DOE would proceed with a request for proposals to facilitate privatization on a competitive basis.

2 The Department has not made a decision regarding if and where to conduct the proposed project. A preferred alternative is identified in an EIS, in essence, to tell the public which way the Department is leaning on a decision, but it does not mean that the decision has been made. Further, Council on Environmental Quality regulations require Federal agencies to identify the preferred alternative in a Draft EIS if the agency has one, and require that the agency identify a preferred alternative in a Final EIS.

The Annular Core Research Reactor/Hot Cell Facility combination at SNL/NM is the preferred alternative for target irradiation and processing for the reasons stated in Section 3.3.1.1.

100 North Morningside Drive
Idaho Falls, ID 83402

February 6, 1996

Mr. Wade Carroll, MIPP-EIS Document Manager
U. S. Department of Energy
Office of Isotope Production and Distribution, NE-70
19901 Germantown Road
Germantown, MD 20874

Dear Mr. Carroll:

May I express my appreciation to you and your staff supporting the recent hearings in Idaho Falls related to the "Medical Isotopes Production Project: Molybdenum-99 and Related Isotopes Draft Environmental Impact Statement." I had the opportunity to present comments orally the evening of January 17, 1996 and am following with written comments to expand on my earlier thoughts. In both cases, I am acting as a private citizen. This letter presents two general concerns and four specific concerns for your consideration in the project's record of decision.

General Concerns

1

1. In view of Secretary O'Leary's emphasis on "privatization" of DOE activities, I am significantly concerned that near-term isotope production "privatization" was not included as a criterion, and further, as a weighted criterion. Not only is it feasible, but in the situation at the INEL, the Idaho Field Office has already signed an agreement for "privatization" of the Power Burst Facility (PBF) reactor for medical therapy use. As one associated with a separate DOE "privatization" project, I have first-hand knowledge on this emphasis being pushed by the DOE. I recommend the near-term "privatization" criterion be added to the decision criteria.

2

2. Cost-sharing of related project work should be considered as an added criterion, or, as a minimum, include such activities in the cost analysis to show more appropriate benefits to the taxpayer. With the shrinking budgets, the DOE is needing to be creative on how to get more with less. Breakthroughs in thought or paradigm shifts are necessary generally to realize such goals. As in the case with the "privatization" of the PBF for use in Boron Neutron Capture Therapy (BNCT), I suggest that DOE obtain a commitment proposal so that a cost-sharing effect could be better evaluated in reaching a final decision on the medical isotopes project.

Specific Draft EIS Comments

3

1. Page viii (Summary): Regarding the statement "The conversion from HEU to LEU for the 3 alternatives discussed could be a relatively simple and inexpensive undertaking.", I question the accuracy of the statement and find it misleading. There is redesign of the core and the associated safety basis to be accomplished and authorized. Further, reducing the fuel density that would be involved would reduce the neutron flux available and thus the reactor's effectiveness.

2. Page xiii (Summary of Safety Consequences): While I agree that all options
shown in the document can be done safely, the INEL option is more inherently safe
because of the large distances to any population centers. The tables in Appendix
4 C.1 dramatically show the preference for the INEL sites compared to the other
options. I know from personal experience the closeness of the SNL option to the
International Airport and City of Albuquerque and the Los Alamos option with the
City of Los Alamos. For example, the shortest route between Los Alamos and TA-2,
site of Omega-West reactor and below in the Los Alamos canyon, is by hang-glider.

3. Page 4.83 (Section 4.4.7.2): For accuracy of presentation, the prototype
reactors at the Naval Reactors Facility (NRF) and EBR-II at Argonne-West National
5 Laboratory (ANL-W) have been shutdown and are planned to no longer operate. It
is likely that any emission releases by restarting PBF will be less than what
these "shutdown" reactors historically emitted and should be addressed
accordingly.

4. Page 6.1 (Section 6.1): The discussion indicates that all options would be
under the DOE regulatory system. Under a "privatization" approach that would
6 likely exist with the PBF option, the regulatory process would be under NRC
license. It is my understanding that the NRC process is written into the
agreement. This approach would also reduce the DOE oversight, thus a DOE cost
7 reduction not available by the other options. This benefit should be considered
in the overall cost picture.

Yours truly,

Roderic W. Thomas

Responses to Comment Letter C070

1 The Department intends to operate as a backup to the Canadian supplier. The Idaho Brain Tumor Center (IBTC) has informed DOE of its interest in coordinating its efforts with those of DOE. The Department is aware of this potential for the INEL alternative. Although the potential for privatization of the proposed action in this EIS is important, the process for privatization is not part of this proposed action. Each of the production alternatives has potential for privatization. DOE has solicited expressions of interest from the industrial community for the privatization of any isotope production activity conducted by DOE, including the proposed Medical Isotopes Production Project. If promising concepts are received, the Department would seek privatization proposals on a competitive basis.

2 The EIS presents cost information only for the proposed Medical Isotopes Production Project at each of the alternatives. The Department recognizes that facilities proposed for use in all of the alternatives under consideration could conduct other cost-sharing activities; however, these other cost-share activities and their impacts are outside the scope of the EIS and therefore are not considered in the EIS.

3 It is true that many research reactors do not perform as well using low enriched uranium fuel. Some cannot operate at all on low enriched uranium because they cannot accommodate enough low enriched uranium fuel in the reactor core. If the fuel and core design has not been completed, then the process is not trivial. However, the core and fuel redesign has been completed for the three alternative reactor facilities that are fueled with highly enriched uranium, and the necessary calculations are complete. The safety documentation for the affected reactor would have to be revised to reflect the change to low enriched uranium fuel. The cost to revise the safety documentation is included in Section 5.22. The core average flux reduces approximately as a function of the ratios of the core volumes with highly enriched uranium and low enriched uranium, respectively. Core power is basically fissile material density times flux times core volume. Slightly more total fissile material per core is normally used to compensate for the reduction in thermal utilization factor caused by the increased uranium-238, but the material is spread out over a somewhat larger core. To keep fission rate constant, the total number of neutrons available to cause fission must go up because of some parasitic capture in the fuel, but again this total number is spread out over a larger core volume. Because of the smaller core buckling of the larger core, some compensation is made by a reduction in leakage neutron loss. The result is a decrease of approximately 20% of the average flux. Reactors that have already converted have typically seen this type of decrease.

4 The benefits of locating the facilities in a remote location are reflected in the largely lower radiological consequences for normal operation and accidents at the facilities.

5 The radiological air quality section is based primarily on information in the Spent Nuclear Fuel Programmatic Environmental Impact Statement (DOE 1995b), which reflects site operations in 1991 updated to include some facilities that were expected to begin operation during 1995. The change in status for facilities noted in the comment is acknowledged; however, this information would not affect analyses or conclusions reached in the EIS.

Estimated emissions from the Power Burst Facility (PBF) were based on historical data scaled up for the increased operating time expected if medical isotope production were implemented there.

6 As stated above, the IBTC has not made a formal proposal to the Department regarding the dual use of the PBF. Therefore, the Department cannot say for certain whether operation of the PBF would be conducted privately (by IBTC) or by DOE. In developing the EIS, the Department assumed that if the PBF were selected for the isotope production mission, DOE would operate the reactor under DOE regulations.

7 The Department is currently preparing a separate response to an independent report that recommended that oversight of DOE operations be conducted by an outside body (e.g., the Nuclear Regulatory Commission [NRC] or the Defense Nuclear Facilities Safety Board). Therefore, it is possible that the NRC would be the regulator regardless of who (DOE or IBTC) restarted and operated the reactor.

LOS ALAMOS COUNTY

P.O. Box 30 Los Alamos, New Mexico 87544 505-662-8080 FAX 505-662-8079

COUNTY COUNCIL
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Vice-Chairman
Ginger Welch
Members
J.R. "Stretch" [illegible]
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[illegible]
[illegible]
COUNTY ADMINISTRATOR
Alex Georgieff

February 6, 1996

Mr. Wade Carroll, MIPP
EIS Document Manager
Office of Nuclear Energy, Science and
Technology, NE-70
U.S. Department of Energy
19901 Germantown Road
Germantown, Maryland 20874

Dear Mr. Carroll:

1 The Council of Los Alamos County endorses the Los Alamos proposal for utilizing the Omega West reactor for production of Molybdenum-99. We believe the U.S. should have a source for this valuable medical isotope within its borders. The Los Alamos
2 solution to this has the immediate potential of producing 50% of the U.S. needs which is the break even point so that Department of Energy (DOE) will not have to subsidize this operation.

The people in Los Alamos have lived with this reactor for 37 years and would not view it as the threat that has been expressed in other communities competing for this project.

Since it is the DOE's plan to privatize this process in five to ten years; this production of these medical isotopes provides an opportunity for a business to spin out of Los Alamos that will provide jobs for North Central New Mexico. Siting this entire process at Los Alamos will accomplish another goal of DOE; that is for Los Alamos to move toward self sufficiency.

Sincerely,

Alex Georgieff
County Administrator

Ginger Welch
Council Chair

cc: County Council

"A Consolidated City and County Government"

Responses to Comment Letter C071

1 Comment noted.

2 The Omega West Reactor, like the Power Burst Facility and the Oak Ridge Research Reactor, would have to be restarted for this project and thus does not have the capability to produce any Mo-99 immediately. All the alternatives would eventually allow the Department to produce greater than the 10%-30% U.S. demand. The purpose of the proposed action in the near term is to create a backup capability, not to create a primary source for Mo-99. Producing 10%-30% on a continual basis would provide some certainty that the alternative could meet production demands up to 100% of the U.S. demand if needed. Current companies that supply Mo-99 to hospitals throughout the U.S. are under contract with Nordion for their supplies. Because of these contractual issues, it is not certain that the Department could sell 50% of the demand immediately.

February 6, 1996

Mr. Wade Carroll
U. S. Department of Energy
Office of Isotope Production and Distribution (NE-70)
19901 Germantown Road
Germantown, MD 20874-1290

Dear Mr. Carroll:

I appreciate the opportunity to review the Draft *Medical Isotopes Production Project: Molybdenum-99 and Related Isotopes Environmental Impact Statement (DOE/EIS-0249D)* and to participate in the public meeting held January 30th in Albuquerque. Again I compliment you and your staff for the professional, businesslike, and patient manner in which the public meeting was conducted. DOE has gone out of its way to accommodate individuals whose comments were not focused on the contents of the EIS but rather broader attacks on the DOE.

1 In fact, the comments made by representatives of the Southwest Organizing Project (SWOP) and the Southwest Research and Information Center (SWRIC) raise the question in my mind. "What has DOE accomplished with this Draft EIS?" In my view, the answer in the technical realm is: nothing. The Draft EIS confirms the results of the earlier Environmental Assessment, the generation and processing of targets at Los Alamos National Laboratory, and Molybdenum-99 at Sandia National Laboratory (the DOE preferred alternative) pose no significant threat to either the workers or the public. Similarly, the affect in the "political" realm is also minimal. The Draft EIS does not give SWOP and SWRIC the answer they wanted, therefore, they conclude it is unacceptable as evidenced by their representative's "return" of the drafts. Furthermore, in my view, one of the approaches these groups take is disingenuous, at best. They argue that DOE should have private industry take over the isotope production role. But anyone with even minimal background in the nuclear safety arena knows exactly what would happen if a commercial entity did attempt to license a new reactor. Antinuclear groups, such as SWOP, would use every avenue available to thwart them, making the effort so economically difficult that it probably would be abandoned.

During the public meeting, Dr. Karen Neuhauser presented some excellent arguments that I commend to DOE. In addition, I strongly second her recommendation that DOE reexamine its policy of "activist appeasement," as she termed it. My own experience suggests that once DOE "waffles," as I believe it did with respect to the earlier Environmental Assessment, it puts itself in a continuing "no win" situation. Each draft published that does not provide the answer sought by the activists leads to a call to "bring us another rock." The resources that have been
2 expended to date on this "non-problem" (which I estimate to be in

Mr. Wade Carroll
February 6, 1996
Page 2

2 excess of $1 million) could much more profitably been spent to bring the project to fruition. An affirmative Record of Decision should be promulgated at the earliest possible date.

Although, as noted, I do not believe the EIS was needed, there are some minor points that if addressed may enhance its presentation.

3
- It is difficult to establish with any accuracy just how many persons are included in the estimates of population dose. The discussions in Chapter 5 seem at times to include every-one within an 80 kilometer radius. On the other hand, the results in section 5.15.1 (e.g., Tables 5-21, 5-23, 5-25, 5-27, and 5-28) appear to consider only some 133,266 persons within 80 kilometers to the "north." I've been unable to ascertain how this number was established. Interpretation of the results would be much easier if these populations were more precisely defined.

4
- The tables in Chapter 5 frequently report results in mixed format. For example, an expected exposure is presented as 0.000089 rem, while the cancer risk is expressed in expo-nential notation as 4 x 10^{-8}. I strongly recommend that only the exponential notation be used.

- In most instances the (impacts) exposures are reported in the tables in units of rem, while the narrative discussion that accompanies the table uses mrem. Obviously, either is correct and the conversion is a simple matter of 1000. However, given the extremely low values being reported, I think readability and comprehension would be enhanced if mrem were used throughout.

- In the Chapter 5 tables Fatal Cancers are reported as None, followed by the actual analytical estimate in parentheses. While I completely agree that the reasonable conclusion from the analysis is that there is no observable effect, it seems incongruous to state None and then quote a value. I recommend that the tables report the numerical results of the analyses and the associated narrative text draw the conclusion.

- In Section 5.21 the narratives accompanying the tables and figures related to minority populations and low-income populations are difficult to follow. These should be examined for possible rewrite to improve clarity.

Mr. Wade Carroll
February 6, 1996
Page 3

I look forward to an early DOE decision in this matter.

Yours truly,

David M. Ericson, Jr., Ph.D.

Dr. David M. Ericson, Jr.
3517 Yosemite Drive, NE
Albuquerque, NM 87111
505/296-8802

Responses to Comment Letter C072

1 The Department decided to prepare an EIS based on the environmental assessment (EA) and comments received on the EA. The EIS was prepared in part to explore additional alternatives for meeting the purpose of and need for the proposed action.

2 Comment noted.

3 Population dose estimates for routine (i.e., relatively continuous) emissions from facilities consider the total population within 80 km of the facility, accounting for the fraction of time the wind blows toward each sector.

In the case of accidents, the wind was assumed to blow in one direction during the entire release, and the direction evaluated for the EIS was chosen to maximize the population dose. If the wind direction were assumed to change during the course of the accident, a larger population might be affected, but the quantities of radioactive materials to which those populations are exposed would be lower, resulting in a smaller total collective dose and a lower average dose to the downwind individuals. The analysis in the EIS chose a single wind direction in order to maximize the potential population dose for each accident, which is noted in the text and tables of Section 5.15.

4 The preferences expressed in the comment regarding presentation of numerical results are noted and have been implemented throughout the EIS as appropriate.

OFFICE MEMO

Subject: COMMENTS on DOE/EIS-0249D

Time: 11:11 AM

Date: 2/7/96

As an interested citizen with recent experience in the preparation of DOE/EIS-0203-F, I attended the July 24,1995 public scoping meeting on the Draft Environmental Impact Statement for the Medical Isotopes Production Project: Molybdenum-99 and Related Isotopes. Because of a previous out-of-town conflict I was unable to attend the public comment meeting on January 17,1996. Please consider the following as my comments on the DEIS:

1. At the scoping meeting, John Brasier of INEL (considered an expert on the Mo-99 process; see page A.1 of the DEIS) gave a discussion on the suitability of ATR. That discussion recognized that the Navy mission for ATR was not compatible with Mo-99 production. Neither Mr. Brasier nor anyone else at the scoping meeting suggested PBF as the most appropriate Mo-99 irradiation source at INEL. Therefore the preparers of the EIS are to be commended for identifying, on their own, this role for PBF.

1
2. At the scoping meeting, DOE made available DOE-NE-0111, its August 1994 strategy document for the production of Mo-99 and other isotopes. This document states that DOE completed a reevaluation of domestic reactors with a capability to produce Mo-99 (p.18), following the primary coolant leak in 1993 at the Omega West Reactor, DOE's original choice after the first evaluation. Based on information in the strategy document, PBF was not considered in this reevaluation, before ACRR was identified as the preferred alternative. Thus PBF has not been given adequate consideration so far in the selection process.

3. The details of the proposed action are subject to misinterpretation:

a. The near-term goal includes the capability to increase production to supply 100% of the US demand, should the Canadian source become unavailable (page v). The most obvious
2
interruption is AECL's plans to shut down the source "near the end of the century" (p. iv). Early capability to meet the full demand therefore appears to be more important than partial supply at an earlier date.

b. The action should also define a period of performance, such as five years from the ROD (when the EIS has to be updated). Such a POP would then include 2-1/2 to 3 years of operation at full demand (or higher if the US demand is projected to grow during that period
3
of time).

The various alternatives should be judged against an action that is better defined according to this comment.

4. The strategy document also states (p. 4-4) that DOE "will strongly encourage private
4
sector involvement with the project at the earliest time in the project including the possibility of leasing the production facility to a private investor". However, the DEIS

- more -

indicates that privatization is beyond the scope of the EIS (p. iii). The basis for this scope
4 limitation needs to be justified. In BNCT PBF already has a potential private mission. ACRR
with a DOD primary mission will not attract private investment.

5. An additional disconnect between the strategy document and the EIS exists. Savoie and
Singh 1994, referenced several times in the EIS (primarily in relation to purpose and need)
5 is "An Independent Assessment of the DOE Plan to Establish a US Production Source for
Mo-99". The plan, of which this document is an independent assessment, is not described
nor referenced in the DEIS.

6. Just like the Navy mission at ATR, the standby defense mission for ACRR is not
6 compatible with an assured, reliable Mo-99 supply in time of national emergency. The BNCT
mission of PBF is compatible with simultaneous full (100% US demand) Mo-99 production.

7. The EIS correctly identifies the need to upgrade the PBF safety documentation to new
requirements including those of DOE Orders 5480.22 and .23. This comment raises similar
questions about ACRR:

a. To meet full Mo-99 production over a significant period of time, ACRR would require a
new fuel type and increasing the power level from 2 MW to either 3 MW (Table 3-2) or 4 MW
7 (p. 3.23). Although the strategy document mentions an upgraded safety analysis (p. 19), the
DEIS does not explain whether the current safety documentation addresses the new fuel, the
higher power level, and the DOE Order requirements. If it does not, the low cost estimate for
documentation in Table 5-52 and any uncertainty advantage in schedule for ACRR over PBF
must be challenged.

b. Significantly, ACRR is the only reactor of the four alternatives for which an SAR is not
referenced in Section 5.23. If Massey and Coates 1995 is intended to serve that purpose,
what DOE safety reviews has it undergone?

8 c. Even if ACRR is available in a year or less to provide a partial Mo-99 supply, it would have
significant later unavailability during conversion to full production.

7. The EIS describes three core modifications for PBF (pp. 3.48 & 3.50) and indicates they
have not been costed (p .5.101) "which could add significantly to the overall preparation
costs". The full Mo-99 production could be met by raising the PBF power level somewhat
9 above the proposed 10 MW and doing only modification 1 (removal of the central
experimental tube), which should be the simplest and cheapest to implement and analyze.

8. Another cost uncertainty for PBF (p. 5.101) is in hot cell preparation and operations. The
hot cells at the Idaho Chemical Processing Plant should be used in the INEL alternative to
reduce these uncertainties.

9. Also on p. 5.101, the INEL cost estimates are purported to suffer because of "limited
resources available at INEL" to perform them. DOE must provide for the necessary time and
resources at the alternate facilities in order to shield itself from criticism that the playing
10 field is not level. Those resources should be adequate to include review of the FEIS (and its
comment resolution) by INEL before the document is issued. The initiative must come from
DOE-HQ because of the local perception that LMIT will not actively participate in the EIS
process involving a preferred alternative for a sister company.

- more -

10. Finally on costs, Table 5-52 should be revised to indicate life-cycle costs for an action
11 structured similar to the suggestions in Comment 3 above. These life-cycle costs should be
used as one basis for the ROD.
11. The explanation of "fuel damage scenario" in the last paragraph on p. 5.42 is not clear.
Like ACRR, PBF is primarily a transient-mode reactor that shuts down when the entire core
12 heats up. Nevertheless individual fuel elements can overheat to melting due to channel
blockage, etc. Is ACRR really immune to similar scenarios?
12. While one cannot expect DOE EIS analyses to be done totally consistently from document
to document, some basic aspects ought to be consistent to allow a comparison of risks. The
public access location at the INEL has traditionally been on the highway between Idaho Falls
and Arco, which is about an order of magnitude further from PBF than the 1000 m used in
13 Tables 5-41 and 5-42. DOE-EIS-0203-F represented an effort to inject consistency in these
analyses between the various DOE sites. On facility accidents the Mo-99 EIS analysis should
be consistent to the greatest extent possible with the methodology outlined in Appendix F-5
of Volume 2 of the INEL EIS. Similar consistency between the two EIS's should be achieved
14 in the transportation analyses. The reasons for, and effects of, unresolved differences in
methodology should be explained. PNL is familiar with these methodologies because its
senior reviewers for the DEIS (p. 8.10) participated in the SNF/INEL EIS.
13. "High-activity low level" waste (p. 5.33) from Mo-99 production points out the difficulty
with DOE definitions of radioactive waste, i.e. by source rather than activity level. A better
15 description of the waste, including the fate of residual HEU, should be included in
appropriate places in the EIS, such as Appendix A. Such description (and associated cubic
meter, curie, and kw numbers) should be consistent throughout the EIS, especially among
Tables 3-1 & B-6 and p. 5.33.

Thank you for your willingness to consider my comments.

George O Freund

George A. Freund
2025 Balboa Drive
Idaho Falls ID, 83404
Daytime Phone 208-522-5647

Responses to Comment Letter C073

1 The commentor is correct in stating that the Power Burst Facility (PBF) at the INEL had not been considered prior to the EIS. Part of the EIS process is to determine a reasonable range of alternatives. Through thorough analysis by the Department and the EIS technical team, the PBF was identified by the team as a reasonable alternative. The PBF has been given the same level of analysis and evaluation in the EIS as each of the other alternatives, including the preferred alternative.

2 To replace their single existing reactor, the Canadians plan to build two new reactors, each with the capability to produce 100% of the worldwide demand for Mo-99. They plan to have these two new reactors operating by the year 2000, so even if one were to shut down, there would be adequate backup production capability at that time.

In the near term, with a single reactor producing 100% of the U.S. demand (and about 85% of the world demand), if that reactor were to be shut down, it would result in a Mo-99 supply shortage. The potential for such a shortage is why the ability to produce even a fraction of the U.S. demand in the near term is considered important.

3 Since the Department's intent is to operate as a backup to the Canadian supplier and to phase out production as soon as adequate backup capability is available from other sources, it is not possible to accurately define exactly what the actual period of performance or production levels would be.

4 The EIS states that production of Mo-99 by private source in the long-term is beyond the scope of this EIS. The EIS also states that the Department encourages private sector production of Mo-99, and if the private sector begins reliably producing Mo-99 in the U.S., the Department will phase out its production. The Department has simply proposed to establish a production capability to act as a backup to the existing Canadian supplier. This near-term goal is the focus of the EIS. The intent is not to compete with Nordion.

Private U.S. production of Mo-99 could be accomplished by privatization of a DOE operation or by a separate initiative by the private sector. The process of privatization is not part of this proposed action. The Department published a Notice for Expression of Interest in the *Federal Register* in December 1995 to solicit concepts from private industry for privatization of DOE isotope activities. Businesses interested in pursuing Mo-99 production have been invited to respond to this solicitation. If the Department decides to implement the action proposed in this EIS and if concepts on privatization of Mo-99 production received from the private sector are promising, DOE would proceed with a request for proposals to facilitate privatization on a competitive basis.

The Annular Core Research Reactor (ACRR) is a DOE, Office of Defense Programs, facility. The Office of Defense Programs has no current or foreseeable need for the ACRR. That Office has requested that, if the ACRR is selected for this mission, the capability of the reactor to perform defense experiments be retained in case of a national emergency. The possible diversion of the ACRR for defense use is highlighted in the EIS because, in an emergency, the ACRR is more likely than the other reactors considered in the EIS to be used for defense purposes. However, the Department has determined that the probability of needing the ACRR for defense purposes is sufficiently low to preclude disqualifying the reactor from consideration and to significantly diminish its potential for privatization.

5 The Department's National Isotope Strategy, DOE/NE-0111, has been referenced and briefly discussed in Section 2.0.

6 If the ACRR is chosen for the proposed project, its mission would change from defense programs to medical isotope production. It is possible that the ACRR, the preferred reactor for the proposed project, could be diverted to support defense missions in case of a national emergency. However, as stated above in response to comment 4, the Department has determined that the probability of needing the ACRR for defense purposes is sufficiently low to preclude disqualifying the reactor from consideration.

7 The ACRR is operating under a DOE-approved 1981 SAR, which was the time of the last major modification to the facility. This SAR has been amended since its approval to account for minor changes to the facility. The ACRR safety documentation meeting the current DOE requirements (DOE Order 5480.23) has been submitted and is in the final DOE approval process. Although this SAR covers those aspects that would be required for initial Mo-99 production activities, it would need to be amended for full production capability. The current SAR addresses the cooling increase for the 4 MW upgrade and beyond (up to 8 MW), but does not address the fuel design changes to the extent that would be ultimately required. The calculations performed for the fuel and core design changes would need to be verified with in-reactor testing, and the SAR would have to be updated to address the characteristics of the new fuel and reactor core.

The main issue regarding cost and schedule uncertainty is vested in the quality of the schedule provided by the various facilities. Los Alamos National Laboratory and SNL/NM have detailed resource-loaded/logic-driven schedules; INEL and Oak Ridge cost and schedule information is based on individual task descriptions which are appropriate for the level of cost/schedule comparisons required for an EIS, but not for detailed scheduling and budgeting.

8 The ACRR would be unavailable for an estimated 2 to 3 months to allow for necessary reactor modifications to achieve 100% production.

9 As described in Section 3.3.4.9, more than one modification would be required to conduct medical isotope production at the PBF, even if the power level were raised above 10 MW. Besides modifying the central cavity, which is a significant modification, the reactor control system would need to be modified for a continued steady state, non-pulse mode. The transient rods would need to be removed and fixtures for target irradiation placed in the vacant locations. All material removed from the central cavity would require disposal, a legacy waste cost and man-hour/man-rem cost. Legacy disposal costs are involved in the transient rods and mechanisms. Cooling flow to the central cavity would need to be appropriately established along with the normal core cooling flow in lieu of the contained loop that currently exists. Flow balance valves for the central irradiation cavity would have to be designed and installed to assure that appropriate target cooling flow is established without flow-induced vibration of the targets occurring. The core would need to be redesigned to supply a hardened spectrum of neutrons to the central irradiation cavity. A thermal spectrum would cause uneven irradiations of the targets. Concentration of the power to the core center would be needed to establish the appropriate flux levels without needing to operate the reactor above 10 MW to make the facility competitive with the others regarding fuel utilization. The additional costs for these modifications have been obtained and are presented in Section 5.22.

The Test Area North (TAN) Annex was identified for use in the INEL alternative rather than the Idaho Chemical Processing Plant (ICPP) because the modification costs would be similar and because the TAN Annex provides a boundary environmental analysis in the EIS. This would not preclude use of the ICPP hot cells for Mo-99 production.

10 The level of information provided for cost estimates by INEL was considered appropriate for the purpose of an EIS. Although it is believed that the uncertainties associated with the INEL estimates are higher than those of other alternatives, the estimates have sufficient accuracy to demonstrate that costs for any of the alternatives is not a major discriminator and is not a basis to disqualify any of the alternatives from consideration within the EIS. Because INEL has not been identified as a preferred alternative for this proposed project in the past as the LANL and SNL/NM alternatives have or even as an alternative in the past as ORNL has, the amount of detail available in support of the proposed project at INEL is less, but what has been developed in support of this EIS is considered appropriate. Additional cost information has been obtained and included in Section 5.22 of the EIS, and cost and schedule information will continue to be developed for the Department's eventual decision on this proposed project. All alternative sites, including INEL and ORNL were provided funds by DOE to support the EIS preparation team. All sites actively participated in the development of the analyses and preparation of the document.

11 The costs for the modification of facilities and facility operations are presented in Table 5-1 and Table 5-52. An analysis of these costs and the projected revenues specific to this proposed project will be evaluated for each alternative as information for the Record of Decision process. Since each alternative proposes the use of existing facilities and the Department is already responsible for facility-related costs, such as facility decommissioning, an incremental cost analysis (rather than a life-cycle cost analysis) was considered appropriate information for the decision-making process for the proposed project.

12 The technical basis of the comment is substantially correct. The EIS attempted, to the extent possible, to utilize existing safety documentation and other analyses in developing accident scenarios that would represent the design basis accidents for facilities considered in the Medical Isotopes Production Project. However, the PBF safety analysis report (SAR) is outdated and does not contain sufficient information on radiological emissions associated with the design basis accidents evaluated in the document. Based on information contained in the PBF SAR, a coolant flow blockage in the core leading to overheating and fuel element damage was included as a credible design basis accident. This is similar to the type of accident evaluated for the Omega West Reactor (OWR) and for which a radionuclide release estimate was available. Therefore the OWR release estimate was used to evaluate a similar accident at the PBF and also at the Oak Ridge Research Reactor in the absence of more recent analyses specific to those facilities. The same releases were not assumed for the ACRR because the power level and core cooling system are substantially different from those of the other reactors, and a relatively recent analysis specific to that facility was available. The release estimates for all sites were combined with site- and facility-specific information (stack parameters, meteorology and location with respect to potential receptors) to estimate the consequences to workers and the public from these accidents.

In addition, the estimated radionuclide releases for fuel damage scenarios (from whatever cause) at OWR and ACRR were similar, and use of the OWR scenario to represent emissions from an accident at the PBF should bound the consequences of a design basis accident at that facility. Assuming a lower release or accident frequency based on the thermal characteristics of PBF fuel might result in a lower risk estimate; however, this would not likely change the conclusions reached in the EIS because the accident risk associated with operation of any of the facilities is low.

13 The access point assumed for the PBF facilities is actually a thermal luminescent dosimetry (TLD) monitoring station at the area boundary. In the absence of more detailed information, it was assumed for purposes of the analysis that a member of the public could gain access to this location. The analyses

presented in the EIS for consequences at the public access location following accidents at the PBF are therefore more conservative (i.e., estimate a higher dose) than if the highway location were chosen. However, this would not likely change the conclusions reached in the EIS because the accident risk associated with operation of any of the facilities is low.

14 The Spent Nuclear Fuel Programmatic Environmental Impact Statement (SNF PEIS) (DOE 1995b) evaluated very different facilities and transportation scenarios from those considered in this document. For purposes of this EIS, it would be more important to maintain consistency in analyses among the alternatives in order to identify any significant differences among them. To the extent possible, the site-specific information used in this EIS was obtained from the sites or from their published reports, and each site had the opportunity to review the EIS before it was issued as a draft. Specific differences in methodology and assumptions referred to in the comment were not provided, and therefore cannot be addressed individually. However, they would be unlikely to change the overall conclusions in the EIS relative to the environmental risks associated with medical isotope production.

15 Section 5.14 describes the quantities, characteristics and components of waste generated by the medical isotope production process (see Table 5-18 and Table 5-19). The fate of highly enriched uranium remaining in the target fabrication process stream is also discussed in this section. Highly enriched uranium may be recycled using a process developed by DOE, or it may be disposed of along with the other process wastes. Inclusion of highly enriched uranium in the solidified process waste is not expected to substantially change the volume or methods by which the waste would be disposed of. The waste quantities reported in the EIS summary tables (Table S-2 and Table 3-1) represent the total quantity of what would be generated by all activities associated with medical isotope production. The 49 m^3 per year of low-level radioactive waste reported in these tables for SNL/NM represents the total from target fabrication (7 m^3 per year, Section 5.14.1.1) and target processing (42 m^3 per year, Section 5.14.1.1). The waste activity levels listed in Table B-6 are those assumed for shipping packages that would be transported to onsite or offsite waste disposal facilities and do not necessarily correspond to the waste activities per drum reported in Section 5.14.

LAND AND WATER FUND

Legal Aid For The Environment

February 15, 1996

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<u>Via Facsimile and U.S. Mail</u>

Mr. Wade Carroll, MIPP-EIS Document Manager
U.S. Department of Energy
Office of Isotope Production and Distribution, NE-70
19901 Germantown Road
Germantown, Maryland 20874
Fax: (301) 903-5434

Re: <u>Draft Environmental Impact Statement Concerning Proposed Medical Isotopes Production Project</u>

Dear Mr. Carroll:

The Southwest Organizing Project ("SWOP") and the Land and Water Fund of the Rockies ("LAW Fund") write concerning a proposal by the Department of Energy ("DOE") to develop medical isotopes at Sandia National Laboratories/New Mexico ("SNL/NM") and Los Alamos National Laboratory ("LANL") and to distribute those isotopes to private parties throughout the United States (the "proposal" or "project"). While the
1 isotopes involved are very important to modern medical procedures in the U.S., DOE's proposal involves the first significant expenditure of public monies, over $60 million per year within the next few years, for their production and distribution.

DOE has prepared a draft Environmental Impact Statement ("DEIS") concerning the proposal, dated December, 1995. DOE has asked for comments on the DEIS, and we have exchanged correspondence concerning the date we should submit those comments to you. We received a letter from you on February 9 indicating that we should provide you comments as soon as possible, and based upon that letter, we have done our utmost to expedite the process in getting these comments to you. We hope that these comments will prove helpful and that DOE will proceed cautiously in light of the substance of these and other comments provided during this period. Based upon a review of the information available, we believe that the DEIS is inadequate, in clear disregard of the letter and spirit of federal law.

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Mr. Wade Carroll
February 15, 1996
Page 2

I. <u>Introduction</u>

DOE has been pursuing aggressively its proposal to develop and distribute medical isotopes. During that time, SWOP and the LAW Fund have participated at every available opportunity. We have provided several comments and suggestions concerning the proposal and how DOE might proceed in a sound manner. To date, DOE has failed to respond appropriately.

Approximately one year ago, DOE attempted to bulldoze the
proposal past all concerned parties in an Environmental
Assessment ("EA"), despite the project's many significant impacts
2 upon the environment. SWOP and the LAW Fund provided substantial
comments concerning that effort, in the hopes that DOE personnel
would address the issues involved in this proposal.

DOE then began to prepare an EIS and invited comments on the
appropriate "scope" for that review. Again, SWOP and the LAW
Fund provided extensive input. We suggested, for example, that
DOE greatly improve its outreach to affected communities,
3 particularly to affected communities of color and low-income
communities. We also suggested that DOE could learn a great deal
from the EA process the agency had spent time and taxpayer
dollars pursuing. Unfortunately, DOE has failed to consider our
counsel.

Because DOE has not incorporated our previous suggestions
into the DEIS, many of the comments herein are destined to repeat
the concerns we have identified previously. In fact, we believe
we have been forced to repeat our concerns far too often, and it
is our hope that DOE will take those concerns seriously at this
stage in the process. We herein incorporate by reference our
April 28, 1995 comments concerning the EA submitted to Kathleen
Carlson ("SWOP/LAW Fund EA Comments") and the comments concerning
4 the scoping process of Dan Moore, Michael Guerrero, and Everett
DeLano in Albuquerque, New Mexico on July 31, 1995 ("SWOP & LAW
Fund Scoping Comments"). We urge you to review those comments
before DOE proceeds.

The comments below identify several critical areas: (1) DOE is attempting to segment this project and its impacts; (2) DOE has failed to consider and address reasonable alternatives to the project; (3) DOE has failed to address several foreseeable impacts associated with the proposal; and, (4) DOE continues to ignore mandated requirements concerning Environmental Justice.[1]

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[1] Additionally, DOE has failed to comply with mandated
5 requirements for public participation. DOE is required to ensure

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II. <u>The DEIS Illegally Segments the Proposal From Other DOE Actions and Related Impacts</u>

The National Environmental Policy Act, 42 U.S.C. section 4321 <u>et seq.</u> ("NEPA"), requires that "[p]roposals or parts of proposals which are related to each other closely enough to be, in effect, a single course of action shall be evaluated in a single impact statement." 40 C.F.R. section 1502.4(a). DOE has isolated the effects of this proposal, as discussed in more detail below, such that the DEIS fails almost entirely to consider the substantial issues of waste management and minimization that should be associated with such a significant project. The almost full-time operation of the nuclear reactor at SNL/NM will produce significantly more waste, hazardous and
6 radioactive, than has been produced at the facility previously.

Despite this situation, DOE has segregated issues of waste management and waste transportation, as if production of medical isotopes is somehow divorced from the handling of that production's byproducts. DOE acknowledges at least three different environmental reviews related to various aspects of waste management and transportation, DEIS at 1.4, yet it fails to consider how decisions in those areas relate to or could affect a decision on the proposal at hand.

III. <u>The DEIS Fails to Provide For Considerations of Several Reasonable Alternatives</u>

An agency's analysis of alternatives is supposed to be the <u>heart</u> of an EIS. 40 C.F.R. section 1502.14. Among other things, agencies are required to do the following:

(a) rigorously explore and objectively evaluate all reasonable alternatives ....;
(b) devote substantial treatment to each alternative considered in detail including the proposed action so that reviewers may evaluate their comparative merits; and,
(c) include reasonable alternatives not within the

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an open and adequate consideration of the issues involved in the proposal. <u>See e.g.</u>, 40 C.F.R. section 1503.1(a)(4). Essential under this scheme is an aggressive effort to involve affected
5 individuals and communities in early and substantive discussions. These requirements are discussed in the SWOP/LAW Fund EA letter, as are additional requirements imposed by Executive Order 12898. Unfortunately, DOE has failed to involve affected stakeholders, proceeding instead to pursue minimal and inadequate public involvement.

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jurisdiction of the lead agency.

Id.

7 The Alternatives Analysis in the DEIS addresses two basic scenarios: "no action" and production at an existing DOE facility. The DEIS dismisses the "no action" alternative, discussing uncertainties associated with the private, and possibly foreign, production and distribution of medical isotopes. It continues by addressing four different options for large-scale (30% or more of the entire U.S. demand) DOE production: (1) the proposal at SNL/NM and LANL; (2) production at the Omega West Reactor at LANL; (3) production at Oak Ridge National Laboratory; and, (4) production at Idaho National Engineering Laboratory. Clearly, these are not the only reasonable alternatives.

8 The DEIS discusses briefly, but does not analyze, three additional scenarios: (1) production at other federal facilities; (2) production at university reactors in the U.S.; and, (3) public/private production options. Its analysis fails to account for DOE's own report of August of 1994, the National Isotope Strategy, which established a preference for private production or a joint public/private venture to produce and distribute medical isotopes. Indeed, this strategy is consistent with efforts at other levels of the federal government to avoid "corporate welfare."

9 Nevertheless, DOE has failed to follow through on this strategy by providing the analysis in the DEIS necessary to give such ventures their appropriate consideration. For example, the DEIS mentions one proposal from Isotopes U.S.A., "a not-for-profit corporation dedicated to education, research, and other scientific purposes relevant to the production and use of stable and radioactive isotopes." DEIS at 3.62. Contrary to NEPA's clear requirements, the DEIS fails to analyze this alternative, dismissing it as a "management, not a production concept." Id. It should be quite clear to those considering medical isotope availability that management concepts and issues are important and necessary considerations.

Similarly, the DEIS, although mentioning possible advantages associated with alternative production methods and alternative producers (such as in the critical area of radioactive waste minimization), fails to analyze those approaches. For example, the DEIS fails to analyze any of the following reasonable alternatives:

- DOE and/or other agency assistance to proceed with development of the Medical Isotope Production Reactor;

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- DOE and/or other agency assistance to proceed with development of small linear reactors to produce Tc-99m;
- DOE and/or other agency assistance to proceed with construction and commissioning of additional reactors in Canada;
- DOE and/or other agency assistance to proceed with development of backup supply availability from Nordion's acquisition of assets of the Institute National des Radio-elements ("IRE");
- DOE and/or other agency assistance to proceed with Federal Drug Administration ("FDA") approval of direct IRE supplies
9 to U.S. markets;
- DOE and/or other agency assistance to proceed with assurance and/or development of sufficient transportation arrangements for shipments from IRE;
- DOE and/or other agency assistance to proceed with development of several sources of supply such that no one source should ever involve 100% of U.S. market need;
- DOE and/or other agency assistance to proceed with FDA approval of supplies from Mallinckrodt Medical; and,
- DOE and/or other agency assistance to proceed with development of backup supply availability from European production sources.

Each of these reasonable alternatives should have been considered, <u>though some may be outside DOE's jurisdiction</u>. 40 C.F.R. section 1502.14(c). The DEIS fails entirely to give the sort of reasoned analysis necessary for an informed decision.

IV. <u>The DEIS Fails to Discuss Several Possible and Likely Effects of the Proposed Project</u>

NEPA requires agencies to discuss the following:

10 the environmental impacts of the alternatives including the proposed action, any adverse environmental effects which cannot be avoided should the proposal be implemented, the relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and any irreversible or irretrievable commitments of resources which would be involved in the proposal should it be implemented.

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Id. section 1502.16. That discussion must include, among other things:

> (a) Direct effects and their significance;
> (b) Indirect effects and their significance;
> (c) Possible conflicts between the proposed action and the objectives of Federal, regional, State, and local (and in the case of a reservation, Indian tribe) land use plans, policies and controls for the area concerned; and,
> (d) The environmental effects of alternatives including the proposed action.

10 Id. Effects, used synonymously with "impacts," are defined to include: "ecological ..., aesthetic, historic, cultural, economic, social, or health, whether direct, indirect, or cumulative." Id. section 1508.8.

A practical consideration of DOE's proposal should entail, at a minimum, a discussion of several prominent environmental effects. A review of the records at past DOE operations and at other nuclear reactors would indicate that this is a reasonable place to begin an analysis of environmental consequences. Unfortunately, the DEIS addresses these and other effects in a cursory and incomplete manner, or it fails to address them at all.

Several effects are likely from the generation, storage, transport, and disposal of significant levels and kinds of waste. These wastes include "high-level" radioactive waste (spent nuclear fuel), liquid "low-level" radioactive waste, solid "low-level" radioactive waste, and "incidental mixed waste." The proposal would entail a significant increase in the generation of
11 the most hazardous of these wastes, spent nuclear fuel. The DEIS, however, fails to consider the impacts associated with the storage of such wastes, dismissing such issues by asserting that significant additional storage capacity could be created on-site at SNL/NM and by asserting that decisions about the ultimate disposal of these wastes will be made through a different DOE NEPA process. See Section II above.

Again, the DEIS has failed to address the issues raised by several commentators during the EA process. These comments raised a number of effects the DEA failed to discuss, and many of the same effects were neglected in the DEIS. DOE should
12 consider, among others, comments submitted during the EA process of the following parties: Letter to Kathy Carlson, DOE, from Dr. Gedi Cibas, New Mexico Environment Department (April 20, 1995); Letter to Kathy Carlson, DOE, from Dr. Gedi Cibas, New Mexico Environment Department (March 17, 1995) ("NMED letter I"); and, Letter to Kathy Carlson, DOE, from James N. Paglieri (March 6,

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12 1995). These letters are incorporated herein by reference.

13 Furthermore, the DEIS tries to dance over an alarming aspect of the proposal -- DOE may not be able to sell the medical isotopes it produces and will be forced to dispose of those isotopes as waste. In other words, DOE will be spending significant taxpayer monies and generating significantly more waste in order to produce isotopes that will themselves be treated as radioactive waste! The DEIS avoids this unpleasant detail, and its consummate effects upon the human environment, treating the prospect as if it were an inevitable aspect of government doing business in the private marketplace.

14 Additionally, the DEIS fails to address and consider the economic effects of the project. For example, the DEIS contains two, remarkably different tables projecting cost estimates, Cf. DEIS at 5.4, Table 5-1 & Id. at 5.100, Table 5-52, with no substantive discussion of their relation to each other. The DEIS provides no discussion of the effects that these heavy expenditures, $226 million in four years (according to Table 5-1), are likely to have upon the private production of medical isotopes.[2] It also fails to consider how these expenditures may affect future costs associated with waste management and disposal for private parties.

The DEIS fails to consider many other reasonably foreseeable effects, including the following:

- 15 effects related to current restrictions at the Nevada Test Site concerning the disposal of non-defense-related low-level radioactive waste, including effects associated with possible changes in operations and procedures at one or more DOE sites, see e.g., Memorandum from George K. Lasker, DOE, Albuquerque Operations Office to Marilyn S. Bange (January 25, 1995) (appended hereto as Attachment 1) ("The most recent projections indicate that the [low-level radioactive waste] generated from the [isotope project] will range from 72 to 127 drums per year, which likely will exceed the total annual volume of [low-level radioactive waste] generated at SNL/NM") (emphasis added);

- 16 effects associated with a lack of federal EPA standards for radiation exposure to members of the public as a result of

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[2] This failure relates to the DEIS's failure to consider several reasonable alternatives, since alternatives involving private producers or joint ventures would have very different economic effects.

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the storage and management of spent nuclear fuel at many DOE sites, including SNL/NM, <u>see</u> 40 C.F.R. part 191;

- cumulative effects associated with the generation, handling, storage, transportation, and disposal of radioactive, hazardous and non-hazardous wastes at SNL/NM and LANL;

- effects associated with the use of highly enriched uranium ("HEU") in the Annular Core Research Reactor at SNL/NM (Table 5-19 discusses wastes associated with spent nuclear fuel assuming the use of low-enriched uranium ("LEU"), DEIS at 5.40, yet the proposal involves the use of 170 HEU
16 beryllium oxide fuel elements, <u>Id.</u> at 3.16);

- effects associated with DOE's past difficulties in waste storage and management, including several past citations for violations of hazardous waste storage and handling requirements at SNL/NM and LANL;

- predictable effects, instead of reliance upon projections and modeling, related to similar operations at other facilities, including the Cintichem facility which has provided the license to DOE for its current proposal and which has had problematic past incidents and accidents, <u>see</u> SWOP/LAW Fund EA letter at 8;

- effects associated with the storage and handling of Uranium-
17 235 at LANL;

- effects associated with emissions to air from the management and storage of wastes;

- effects associated with emissions to water (the DEIS dismisses any possibility of such releases, DEIS at 5.12, 5.23 & 5.44), despite the release of 30,000 gallons of contaminated effluent into a local drinking water supply
18 from the Cintichem facility during its operation as a producer of medical isotopes, <u>see</u> our EA letter at 8, and the release of cooling water spills and other spills at several DOE facilities, <u>see</u> NMED letter I at 3;

- effects associated with water use downstream from SNL/NM, including effects upon members of the Isleta Pueblo and restrictions imposed by the City of Albuquerque, <u>see</u> 40 C.F.R. section 1502.16(c);

- cumulative effects upon particular populations, such as
19 exposed workers who also live nearby and eat locally grown produce;

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20 • effects unrelated to cancer, such as immediate deaths, short-term health effects such as nausea or loss of appetite, and long-term effects such as genetic harms (the DEIS dismisses consideration of non-cancer effects because, it claims, many of these "would occur at lower rates" than cancer, DEIS at 5.7), despite the fact that these and other effects are very germane to human health and the environment;

21 • cumulative effects associated with operations, accidents, transportation, waste management and storage, air quality, and other factors (the DEIS inadequately discusses "cumulative impacts," merely summarizing the discussion from five previous sections, DEIS at 5.73-5.79);

• cumulative effects to workers and others from past exposures from DOE activities and from exposures to other sources, despite the fact that the project will involve a ten-fold increase in radiation doses to workers, DEIS at 5.74; and,

22 • predictable effects, instead of reliance upon projections and modeling, associated with current rates of transportation accidents and incidents from similar operations and from available information concerning New Mexico highways.

V. <u>The DEIS Fails Entirely to Address Considerations of Environmental Justice At All Levels</u>

We are perplexed by the DEIS's trite dismissal of Environmental Justice considerations. We believe that our repeated admonitions to DOE on the subject have been ignored entirely. DOE's utter failure to be guided by its own materials and by the materials of other agencies strains credulity.

23 We have segregated discussion of Environmental Justice in these comments because it is an essential element of the NEPA process and because to do otherwise would have meant that we were discussing such issues within the context of each of our other comments. Environmental Justice considerations are necessarily a part of each element of the EIS analysis. NEPA and Executive Order 12898 are clear in this regard -- whether the agency is considering alternatives, impacts, or other aspects of a proposal, it must address their relationships to communities of color and low-income communities. DOE should not segregate its consideration of Environmental Justice.

We have discussed previously how DOE's own guidance, U.S. DOE Environmental Justice Strategy (April, 1995) and U.S. DOE Effective Public Participation under [NEPA] (December, 1994),

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describe several practical steps DOE must take in implementing federal law. See SWOP/LAW Fund EA letter and SWOP & LAW Fund Scoping Comments. These and other available materials should prove adequate to assist the preparers of the EIS, and there are certainly DOE and other personnel available to assist.

While we have identified numerous inadequacies in the DEIS, perhaps none are as stark as its utter disregard of Environmental Justice considerations. 24 All of the issues discussed above should have been analyzed in the context of such considerations. 25 The DEIS's circular maps, DEIS at 5.82-5.99, are useless. For no other environmental considerations has DOE relied upon an arbitrary "zone" taken entirely out of context of such relevant factors as land use, human behavior, possible exposure routes, and susceptibility.

Among other things, the DEIS failed to address the following:

- 26 communities of color are significantly more likely to live in "hot spots," locations with greater possibilities for harmful exposure, despite several studies demonstrating this situation;
- workers of color are significantly more likely to be exposed to harmful substances (DOE's own report of June, 1981 revealed this potential for workers at SNL/NM);
- 27 transportation impacts from the proposal are more likely to affect the several Native American Pueblos along the transportation routes (the DEIS dismisses these considerations, claiming that its previous analysis had revealed no significant affects associated with transportation, yet it fails to consider how Pueblo residents might be affected in ways different from other populations);
- 28 disproportionate effects associated with the disposal of wastes upon Native American lands and communities;
- disproportionate effects experienced by certain communities of color upon nearby lands and crops; and,
- disproportionate effects associated with limited access by many people of color to procedures involving medical isotopes.

VI. Conclusion

We have identified numerous inadequacies in the DEIS. We

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urge DOE to proceed cautiously and to comply with the letter and the spirit of NEPA. In doing so, the true effects of the medical isotope project should be clearly defined.

Thank you for your consideration of these comments. Please call us at the numbers listed below if you wish to discuss them.

Sincerely,

Everett DeLano
Land and Water Fund
(619) 299-4484

Michael Guerrero
Southwest Organizing Project
(505) 247-8832

Enclosure

United States Government

Department of Energy

Albuquerque Operations Office
Kirtland Area Office

memorandum

JAN 2 5 1995

REPLY TO ATTN OF: KAO:ESHCB:TPP

SUBJECT: Request for Exemption to Dispose of Non-Defense, Low-Level Waste at Nevada Test Site

TO: Marilyn S. Bange, WMD, AL

On June 3, 1994, a memorandum was transmitted to you requesting an exemption to dispose of non-defense, low-level waste (LLW) at the Nevada Test Site (NTS). This exemption was requested due the new non-defense isotope Production Program (IPP) being pursued by Sandia National Laboratories, New Mexico (SNL/NM) for the production of radiopharmaceuticals. Subsequently, your office forwarded this request to DOE/HQ, and in response the attached September 29, 1994, memorandum was received from Jill E. Lytle, EM-351.

The attached letter states, "...the Sandia National Laboratories, and all other AL sites, will continue to be designated as defense waste generators for the purpose of disposing LLW at the NTS, as long as the amount of non-defense generated LLW is small in relation to the site's total LLW generation." Subsequent discussions with your staff indicated that as long as SNL/NM did not exceed 50% generation of non-defense LLW with respect to the total amount of LLW generated at the site, SNL/NM would be allowed to ship IPP LLW to NTS for disposal.

The most recent projections indicate that the LLW generated from the IPP will range from 72 to 127 drums per year, which likely will exceed the total annual volume of LLW generated at SNL/NM, except possibly during a few years of significant ER and D&D field work. There are many variables in SNL/NM's future LLW projections, such as the funding rate for ER cleanup and the percent of national medical isotope requirements to be supplied by SNL/NM, that prevent assurance that the 50% requirement can be met every year.

Due to the high visibility and priority of the IPP, it is crucial that assurances be made that LLW generated by this program have the NTS as a certain disposal option, or that other federal or commercial options be secured. Hence, I am requesting further assurance from your office and/or DOE/HQ to be certain that the LLW resulting from the IPP can be appropriately managed.

Marilyn S. Bange 2

Any assistance you can provide in resolution of this issue is appreciated. If you have any questions or require additional information, please contact Ted Pietrok of my staff at 505-845-5649.

George K. Laskar
Assistant Area Manager
Environment, Safety, and Health

Attachment

cc w/attachment:
T. Wallace, KAO
J. Retelle, KAO
J. Orban, WMD
M. McDonald, MS 1143, SNL/NM
T. Blejwas, MS 1315,
J. Guth, MS 1303, SNL/NM
E. Conway, MS 1310, SNL/NM
M. Lucas, MS 1303, SNL/NM
R. Seylar, MS 1303, SNL/NM

Responses to Comment Letter C074

1 As shown in Section 5.22 of the EIS, the estimated costs to prepare the facilities at the alternative sites for medical isotope production range from about $17 million to $21 million. Annual operating costs of the alternatives range from about $8 million to $13 million, but could be offset by revenues from isotope sales.

2 If a project does not clearly require an EIS but cannot be categorically excluded from further NEPA review, an environmental assessment is prepared. DOE's approach for the environmental assessment gave all interested parties a chance to review the proposed action and its impacts before it was approved. This approach is used to help the agency determine whether a project is significant enough in its scope and potential impacts to warrant the preparation of an EIS. In this instance, the Department responded to the results of the environmental assessment and to the public's comments and decided to prepare an EIS.

3 NEPA regulations require that public input be solicited at two points during the EIS process. Specifically, the Department is required to hold at least one scoping meeting before preparing the Draft EIS and one hearing to obtain public comment on the draft. Throughout the EIS process for the proposed Medical Isotopes Production Project, the Department has maintained an open channel of communication with members of potentially affected groups and other interested parties. The Public Participation and Outreach section (Section 1.4) highlights the range of outreach efforts in which the Department's project representatives have engaged to ensure that a full exchange of information has been achieved with the public. The Department held eight scoping meetings and eight public hearings. In addition, the Department has held numerous informal meetings and conference calls with the most interested stakeholders. A one-on-one meeting and a conference call were held with representatives of the SouthWest Organizing Project (SWOP) prior to the Department's decision to proceed with an EIS. SWOP representatives were also invited to an informal meeting following the release of the Draft EIS. The Department believes that it has allowed stakeholders ample opportunity to participate in the NEPA process.

4 Comments on the environmental assessment were considered in determining whether to prepare an EIS or issue a Finding of No Significant Impact (FONSI). The comments received during the scoping period were incorporated and responded to in the Implementation Plan and were reflected in the scope and content of the Draft EIS.

5 See response to comment C074-3 above.

6 Section 5 of the EIS discusses the potential impacts of the operation of the facilities during the proposed Medical Isotopes Production Project. Current resource use and waste generation were identified and compared with anticipated resource use (see Section 5.13) and waste generation (see Section 5.14). Potential impacts from this use and generation were then identified.

The potential impacts of the transportation of wastes are evaluated in Section 5.11. The EIS includes all aspects of the proposed program as well as potential cumulative impacts. Section 1 of the EIS identifies programs and proposed actions that are related to but not dependent upon the proposed action of the EIS. Changes in the proposed actions described in the related NEPA documentation section might require a modification to the proposed action in the EIS (for example, see discussion of waste management practices, in Section 3.3.4.8). If the modification required had not been anticipated and included in this EIS, supplemental analysis might be required.

7 The Department considered a full range of alternatives to meet the stated purpose and need. During the scoping process, public input was received to assist the Department in identifying a reasonable range of alternatives. Proposed alternatives were presented at the public meetings. Based upon public input and a diligent search and analysis, the Department revised the range of reasonable alternatives it analyzed in the EIS.

8 The three scenarios listed were subjected to a preliminary analysis and were found to be unable to meet the purpose of and need for the proposed project. Therefore, these alternatives were considered but eliminated from detailed analysis for the reasons identified in Section 3.4 of the EIS.

The Department would prefer that the private sector assume responsibility for ensuring that a reliable supply of Mo-99 is available to the U.S. medical community; however, private industry has thus far been unwilling to do so. Therefore, DOE has proposed to conduct the Medical Isotopes Production Project. If private industry is able to ensure a reliable supply of Mo-99 on its own, the Department could phase out its production activities.

Private U.S. production of Mo-99 could be accomplished by privatization of a DOE operation or by a separate initiative by the private sector. The National Isotope Strategy states that DOE would consider privatization of its facilities if, by such an action, isotope production and delivery would be enhanced. The process of privatization is not part of this proposed action. The Department published a Notice for Expression of Interest in the *Federal Register* in December 1995 to solicit concepts from private industry for privatization of DOE isotope activities. Businesses interested in pursuing Mo-99 production have been invited to respond to this solicitation. If the Department decides to implement the action proposed in this EIS and if concepts on privatization of Mo-99 production received from the private sector are promising, DOE would proceed with a request for proposals to facilitate privatization on a competitive basis.

9 The process by which DOE determined the alternatives to be analyzed in detail is discussed above. DOE's position on involvement of the private sector is also discussed in the above response and in Section 2.1.

DOE did not regard the concepts of the Medical Isotope Production Reactor and small linear accelerators as capable of addressing the near-term vulnerability of Mo-99 supply. Nor did DOE believe that issues related to the construction and commissioning of additional reactors in Canada and development of a backup supply through Nordion's acquisition of assets of the Institute National des Radio-Elements (IRE) to be in the purview of DOE or within the scope of this EIS. Furthermore, such alternatives would be further subsidizing a single source, and thus contrary to DOE's objectives.

Federal assistance for sufficient transportation arrangements for shipments from IRE is not necessary; sufficient transportation casks are available for the limited quantities IRE could supply (see Section 3.2.2).

The establishment of several sources of supply does not meet the facility needs set forth in Section 3.1. Since only a relatively small (4 to 10 MW) reactor is required to meet 100% of the U.S. demand for Mo-99 and DOE is proposing this action as a backup rather than the primary supply, the use of multiple facilities would introduce unnecessary infrastructure requirements and additional costs.

Mallinckrodt Medical does not need DOE assistance to obtain FDA approval of the isotopes they produce in the Netherlands. Even after Mallinckrodt obtained necessary approval, it would not have the capability to satisfy the U.S. need for a backup supply. The discussion in Section 3.2.2 of Mallinckrodt's Mo-99 produciton initiative has been updated.

DOE assistance with the development of backup supply from European production sources would not meet the purpose and need for the proposed action. As discussed in Section 3.2.2, foreign sources do not have the excess capacity to provide 100% of the U.S. demand for Mo-99 in a backup capacity.

10 DOE believes the EIS addresses all required and significant types of environmental impacts associated with the proposed Medical Isotopes Production Project. Adverse environmental impacts that cannot be avoided, the relationship between short-term uses of the environment and maintenance of long-term productivity, and irreversible or irretrievable commitment of resources are discussed in Sections 5.17 - 5.19 of the EIS. Direct, indirect (secondary), and cumulative impacts of the proposed action and each alternative are described in Sections 5.2 - 5.16, 5.21, and 5.22 of the EIS, including impacts on ecological, aesthetic, historic, cultural, and socio-economic resources, as well as land use and human health.

In keeping with its efforts to streamline the NEPA process and minimize costs, DOE has presented the various types of consequences at a level of detail appropriate to the potential magnitude of the impact. For example, more extensive analyses are presented for air quality, facility accidents, waste management, and transportation, which are the areas where impacts could occur. Historic experience with the DOE facilities involved, or with similar facilities, was used to the extent possible in estimating these impacts. Many other types of impacts, such as those on land use, aesthetic resources, historic resources, and ecological resources, would be minimal to nonexistent because all alternatives propose to use existing facilities with relatively minor modification. Consequences to these resources are described in less detail because of their relatively lower potential for significance.

11 Storage and disposal of wastes and spent nuclear fuel from the proposed EIS alternatives have been or will be addressed by other NEPA documents such as those for the proposed waste disposal facilities and DOE's programmatic EIS for management of spent nuclear fuel (SNF PEIS). The SNF PEIS was completed in 1995 in combination with the Waste Management PEIS (DOE 1995a); other potential waste storage sites such as the Nevada Test Site (NTS) and LANL are in the process of planning or preparing site-wide EIS documents that will address future waste management activities.

The quantities of either mixed waste, low-level radioactive waste, or spent fuel generated by the Medical Isotopes Production Project would be small compared to the total quantities of those materials managed at the receiving sites. For example, the quantities of low-level radioactive waste that would be generated under the alternatives in this EIS amount to 20-80 m^3/yr, compared with the total volume of such waste managed at the potential receiving sites - 150,000 m^3 at INEL, 220,000 m^3 at LANL, and 460,000 m^3 at NTS (DOE 1994b). Management of all radioactive wastes at the INEL was estimated to result in cumulative doses over a 10-year period of 1 to 8 mrem to a maximally exposed member of the public, and 4 to 35 person-rem to the population within 80 km of the site, depending on the options chosen for treatment and storage (DOE 1995j). Because it would require minimal additional treatment or packaging, the small incremental quantity of waste generated by the alternatives in this EIS would not be expected to increase the total impacts from radioactive waste management at any receiving location.

Generation of spent fuel by the proposed Medical Isotopes Production Project amounts to, at most, a few kilograms per year even at production levels sufficient to meet 100% of the U.S. demand for Mo-99. Immediately after removal from the reactor at the production site, spent nuclear fuel (SNF) would require temporary onsite storage because of heat generation in the fuel elements. The intent of the analysis in this EIS was not to imply that spent fuel would necessarily be left at these sites for an extended period, but to assure that the candidate isotope production sites could safely manage it during the onsite storage time. After suitable cooling period to provide for safer handling and transport, the spent fuel could be shipped offsite for storage in accordance with the 1995 Record of Decision for the SNF PEIS either at INEL or Savannah River (SRS). The timing and logistics of the transportation would be subject to arrangements between the shipping and receiving sites.

The consequences of transport and storage of spent fuel were evaluated in the SNF PEIS. The analysis in that document predicted no accidental or latent cancer fatalities resulting from all transportation of DOE-managed fuel in the preferred alternative (DOE 1995b, Volume 1, Appendix I). Storage of the fuel at either INEL or SRS would likewise be associated with very small doses to the public — less than 0.01 mrem/yr to the maximally exposed individual and less than 0.2 person-rem to the offsite population (DOE 1995b, Volume 1, Appendices B and C). Compared to the total quantities of SNF managed at DOE's designated regional management facilities, which amounts to several hundred metric tons, the kilogram quantities that would be generated under the proposed action would not substantially increase the risks at these sites.

12 Comments on the Environmental Assessment were considered in determining whether to prepare an EIS or issue a Finding of No Significant Impact (FONSI).

13 If the Department decides to pursue this project, it would only produce Mo-99 at full capacity in the event of a Mo-99 supply shortage. At all other times, it would operate under its normal backup mode and would only produce enough Mo-99 to maintain the capabilities of the facilities and staff to respond to a Mo-99 shortage.

In this backup mode, the Department would attempt to sell all of the Mo-99 and related isotopes (xenon-133 and iodine-131) that it produced. There may be times, however, when the Department would be unable to sell all of the isotopes and would have to dispose of them as waste. If Mo-99, iodine-131, and xenon-133 were disposed of as waste, they would not add substantially to the volume, activity, or cost of waste disposed. All are short-lived radionuclides that decay to nonradioactive or very low-activity isotopes, and could be incorporated into the normal process waste streams. The waste generation figures presented in Section 5.14 take into account the potential need to dispose of unsold isotopes. The EIS is forthcoming about this possibility, and the analyses of waste generation impacts in the EIS take this possibility fully into account.

14 Table 5-1 and Table 5-52 provide the same information in different formats required by the respective analyses. Because regional socioeconomic effects depend upon the rate of local spending and employment, as well as the total amount spent, Table 5-1 allocates the remaining total investment to complete the project (shown by facility, but not by year in Table 5-52) across the construction years discussed in the schedule for each alternative site. Annual operations expenditures and employment (shown in Table 5-52 by facility) are also shown (in Table 5-1) for those years in which they would occur if the facilities were operated to produce 100% of U.S. national demand for Mo-99. For some alternatives, construction and operations activities overlap in some years.

The commentor appears to have misread Table 5-1. In no alternative did the costs over 4 years reach $226 million. In the table, the highest construction expenditure was $21 million, the lowest $17.2 million, consistent with Table 5-52. Annual operations costs range from $12.8 million down to $8.4 million. Expenditures during particular years are a mix of construction and operations costs, reflecting the special schedule conditions at each site: for example, operations labor would come on earlier with the SNL/NM alternative, and its 4 years of expenditures account for about 1 extra operating year.

DOE plans to sell the Mo-99 at prevailing world market prices; thus, the costs incurred may or may not be fully recovered, depending on the level of demand. Full recovery of operating costs is anticipated at about 30% to 40% of U.S. demand. In any case, the expenditures shown in Table 5-1 are not expected to adversely affect private production of medical isotopes. Private costs for waste management and disposal are not expected to be affected.

15 The NTS has issued a draft site-wide EIS which includes waste that would be generated from the Medical Isotopes Production Project. The Department believes that any uncertainty surrounding the NTS's ability to accept the waste from the proposed project is sufficiently small that there will not be an impact on the project.

16 Effects of DOE operations, including interim storage of SNF, are subject to the requirements of both EPA and DOE regulations. For example, fuel storage facilities would be required to demonstrate compliance with EPA regulations for atmospheric radionuclide releases in 40 CFR 61 and protection of groundwater in 40 CFR 141. DOE regulations in 10 CFR 835 and proposed 10 CFR 834 (expected to be finalized in 1996 and currently implemented as DOE orders) would govern radiation protection of workers, the public, and the environment. The regulation in 40 CFR 191 applies only to ultimate disposal of high-level radioactive waste and spent nuclear fuel, which is the subject of ongoing discussions between EPA, DOE, and the U.S. Nuclear Regulatory Commission.

Management of DOE's spent nuclear fuel over the next 40 years would be in accordance with the Record of Decision for DOE's programmatic EIS on spent nuclear fuel management (SNF PEIS). This decision designates regional storage and management facilities for different types of spent nuclear fuel, to be located at the INEL, the SRS, or the Hanford site. The programmatic EIS evaluated the impacts associated with spent fuel transportation to, and storage at, these regional facilities until the Federal agencies issue revised regulations and a decision is made regarding its ultimate disposition.

- Waste management activities are either included in Section 5 of the EIS or are covered by NEPA documentation for waste disposal facilities at the receiving sites. The cumulative impacts associated with waste management are not expected to exceed those discussed in Section 5.16 of the EIS. As indicated in that section, the quantities of wastes generated by the EIS alternatives are small compared to the total quantities of these materials managed by DOE at the receiving facilities.

- Management of spent nuclear fuel (discussed above) would apply equally to highly enriched uranium and low enriched uranium fuel. The quantities of spent fuel generated were based on use of low enriched uranium in the reactors because this estimate bounds the analysis; the quantities of spent fuel would be smaller than those presented in the EIS if highly enriched uranium were used.

- The cumulative effects of the EIS alternatives and past actions by DOE or others, to the extent that they have ongoing impacts, are considered in Section 5.16 of the EIS. Any future waste disposal activities would be subject to review and permitting by appropriate agencies and would be conducted in accordance with applicable Federal, state, and local regulations.

- Impacts of activities associated with the proposed alternatives are in large part based on past experience with the specific facilities considered at each site or on similar facilities, including the Cintichem facilities. The modeling conducted for the EIS accounts for these potential impacts using site-specific data appropriate to each location where the medical isotope project could be implemented.

17 A substantial amount of uranium-235 generated as a result of prior activities is currently in storage at LANL. Because of the nature of the target fabrication operations and the small quantities of material involved, fabrication of targets containing uranium-235 at LANL is not expected to result in environmental impacts that would be measurably greater than those now occurring from site operations. These impacts are described in Sections 4 and 5 of the EIS.

18 Management of radioactive waste at the alternative sites is bounded by the impacts evaluated for the processing facilities in this EIS or is included in NEPA documentation for the ultimate disposal facilities. Because the wastes would be solidified and packaged in sealed containers before removal from the processing facility, air emissions resulting from waste disposal activities would not be expected to contribute measurably to offsite consequences.

Releases of water by the Cintichem facility would not necessarily imply that such releases would occur, or would even be possible, at DOE production facilities because of the different design features of these facilities. For example, modifications to the Annular Core Research Reactor would provide containment of any potential overflow from the reactor cooling system. Other parts of the reactor cooling system, such as the cooling towers, are isolated from the reactor core cooling loop and would not be contaminated under normal conditions. Any accidental leakage between the systems that could result in environmental releases would have consequences substantially lower than the types of accidents evaluated in the EIS, as indicated by the minimal impacts associated with the liquid release accident at LANL (see Section 5.15.2.3). Liquid wastes would be solidified before disposal, which would take place in approved disposal facilities that meet applicable Federal, state, and local regulations. None of these systems would result in routine release of liquid effluents to the environment, other than normal sanitary wastes, and there would be no anticipated impacts on the Isleta Pueblo, the City of Albuquerque, or any other downstream population.

19 The maximum radiological impact to an individual who happens to be a DOE worker and a nearby resident would amount to the sum of the doses presented in the EIS for the offsite maximally exposed individual, and the maximum occupational dose to an individual worker. The maximum occupational dose to any DOE worker is limited by law to 5 rem/year. This limit is administratively controlled to lower levels, typically 500 mrem/year at many DOE sites including SNL/NM, although most workers receive much lower than the maximum dose. The dose from environmental exposure at a nearby residence would be less than 0.2 mrem/year for any alternative considered in the EIS.

20 The consequences of the actions proposed in the EIS would not be expected to result in any cancer fatalities as a result of radiation exposure or any other emissions to the environment, such as those from vehicles. If cancer fatalities would not be expected, neither would one expect to see genetic effects or other consequences that occur at lower rates for comparable levels of exposure. The intent of the EIS was

not to dismiss these other types of effects as insignificant, but to use the most prevalent type of effect — cancer fatalities — as an indicator of the level of consequences that might be expected. As the EIS analysis demonstrates, no observable health effects of any type would be anticipated from implementation of medical isotope production under any of the alternatives.

Short-term effects, such as acute deaths, nausea, or other indicators of high-level radiation exposure, would only be expected in the event of a severe accident and would likely only affect a small number of directly involved onsite workers at most. Environmental exposures resulting from routine operations, or from all but the most severe (and low probability) accidents, would not produce these types of affects in any member of the surrounding population. The maximum reasonably foreseeable accident directly involving an onsite worker might produce some observable short-term effects (such as temporary effects on blood cell counts or fertility), but the estimated exposure level would not be considered life-threatening.

Effects of current site operations, as well as any planned future activities at the alternative sites, are considered in the cumulative impacts section. The nature and consequences of these activities are indicated in the text of Section 5.16.

21 The cumulative impacts of radionuclide air emissions are discussed in Section 5.16 in terms of current and anticipated future operations at the alternative sites. The cumulative impacts of air emissions compared to past operations would depend on the types of activities that have historically been conducted at each site. For sites such as SNL/NM or LANL, where operations have typically been research-oriented, the proposed action may very well represent an increase in the recent collective doses to the offsite population as reported by the site. Cumulative doses to the population within 50 miles of LANL amount to about 13 person-rem from 1990-1994, and 0.6 person-rem at SNL/NM over the corresponding period.

For other sites, where the operations have been oriented toward strategic materials production, the cumulative historic doses would be expected to be much greater than those estimated for the EIS proposed actions. For example, cumulative offsite doses to the population surrounding the Oak Ridge Reservation, which historically has produced enriched uranium in addition to supporting a number of research missions, amounted to about 17,000 person-rem during the period from 1944 to 1987 (DOE 1988c). However, in recent years, many of the DOE defense materials production facilities have been shut down, and the missions at these sites have become oriented toward environmental restoration, which has dramatically reduced air emissions. Collective doses to the offsite population from 1990-1994 at the Oak Ridge Reservation amounted to 170 person-rem from a combination of defense materials reclamation activities (at a much reduced level) and research. At the INEL, where the historic spent fuel reprocessing mission has virtually ceased, the offsite doses are much lower — 0.47 person-rem over the same 5-year period. Air emissions from the medical isotope project would result in a relatively small increase (0.7-15%, depending on location) in the annual collective dose to the public from all DOE facilities, which was about 100 person-rem during 1994.

The pattern of cumulative occupational dose would likewise depend on the historic missions of the respective sites, and these too have been changing with the site missions. The annual occupational doses from the proposed Medical Isotopes Production Project would amount to a few percent of the 5-year cumulative doses to workers at LANL or INEL (about 1300 person-rem cumulative dose at each site from 1990 to 1994), whereas it would result in a proportionately larger increase in occupational dose at either

SNL/NM (5-year cumulative dose of about 100 person-rem) or ORNL (about 400 person-rem over the same period). As with the offsite cumulative doses, the occupational doses at former production sites have declined rapidly during recent years. For example, the historic doses to workers at the ORNL amount to about 19,000 person-rem over the 32-year period between 1943 and 1974 (National Research Council, BEIR 1990). The proposed project would also represent a small (less than 2%) increase in annual worker dose across the DOE complex, which amounted to about 1800 person-rem in 1994.

Collective doses to the public from air emissions at DOE facilities are taken from their annual air emission reports to the U.S. Environmental Protection Agency for calendar years 1990-1994.

Collective occupational doses at DOE facilities are taken from annual statistics submitted to DOE, which are summarized and published each year (see DOE/EH-0287T for CY-1990 and DOE/EH-0430 for CY-1991; more recent data are available from DOE's technical information service on the Internet).

22 The estimated consequences of transportation in the EIS are based on recent statistics concerning vehicle density, population density, and vehicle accident rates specific to the potentially affected routes, as well as on the relative severity of vehicle accidents. The models used to estimate accident impacts incorporate these data, along with information about the types and quantities of materials to be transported, in order to estimate the consequences of incident-free transportation and potential accidents.

23 There is no requirement in NEPA or Executive Order 12898 that each environmental impact element in an EIS include, in the context of the discussion of the element, an analysis of environmental justice considerations. DOE has consolidated such considerations in Section 5.21. Section 5.21 identifies and shows the location of minority and low-income populations relative to the alternative sites and considers the paths by which minority and low-income populations could experience disproportionately high and adverse impacts. No such impacts were identified in the course of normal operations of the proposed facilities. Accidental releases are discussed in Section 5.21. It was found that the impact on populations located in particular places depends on the direction of travel of any release, which cannot be known in advance. However, disproportionate impacts were discussed as a possibility if an accidental release occurred and if the wind were blowing in a particular direction. In several cases, depending on wind direction, the majority population is more likely to be affected.

Demographic and socioeconomic factors offer the possibility that subsistence resources are an extra possible pathway of contamination at some sites, especially for Native American populations. For this to occur, an environmental pathway from release, to subsistence resource, to human consumer must exit.

In the EIS, land use, human behavior, and possible exposure routes all were given consideration, along with direction and type of accidental airborne release. Because effects were small and uncertain for any population, however, detailed analysis of any particular sub-population for which potential impacts were even more uncertain was not performed. Differential susceptibility to effects, given exposure, was not considered because the possibility of disproportionate and adverse effects was itself considered so highly uncertain. Similarly, waterborne releases, which have a potentially different geographical pattern than airborne releases, were not considered likely enough or extensive enough even under accident scenarios to harm any offsite population.

24 Please see response to C074-23 above.

25 The practice of providing maps of the location of minority and low-income populations surrounding a proposed site as the beginning point for an analysis of environmental justice is accepted practice. The use of an 80-km zone for analysis of offsite effects of environmental releases and the use of "wind roses" to analyze the path of potential airborne releases for purposes of safety analysis and environmental analysis as it applies to offsite populations has been a standard practice of both DOE and the Nuclear Regulatory Commission for many years. Adding location of minority and low-income populations to these maps further specifies the geographic location of populations which are to be given special consideration in determining whether they face negative and disproportionate environmental impacts because of their location.

26 Consideration of the existing location of minority and low-income communities surrounding the four alternative sites considered in the EIS did not identify a potential for communities of color to be any more likely to be affected by environmental releases than communities composed of majority populations.

It is speculative and inappropriate to try to specify in advance which workers at the proposed facilities would be minority workers.

27 The comment states that "transportation impacts from the [proposed action at SNL/NM] are more likely to affect the several Native American Pueblos along the transportation routes," but provides no information to substantiate this assertion. DOE has not identified any mechanism by which Native Americans might be at higher risk than other members of the potentially affected population along the route. The relative risk of severe consequences following an accident would depend on a number of factors, including the length of the route that traverses the pueblos, the proximity of Native American populations to those routes, local meteorological conditions, and other circumstances of the accident. Because the consequences of transportation would not be expected to result in any health effects among the entire population at risk, no such consequences would be possible among Native Americans included in that population.

28 No waste disposal is planned on Native lands or communities. Before communities of color could experience disproportionate effects from this source, their lands and crops would have to be disproportionately affected or they would have to be disproportionately dependent on them. Section 5.21 allows for and admits such possibilities, but states that there is not enough known about the potential timing and direction of releases (which crops or lands would be affected) or ownership and dependency to state that communities of color would be adversely and disproportionately affected. Access to procedures involving medical isotopes is not an environmental effect of any of the alternatives and, thus, is outside the scope of this EIS.

NEW MEXICO ENERGY, MINERALS & NATURAL RESOURCES DEPARTMENT

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Jennifer A. Salisbury
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February 9, 1996

Mr. Wade Carroll
EIS Project Manager
Medical Isotopes Production Project (NE-70)
U.S. Department of Energy
19901 Germantown Road
Germantown, Maryland 20874-1290

Subject: **STATE OF NEW MEXICO'S COMMENTS AND RECOMMENDATIONS ON THE DRAFT EIS FOR THE MEDICAL ISOTOPES PRODUCTION PROJECT**

Dear Mr. Carroll:

Following are the comments of the State of New Mexico's Radioactive Waste Consultation Task Force (Task Force) on the draft Environmental Impact Statement for the Medical Isotopes Production Project, DOE/EIS-0249D, December 1995. These comments supplement our earlier comments of March 15, 1995, pertaining to the draft Environmental Assessment for the proposed project. The request for public comment was noticed in the *Federal Register* of December 22, 1995, Vol. 60, No. 246, p. 66542.

The Task Force, created by state statute in 1979, is composed of the Cabinet Secretaries of the Energy, Minerals and Natural Resources Department (EMNRD), Environment Department, Department of Health, Department of Public Safety, Taxation and Revenue Department, and the State Highway and Transportation Department. The EMNRD Cabinet Secretary currently chairs the Task Force. Included among its duties, the Task Force represents the Executive Branch of New Mexico State government in various areas relating to the management and disposition of high-level, transuranic, and low-level radioactive wastes. [Section 74-4A-7 New Mexico Statutes Annotated 1978] Hence, the Medical Isotope Production Project falls within the purview of the Task Force.

<u>GENERAL COMMENTS</u>

To begin, the State of New Mexico commends the U.S. Department of Energy (DOE) for its decision to prepare an Environmental Impact Statement (EIS) for the proposed Medical Isotopes Production Project. We believe the scope and potential effects of this project merit the more in-depth analyses inherent in the EIS process. And, even though the EIS process may have delayed commencement of the project, the resulting increase in public participation and input should significantly enhance the quality of the assessment. Hence, a more informed, extensive basis for issuance of a DOE Record of Decision on the project is anticipated. This is a particularly important consideration to the citizens and communities surrounding the alternative facilities being evaluated due to the project's nature (i.e., production, separation, and transport of radioactive isotopes) and corresponding implications.

1 The State generally concurs in the DOE's selection of its preferred alternative. This alternative (Annular Core Research Reactor: Sandia National Laboratories/New Mexico in conjunction with the Chemistry and Metallurgy-Research Facility: Los Alamos National Laboratory) appears to best meet the specific technical criteria established to satisfy the purpose of, and need for, the proposed action. In combination, the targeted facilities at Sandia National Laboratories/New Mexico (SNL) and Los Alamos National Laboratory (LANL) appear to offer several advantages over the other reasonable alternatives. These advantages include: 1) SNL's Annular Core Research Reactor is a currently operating (albeit "research") reactor, with qualified, experienced personnel readily available onsite to provide technical guidance and assistance on the project; 2) SNL is located in close proximity to Albuquerque International Airport, thereby minimizing potential transportation-related impacts; and 3) sufficient quantities of HEU (highly enriched uranium) feedstock already exist at LANL to support the project's full production requirements for several years.

2 Another factor that weighed somewhat heavily in the State's concurrence in DOE's preferred alternative is the significantly lower estimated radiological dose to the so-called maximally exposed individual (MEI) from <u>target irradiation</u> activities at SNL. It is projected that this hypothetical offsite resident would receive a radiological dose of 0.00017 millirem per year--an order of magnitude below the alternative with the next lowest estimated annual dose. Although target irradiation activities associated with all of the reasonable alternatives had estimated MEI dose rates far below established regulatory limits, the preferred alternative (SNL) is clearly superior in comparison to the other facilities.

3 In reviewing the draft EIS, we noted that the estimated annual MEI radiological dose rate from <u>target processing</u> at SNL was considerably higher than the LANL alternative. Upon closer inspection, however, it was determined that estimated air emissions from the SNL hot cell facility are based on historical emissions data from the Cintichem process. Because the ventilation system for the SNL hot cell must undergo a major upgrade if that site is selected for the project, the radiological consequences of actual air emissions would presumably be reduced as a result. If this is not the case, the State encourages DOE to comparatively evaluate even more closely the SNL and LANL alternatives--especially with respect to estimated cumulative air quality impacts on the public. The fact that SNL is situated within New Mexico's largest population center (Albuquerque) must be a primary consideration in the decision-making process for siting and configuring the Medical Isotope Production Project.

The State of New Mexico fully supports DOE's long-term goal regarding domestic production of Molybdenum-99 for the U.S. medical community: It should be conducted by the private sector. As you are well aware, one of the most controversial aspects of this project relates to its estimated substantial subsidy by the federal government. DOE's own cost estimates indicate that preparatory costs for the alternatives range from $16.8 million to $21.0 million, with operating costs expected to run between $8.4 million and $12.2 million a year. To most citizens, these are considered to be significant future expenditures of taxpayer

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dollars. Consequently, we were pleased to see DOE's apparent commitment to privatization of DOE isotope activities in the form of a Notice for Expressions of Interest. This Notice was published in the *Federal Register* of December 11, 1995, Vol. 60, No. 237, p. 63515. It calls for innovative approaches to privatizing such DOE isotope activities as selling or leasing existing DOE facilities for commercial use; sale of existing isotope inventory; isotope marketing, distribution or technical services; and other possible arrangements for enhanced private-sector involvement in isotope operations. Issuance of the referenced Notice is an excellent first step toward privatization. Notwithstanding this initiative, if the Medical Isotope Production Project proceeds, the State urges DOE to move aggressively in facilitating its transfer to the private sector at the earliest available opportunity.

A related issue that has raised some concern with the State of New Mexico pertains to various operational aspects surrounding implementation of the preferred alternative. Specifically, SNL has not in the past been called upon to produce and market radioactive isotopes. The EIS clearly states that this type of mission would be new to the SNL/NM facilities. Indeed, the SNL Annular Core Research Reactor has never functioned as a continuous production reactor. As with any new undertaking, the production of radioisotopes will require establishment of a broad spectrum of facility-specific operating procedures, safety protocols, training programs, and other measures designed to protect both occupational workers and the general public. Effective radioisotope marketing will be an equally challenging effort. Our point is this: It is incumbent upon DOE to proceed cautiously in this new
4 endeavor; to take full advantage of private-sector experience and expertise; and to err on the side of conservatism in terms of project risk management.

Finally, with respect to waste and spent nuclear fuel management, the State recognizes that varying quantities of both solid and liquid low-level radioactive wastes, as well as spent nuclear fuel, would be generated under each of the alternatives. We are confident these materials can be handled, processed, and transported safely at any of the DOE facilities under consideration, *provided* such activities receive priority attention and adequate resources. In particular, issues relating to on-site storage of spent nuclear fuel at SNL must be addressed carefully and thoroughly. Planning for the transportation of
5 low-level radioactive waste offsite should also be comprehensive and detailed. Toward that end, we strongly encourage DOE to consult and coordinate closely with the State of New Mexico in the project's waste management and transportation activities.

SPECIFIC COMMENTS

The following comments are limited to those sections of the EIS relating to the SNL and LANL alternatives.

6 p. 3.14, **Target Fabrication at SNL/NM**: This section states that the highly enriched uranium (HEU) needed for target fabrication at SNL would be transported from DOE facilities at either Portsmouth, Ohio,

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or Oak Ridge, Tennessee. It is unclear why the uranium existing in
various waste streams at LANL could not be extracted and then shipped
6 to SNL if DOE determines that target fabrication should occur there.
Irrespective of the source, the specific location where this HEU
material would be stored at SNL is not provided. Please clarify.

p. 3.23, **Annular Core Research Reactor Modifications at SNL/NM:** It is
noted that a replacement fuel would have to be installed in the ACRR
so the present fuel would not become highly exposed by the Mo-99
7 production activities. However, the document does not provide any
discussion of replacement fuel options, their sources, costs, or
other considerations. The final EIS should explicitly address these
issues.

p. 3.25, **Hot Cell Facility Modifications at SNL/NM:** Insufficient
detailed information is contained in this section regarding the
existing ventilation system and its proposed "major" upgrade.
8 Because the ventilation system has a direct bearing on such important
aspects of the project as operational efficiency and air emissions
containment, a much more comprehensive discussion is warranted here.

p. 3.37-.38, **Waste and Spent Nuclear Fuel Management at LANL:** The draft
EIS states that spent nuclear fuel (SNF) from the Omega West Reactor
"...will be cooled for approximately six months and then transported
to the onsite storage area." Please specify both here and in Table
5-19 in the final document the 6-month storage capacity at the OWR
9 facility by number of fuel elements; and whether the "interim storage
capacity" referenced in that table is the total capacity now existing
(i.e., clarify how many elements are currently in storage and what
remains for the SNF to be generated from the Medical Isotope
Production Project). In addition, please identify precisely where
the LANL "onsite storage area" is located. A relatively large-scale
map of TA-54 may be appropriate for inclusion.

p. 3.38, **Required Modifications to the LANL Omega West Reactor:** Previous
discussions in the EIS indicated the OWR was constructed in the mid-
1950s and was operational for almost 40 years without a major
incident. In December 1992, the reactor experienced an unplanned
shutdown which led to the identification of a leak from the primary
cooling system. Although this problem has been analyzed and plans
are in process to avert future such occurrences, this event raises an
important issue about the integrity and longevity of other reactor
components. From the information provided in the draft EIS, it is
difficult to determine the extent to which the OWR has been evaluated
10 in terms of its remaining useful life. To what degree will the DOE
5480.23 Safety Analysis Report address this issue? Please provide
more in-depth information on the planned assessment and its scope.

p. B.1, Appendix B, **Analysis of Transportation Impacts:** We want to
express our appreciation to DOE for inclusion of this extremely
comprehensive and useful appendix dedicated to potential
transportation impacts associated with the project. Because the
prospective air and truck transport of radioactive isotopes is the
activity that will affect the greatest number of people, this

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appendix goes a long way toward demonstrating the significant attention focused on this important issue. The State encourages DOE to give comparable priority to the environmental justice implications of its proposed transportation decisions in accordance with Presidential Executive Order 12898 and corresponding DOE directives.

In conclusion, the State of New Mexico acknowledges the precarious situation faced by the U.S. medical community should an interruption in existing Molybdenum-99 production occur. Total reliance on the sole Canadian producer of medical radioisotopes is not in the best interests of our Nation. We are pleased, therefore, that DOE is moving forward with a short-term solution to rectify this supply vulnerability. However, the State believes the conduct of this type of activity more appropriately belongs in the realm of the private sector. Consequently, DOE should proceed aggressively with its plans to privatize all isotope activities that make sense from an economic, efficiency, and safety perspective.

Thank you for the opportunity to present these comments on behalf of the Radioactive Waste Consultation Task Force and the State of New Mexico.

Sincerely,

JENNIFER A. SALISBURY
Cabinet Secretary and Chair
N.M. Radioactive Waste Consultation Task Force

c: Governor Gary E. Johnson
Task Force Member Agencies

5

Responses to Comment Letter C075

1 Comment noted.

2 The comment correctly notes that air emissions from target irradiation have lower consequences to an offsite member of the public at SNL/NM relative to the other sites. However, the total dose from target irradiation and processing at SNL/NM is comparable to that for the other alternatives. The dose to offsite individuals and workers is well within regulatory guidelines for all alternatives.

3 The estimated emissions from target processing at SNL/NM, INEL, and ORNL are based on historical emissions from the Cintichem facility during its final years of operation prior to 1989. At that time, the Cintichem facility employed emission controls to remove both particulates and iodine from its airborne effluents. The types of emission control systems that would be installed at SNL/NM, INEL, and ORNL would be expected to be similar to those used at Cintichem and would meet all applicable Federal, state and local standards.

The majority of radionuclide emissions from target processing consist of noble gases, which are unreactive and are not removed by either the particulate or iodine emission control systems. The only way to prevent noble gas emissions from these facilities is to hold up the gases that would normally be vented from the system long enough to permit decay of the shorter-lived radionuclides. A hold-up system has been proposed for the LANL alternative, using a process developed at that site, resulting in lower emissions from target processing than for the other alternatives. This system was not assumed for any alternatives other than LANL because it is currently under development, but the Department could use this system at other sites in an effort to keep doses as low as reasonably achievable.

4 If the Department decides to proceed with the proposed project, the effort would be coordinated with the private sector. The radiopharmaceutical companies have offered their assistance in executing the medical isotope production activities. The project would be carried out in accordance with all applicable DOE orders and other environmental, safety and health requirements.

5 Onsite storage of spent nuclear fuel would occur in existing facilities, with upgrades as needed to meet current DOE standards. Any shipments that would occur involving spent fuel, waste, or isotopes would be conducted in accordance with Federal and state standards for transportation of radioactive materials. Detailed planning for such transportation would occur after it had been decided whether to implement the medical isotope project and at which location it should be sited. Appropriate planning for routing of these shipments and contingencies for emergency response in cooperation with state, local and tribal governments would be in place before these materials would be removed from the SNL/NM site.

6 Shipment from Portsmouth, Ohio, or Oak Ridge or possibly LANL could all be performed. Portsmouth and Oak Ridge have established programs regarding shipment of highly enriched uranium material, and they do this with some frequency. LANL has little experience in the shipment of highly enriched uranium, but possesses a substantial quantity of the material. Portsmouth or Oak Ridge would be preferable because of their experience. Shipment from LANL is feasible, but LANL is not the Department's planned highly enriched uranium source.

A specific building for storage of the highly enriched uranium has not been designated by SNL/NM. Several buildings in the Tech Area V environs could be made to function as acceptable storage areas.

Historically, Room 108 in the Hot Cell Facility has been used to store highly enriched uranium for the Annular Core Research Reactor. The highly enriched uranium storage vaults at the Sandia Pulse Reactor (SPUR) facility currently contain many kilograms of highly enriched uranium, and this vault facility can easily accommodate more material.

7 Sections 3.3.1.4 and 3.3.1.9 describe the replacement fuel. The cost is factored into the annual operating cost of the reactor given in Table 3-1. The number of fuel bundles expended per year is also delineated in Table 3-1, which also refers to the usage of the new fuel design.

8 As discussed in Section 3.3.1.9, the ventilation system for the hot cell facility at SNL/NM would contain emission controls to remove both particulates and iodine from the airborne effluents and would meet all applicable Federal, state, and local standards. The majority of radionuclide emissions from target processing consist of noble gases, which are unreactive and are not removed by either the particulate or iodine emission control systems. However, the doses to the public from radioactive effluents that are not trapped by the emission control system would be well within Federal and state standards.

9. The interim spent nuclear fuel storage capacity referred to in Section 5.14 is the total unoccupied storage space which is currently available at the various sites or which would be available following facility modifications proposed in the EIS alternatives. The storage capacity at the Omega West Reactor represents less than 10% of the total available at LANL. Spent fuel could eventually be transferred from the reactor storage pool to other onsite storage at TA-54, or it would be shipped offsite after a suitable cooling period to permit safe handling and transport.

According to the 1995 Record of Decision for DOE's spent nuclear fuel programmatic EIS (SNF PEIS), spent fuel from the Medical Isotopes Production Project would ultimately be transferred to one of DOE's designated regional management facilities for these types of fuel—either at INEL or Savannah River. It was DOE's intent that sites other than those designated in the programmatic EIS would not undertake storage of spent nuclear fuel for longer than necessary. The timing and logistics of the transportation would be subject to arrangements between the shipping and receiving sites. The consequences of transport and storage of spent fuel were evaluated in the SNF PEIS. Compared to the total quantities of SNF managed at DOE's designated regional management facilities, which amounts to several hundred metric tons, the kilogram quantities that would be generated under the proposed action would not substantially increase the risks at these sites.

10 An investigation regarding Omega West's age and useful life has been documented in a LANL report titled "Reassessment of the Probable Lifetime of the Omega West Reactor" (LA-UR MO-5031). This report concluded that Omega West could easily operate for at least 10 more years.

A complete 5480.23 safety analysis report (SAR) for the Mo-99 activity has been prepared by LANL. The SAR has not been approved by DOE.

Response to Draft Environmental Impact Statement
for the Medical Isotope Production Project

February 9, 1996

Suzanne Noga
PO Box 6183
Santa Fe, NM 87502-6183
(505) 986-2008;fax 986-0028

DOE
Office of Isotope Production and Distribution,NE-70
19901 Germantown Road
Germantown, Maryland 20874

Att: Wade Carroll, MIPP-EIS Document Manager

Dear Mr. Carroll, February 9, 1996

The following comments address the information presented by the DOE in it's Medical Isotopes Production Project Draft Environmental Impact Statement and it's predecessors, the Notice of Intent (NOI), dated July 6, 1995 in the Federal Register, as well as the Implementation Plan, dated September 1995, which reports the results of the Public Scoping Process and provides guidance for the preparation of the draft EIS. The MIPP-DEIS is dated December 1995.

The NOI announced to the Public, the intentions of the DOE to prepare an EIS instead of the Environmental Assessment (EA) which was not sufficient in addressing the issues brought forth by public comment. One of the issues earmarked by the DOE in this NOI was set forth as such;

> " (8) Potential economic impacts, including those from producing radioisotopes for commercial sector use. "

The Implementation Plan outlined comments presented by the Public for inclusion in the DEIS. Under Cost and Schedule the following is recorded;

> " 7. There is no discussion of the overall cost of the technology versus the cost of the medical applications and how the U.S. Government, the taxpayers, will be fully compensated for these costs.(etc.)
> 10. Why should the taxpayer foot the bill for items that will reap income for the distributors? Why are we unwilling to have the public sector support a health care system but (are) ready to finance private distributors? (etc.)

The disposition of the DOE on the above was: Chapter 3 and 5 will discuss the estimate cost and schedule for implementation of the various alternatives.

In the Draft EIS there are 429 pages.

In the section on Costs (5.22) there are 4 paragraphs and one chart which compares prep and operating costs between the candidates sites chosen by the DOE as alternatives but which actually are the same option exercized at four different locations. The text of this section includes a description of how these costs were achieved and takes up 4 paragraphs.

1

One other chart, listed on table 5-1 located on 5.4, lists costs for facility modifications and operations for FY1996-FY1999.

After reviewing the Draft EIS, I have located some points of interest with regard towards the economic impact potentials but have found them here and there as a line or two. For your perusal and convenience I have made some notes which I would like to share with you which were taken from the chapter and pages listed.

iv Nordion & Cintichem only FDA approved suppliers at present.
2.2 Nordion supplies 100%US and 85% worldwide Mo-99.
3.5 NRU reactor operated by Atomic Energy of Canada Limited (AECL), a Crown Corporation.
iv Rights for Cintichem process are owned exclusively by US DOE.
2.2 Rights sold to US DOE for $750,000 plus 4% royalty on first five years of production. Title and liability for waste transfered to U.S. and DOE accepts spent fuel. November, 1991.

<u>Digression on Cintichem</u>:

1961 Union Carbide opens reactor
1982 Bought by Hoffmann-LaRoche, parent company of Cintichem.
1989 Cintichem's HLW classified as LLW. Demands made by public groups that generators keep title and liability for waste. (ref. 1) NIRS presentation 2/25/89
1990 Cintichem closed 4/5/90. Expect 3 yrs. to decommission. (ref.2) The Report, RWC.
1990 Amersham buys Medi-Physics from Hoffmann-LaRoche but leaves out Cintichem which had been operated through Medi-Physics. Cintichem was cut out of the deal on 6/13/90 because of its regulatory problems. 6/16/90 Cintichem agrees to pay $300,000 fine and to issue $5 million letter of credit to guarantee company lives up to its promises with regard to the radio-active clean-up necessary to decommission reactor & plant. (ref. 3) The Time Herald Record, 6/16/90.
1990 In September, the plant manager, James McGovern, estimated the cost to repair the three leaks at $3-$5 million and de-commissioning as much as $20 million.Instead, Hoffmann-LaRoche decided to get out of the business entirely.However, Cintichem continued to import isotopes from Nordion and shipped them to Amersham who is expected to build its own plant in 3 yrs. (ref.4) The Time Herald Record, 9/6/90
1991 Amersham, with Terry Fox, buys Nordion on June 12, 1991 as noted in the Wall Street Journal Index-Corporate News 1991.
1991 In November, US DOE closes deal with James McGovern for amount and conditions listed above in DEIS 2.2.
1992 Article on $20 million clean up does not mention who pays. (ref 5) Sunday Record, February 2, 1992.

5.2 The pharmaceutical companies that are waiting for their shipments, will not be obligated to buy the US DOE produced Mo-99 or any of the other isotopes. US DOE will throw it away in that case as LLW.
6.2 Pharmaceuticals may need FDA approval to market these products.
B.3 Dupont-Merck, Mallinckrodt Medical, and Amersham Mediphysics are the only pharmaceuticals to be shipped to.

1 It is my opinion that there are costs and economic impacts that are not being explained or analyzed.

2

I do believe that Teddy Roosevelt said it was best to walk softly but to carry a big stick. I also do believe the Public has been walking softly. I think the big stick comes about with law suits and such.

It appears to me that there has been a monopoly in radioisotopes for many years due to the sources being connected to nuclear businesses or to Governmental Agencies that were producing these by-products.

It seems foolish to me for these same entities to expect to carry on into the new century with these old ideas but old habits die hard.

2 I also noticed in the DEIS, that the FDA has a restrictive "catch-22". Nordion's European subsidiary is IRE in Belgium who has never sold Mo-99 in the US. To do so they would need FDA approval. The IRE submitted a Drug Master File to the FDA in 1991, but no action has been taken by the FDA because IRE has no US customers. (DEIS 3.6)

Perhaps the FDA might be encouraged to step up interest in medical isotope process and distribution licenses so that new companies can enjoy the benefits of the huge profits that come with very little string attached.

Having brought up information on Cintichem, Amersham or DOE, for that matter, I do not wish to impose judgement or imply impropriety but there is a long term relationship going on here and the Moly-folk seem to intermarry.

3 Although the DOE has declared long-term Mo-99 production a private sector issue, I believe it is being demonstrated that the private sector is unwilling to proceed with that course and why limit ourselves to the short term? If Nordion has 100% of the US market, then the US DOE can have that entire market in the not so distant future and make a good profit for the Treasury. By absorbing the responsibility for production and waste disposal, it would seem only fair to be able to sell it to any and all appropriate takers, domestic or world-wide and the heck with operating in the red.

4 And for the first five years, why not operate at the barest minimum so as to reduce our financial burden and to give the private sector some time to think about opening their own reactor or participating more fully in the democratic process.

I would assume that that Crown Corporation north of the border knows how to turn a profit. And why not us? After all...good old American know-how shouldn't be out shadowed by foreigners when we're the ones with such enormous purchasing power.

5 By keeping the production rate way down for five years, there appears to be enough room at the Hot Cell Facility at Sandia, for example, to sufficiently store the waste within the HCF itself.(DESI 3.22)

6 It should also be noted that refurbishing existing facilities would result in lower environmental impacts than construction of new facilities either by DOE or by a private enterprise.(DEIS 5.80)

3

7 To reference back to the Implementation Plan used to prepare for the DEIS, the evaluation of isotope and waste disposal by medical users is not considered within the scope of the EIS,(C.16) Nor was the use and administartion of isotopes by the medical community considered a candidate for inclusion. (C.28) Nor were any cumulative health impacts from the global disposal of radioisotopes, some of which are disposed of in landfills, found to be appropriate for consideration in this document. In which document are they considered? If there is an international agency charged with this monitoring, I would appreciate knowing about it. If it does not exist then it's time. Who writes the EIS for the whole planet?

The interest in this project was first introduced through the House Government Operations, Environment, Energy and Natural Resources Subcommittee. When Mike Synar charged the DOE with developing a US source of Mo-99, it was anticipated that the isotope program would pay its own way. Since that time, several other realities have set in and that stipulation has been removed from the program but that doesn't mean we need to omit prudence and wisdom in handling our nuclear resources.

Since then, the Committee on Appropriations has stepped in to support the domestic production of medical isotopes, particularly Mo-99. Pete Domenici, a member of that committee, stated on February 14, 1994 at a meeting of the Board of Governors of the National Center for Genome Resources here in Santa Fe in a consensus statement refining the mission of the Center, in part: "In all cases, the primary goal will be the delivery of cost-effective solutions to the pressing resource needs of the national research community and the biotechnology industry."

Let us not forget the pressing needs of the US taxpayer.

(It was noted in the New Mexican on 8/24/95 and 11/10/95 respectively, the National Center for Genome Resources received $10 & $2 million in federal funds. Just by chance, Merck & Co is represented on the Board. It seems to me that some of these resources could be sold, particularly when there are many large companies that can afford to pay.)
ref. 6 the New Mexican

In addition to the environmental impacts analyzed in this EIS, the DOE has announced that it will also base its decision on cost, policy, national need and other considerations. Balance is the key word. We
8 shouldn't charge too much but we shouldn't charge too little either. Integrity, balance and common sense...I hope I've helped to elicit this somewhat and that my comments are helpful and may this be a window of prosperity, not vulnerability.

Sincerely,

Suzanne Noga

ref. 1
Nuclear Information & Resource Service

Presentation, Saturday, February 25, 1989 in Norwich, NY

Radiopharmaceutical Reactor Waste should be high-level.

In New York, we have a special situation, because there is a reactor that generates the short-lived radiopharmaceuticals for most of North America. The Cintichem reactor, in Tuxedo Park, NY, takes stainless steel bottles, lined with U-235, and bombards them with neutrons in the reactor core (in the same manner that power reactors bombard U-235 in fuel rods with neutrons). The bottles are rinsed with chemicals to extract molybdenum-99 which decays into technetium-99m which is used in medicine. The radiopharaceutical products are short-lived but the reactor wastes are similar to the wastes from any reactor. Some of the wastes are really high-level, by federal definition of high-level waste. But, because of its importance in health care, all of the Cintichem waste is considered "low-level" despite the similarity of the waste to high-level waste and irradiated fuel. Citizens in New York are beginning to demand that the Cintichem waste be considered high-level waste, thus a federal or corporate responsibility rather than a NY State responsibility. This is for the technical reason that the waste fits the description of high-level waste and for the logical reason that the products benefit the entire continent and should not be the motivating reason to site a dump in New York.

Conclusions:

Get the Cintichem (Hoffman-LaRouche) waste from radiopharmaceutical production out of New York's "low-level" waste stream. It should be an industry or federal responsibility, not NY taxpayers.

Redefine "low-level" waste to exclude any waste hazardous longer than the active institutional care period for the dump.

Store the waste retrievably for its entire hazardous life.

Reduce the production of long-lived radioactive waste by implementing alternative means of generating electricity and as many other procedures as possible that lead to waste generation.

Say "no." It may "have to go somewhere," but it IS somewhere. If it shouldn't be where it is, should we keep making it?

Demand that generators keep title and liability for the waste, to encourage the incorporation of waste costs into the real costs of doing business.

ref. 2

RADIOACTIVE Waste Campaign

THE REPORT

▲ SPRING 1990

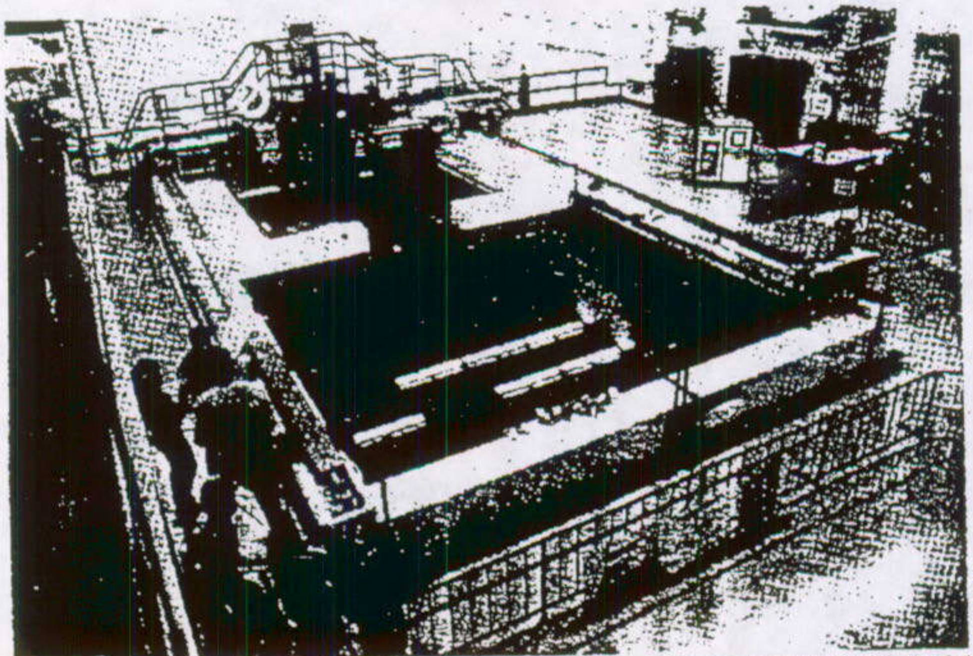
Cintichem Closed!

See Story p. 4

On April 5, 1990, Cintichem announced that it would dismantle its nuclear reactor. Cintichem faced expensive repairs after three radioactive leaks were discovered.

Plans are that the plant will continue to assemble and package radioactive isotopes. But, the raw materials are expected to be brought in from a Canadian company, Nordion International Inc.

Decommissioning is expected to take three years to complete and Cintichem must submit a plan for the dismantling of the reactor to the Nuclear Regulatory Commission (NRC) for approval.



Visitors view the pool where Cintichem's nuclear reactor core, beneath the bridge, is cooled.

embark on a monitoring program designed to pinpoint any lasting or further instances of contamination. The firm must also post a $5 million bond with the state to assure terms of the agreement aren't violated.

In details of an out-of-court settlement released yesterday, the state Department of Environmental Conservation alleges:

– CintiChem didn't notify the DEC about an Oct. 18, 1989, radioactive leak that registered between 6,000 to 60,000 times the maximum permissible level for two months. The company denies this.

– During heavy rains this past Feb. 9, CintiChem released 30,000 gallons of radioactive water to the Indian Kill Reservoir, which supplies drinking water to more than 150 people in Sterling Forest. CintiChem has said the water was only very slightly radioactive and was released to prevent a dam washout.

– Groundwater tested Feb. 13 showed higher than allowed levels of the radioactive isotope iodine-131. The company denies this.

– CintiChem has never had a valid air emission permit for its isotopes, going back to 1978. The company says the DEC never acted on its application for a permit. The emissions are controlled by terms of a 1976 out-of-court settlement, CintiChem says.

State officials could not be reached for comment yesterday, but a spokesman for the federal Nuclear Regulatory Commission, which actually licences reactors, says the fine is one of the largest ever levied in the state.

Marvin Resnikoff, a nuclear physicist who was involved in the fight to shut down the plutonium recycling plant in West Valley, N.Y., said the fine against CintiChem "is pretty strong."

CintiChem is seeking the NRC's permission to decommission its reactor. The company pulled the reactor's switch Feb. 9 to undertake extensive leak detection and repairs. The NRC ordered it to remain shut down until CintiChem could prove that there would be no more leaks.

When the reactor went down, CintiChem laid off 27 employees. Wasilewski said yesterday it was hard to say whether there will be further layoffs until CintiChem gets a better idea about when the NRC will approve decommissioning the reactor.

The NRC found 23 violations of federal nuclear standards in the past five years at CintiChem, including employee contamination. During that time, CintiChem was fined $12,500 for an employee's mild external contamination and was criticized a number of times for lapses in day-to-day operations.

On Wednesday, an English company, Amersham, purchased Medi-Physics, a Paramus, N.J., subsidiary of Hoffmann-LaRoche. CintiChem, which had been operated through Medi-Physics, was cut out of the deal, in part because of its regulatory problems, Wasilewski said. 6/13/90

17 of 62, 21 Terms Pg 1 of 2

m190 CINTICHEM WILL PAY MASSIVE FINE 06/16/90

The Times Herald Record Saturday, June 16, 1990

CintiChem agreement

CintiChem will pay a $300,000 fine in connection with radioactive discharges at its Sterling Forest plant.

The agreement also requires:

- A $5 million letter of credit to the DEC to guarantee the company lives up to its promises.
- A groundwater monitoring program, including an extensive hydrogeological study and underground monitoring wells.
- Plans for cleaning up contamination under or above ground. - An evaluation of air emissions, including the effectiveness of ventilation systems. The company must submit an air permit application.
- Daily sampling of the reservoir at the intake point to the filtration system, including analyses of water quality and aquatic plants and soil sediments.
- Analysis of the plant's safeguards against internal and external contamination from current manufacturing operations.

CintiChem says it has already taken many of steps as part of the company's efforts to satisfy federal Nuclear Regulatory Commission requirements.

ref. 3 6/16/90 2 of 2

ref. 4 p. 1

9/6/90
1 of 2

1 of 62, 4 Terms
mi90 CINTICHEM TEARS DOWN EQUIPMENT 09/06/90

The Times Herald-Record

Thursday, September 6, 1990

TAG: 9009060002
EDITION: Final
SECTION: News PAGE: 3
LENGTH: Medium: 85 lines
ILLUSTRATION: Record photo by Jeff Goulding: Chris Navarra of Queens mans a device that injects grout into cracks of the canal at the Cintichem plant. Record illustration by Sherry Svec: Shows small map of area - and area of cintichem complex.
HEADLINE: CINTICHEM TEARS DOWN EQUIPMENT
BYLINE: By WILLIAM BEREZANSKY Staff Writer
DATELINE: STERLING FOREST
TEXT:

Crews have started dismantling radioactive production equipment at Cintichem Inc., and will eventually level the buildings where nuclear medicines were once produced, company officials said.

The 145 employees at the plant, plagued in the past year by radioactive leaks, face an uncertain future.

Plant manager James McGovern said this week that Cintichem's parent company Hoffmann-La Roche of Nutley, N.J., is getting out of the radio-pharmaceutical business. He said he doesn't know what will happen to the Sterling Forest plant.

''We have no plans right now,'' McGovern said.

Until this year, Cintichem's wooded campus on the banks of the Indian Kill Reservoir produced most of the drugs the nation used for radiological medical tests.

But last October, a leak was found at the firm's aging 5-megawatt nuclear reactor. Problems, including a leak into the reservoir, persisted until Feb. 9, when the company shut down the reactor. The federal Nuclear Regulatory Commission ordered the company to keep it shut down until the leaks were fixed.

McGovern estimated that would have cost between $3 million and $5 million. Instead, Hoffmann-La Roche decided to get out of the business entirely. Decommissioning the reactor and radioactive production areas could cost as much as $20 million, McGovern said.

Cintichem has hired a consulting firm, and expects to submit a plan for dismantling the reactor to the Nuclear Regulatory Commission by the end of the month, the plant manager said.

McGovern said about half of the company's employees will have work for the next two years helping to put that plan in action. They've already started - painting a series of 6,000 yellow numbered dots on walls, floors and ceilings in the reactor building.

The dots mark where radioactive samples have been taken. The levels are logged to identify low level nuclear waste, McGovern said.

In all, more than 60,000 samples will be measured in the 20,000-square-foot, three-story building.

The plant was built in 1961 as a research reactor for the Union Carbide Co.

Building material that does not show higher than normal radioactivity could e disposed in a construction and demolition debris site.

Cement and equipment contaminated with low-level radiation would be shipped o a federally-licensed low level disposal site at Barnwell, S.C., McGovern aid.

At the reactor, workers continue to watch radiation levels.

The highest radiation can be found in the "hot cells" where workers once ised glove boxes or mechanical arms to package isotopes. The room is generally closed to workers; special suits will be worn to clean up the rooms.

A pool of water covers the last of the plant's radioactive fuel on the floor of the reactor pool. Once used for cooling the reactor process, the water now acts as a shield to contain the waste.

Eventually, the water will be pumped out and cleaned further before it is released outside, McGovern said. The waste fuel will be taken by the federal

Pg 1 of 2
13 of 62, 10 Terms
CINTICHEM TEARS DOWN EQUIPMENT 09/06/90
mi90

Department of Energy, he said.

Because Cintichem is voluntarily decommissioning, the NRC is not requiring the company keep to a deadline.

However, McGovern said the company's low-level nuclear waste site in Barnwell, S.C. will not accept out-of-state waste after 1993. This would include any construction debris or equipment contaminated by radiation, he said.

Under federal law, companies that generate low-level waste would be required to store or dump their waste in New York state. The state does not have any sites to store or dispose of nuclear waste.

An NRC spokeswoman said a public comment period would be scheduled within several months, after the agency reviews the decommissioning plan.

Since the reactor closed, Cintichem has been importing isotopes to continue packaging pharmaceuticals, in a section of the administration building. About half the company's employees are working on that project. The medicines are sold under a contract with Amersham, an Illinois firm.

But Cintichem expects to run out of work within three years, when Amersham builds its own plant.

"Roche strategically didn't want to be in this business any longer," McGovern said. "It just didn't fit into the mainstream of their business."

ref. 4 p. 2

OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT
SPECIAL INSTRUCTION SHEET

1. QA: N/A

Complete Only Applicable Items

This is a placeholder page for records that cannot be scanned.

2. Record Date 04/01/96	3. Accession Number ATTACHMENT TO: MOL.20010727.0169
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13. Comments

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Responses to Comment Letter C076

1 A major purpose of the EIS is to ensure that environmental information is available for consideration in the decision-making process. While the EIS does not provide an evaluation of the dollar costs associated with the proposed action, it does provide the best comparable information regarding the cost of start-up and operations available at this point in the process. The Department has attempted to explain the basis and source for the analysis contained in the EIS. Economic impacts that might arise at the alternative sites as a result of potential cost-sharing uses of the production facilities are outside the scope of this EIS.

2 The FDA's actions with respect to foreign Mo-99 producers are outside of the scope of the EIS.

3 The Department is not proposing to replace the Canadian reactor or to compete with Nordion. Instead, the Department is proposing to establish a backup to the Canadian reactor, to act as an "insurance policy" in case that reactor unexpectedly shuts down. If the DOE decides to proceed with this proposed project, it will operate its Mo-99 facilities at full production capability only in the event of a Mo-99 supply shortage.

If it became apparent that the Canadians were going to be unable to build even one new production reactor, DOE would assess the world supply situation at that point and might investigate the possibility of increasing its role in the Mo-99 supply market or establishing further production capability.

4 Unless a supply shortage arises, the Department would produce only as much Mo-99 as is necessary to maintain the capabilities of the facilities and staff to be able to produce 100% of the U.S. demand.

5 The reason that DOE has commenced the Mo-99 initiative is the concern that the National Research Universal reactor may be unavailable. For example it is possible that this reactor may be forced to shut down before Maple I (Canada's proposed reactor) is built and running. In this instance, should DOE decide to proceed with the proposed project, full production would be required from the selected site. For this reason, waste generation was calculated and planned from a full-production level. However, production at levels lower than 100% would allow greater use of the Hot Cell Facility for interim storage if needed.

6 Comment noted.

7 The small quantities of radioactive waste generated by the end users (hospitals and medical clinics) would be disposed of according to the arrangements currently in place by those users. It should be emphasized that these users are currently receiving, using, and disposing of Tc-99m generators in their operations and that under the actions proposed in the EIS, only the source of the isotope might change. The types and quantities of isotopes used in medical procedures by these institutions would remain substantially the same as their current practices under any alternative, unless the current Canadian supplier ceased production and no backup supply were available.

Management of radioactive material by commercial institutions, including the pharmaceutical manufacturers, medical isotope end users, and commercial radioactive waste disposal facilities is regulated by the Nuclear Regulatory Commission (NRC). The end users typically return spent Tc-99m generators to the pharmaceutical manufacturers, where the nonradioactive components are recycled. The quantity of residual radioactive material remaining in the generators would be small because of the short radioactive half-life of the isotopes. This waste would be disposed of, along with other radioactive wastes generated by the pharmaceutical companies, in an NRC-licensed, low-level radioactive waste facility. Any NRC-licensed commercial radioactive waste disposal facility must undergo a NEPA review similar to this EIS before construction, and it must meet all NRC standards for licensing, operation, and decommissioning of the facility during its life cycle.

Any radioactive wastes generated at DOE-controlled facilities by the production of medical isotopes would either be disposed of at a DOE-approved facility within the generation site (in the LANL or INEL alternatives) or shipped to an offsite DOE-approved facility (in the SNL/NM and ORNL alternatives). The impacts of medical isotope waste disposal would be evaluated, in conjunction with other wastes to be managed at the location, by a risk analysis for the ultimate disposal facility (such as a waste management EIS for the receiving site, or other appropriate NEPA review). Because the medical isotope waste would be a relatively small fraction of the waste disposed of at any site, the consequences of such disposal would likely be small by comparison to the total, or to any regulatory standard.

Disposal of low-level radioactive waste at DOE and commercial facilities is regulated by the DOE and the NRC, respectively. In addition, the disposal of waste is subject to any applicable regulations adopted by the receiving state or local governments. The U.S. Environmental Protection Agency has also considered issuing standards for disposal of low-level radioactive waste, but has not finalized such regulations at this time.

8 The Department intends to charge the prevailing world market rate for the Mo-99 it produces.

1990 Camino Mora
Los Alamos, NM 87544
February 1, 1996
(505) 661-6505

Mr. Wade Carroll
EIS Project Manager
Office of Nuclear Energy, Science
and Technology (NE-70)
U.S. Department of Energy
19901 Germantown Road
Germantown, Maryland 20874-5434

Dear Mr. Carroll:

I am taking this opportunity to comment on the "Medical Isotopes Production Project: Molybdenum-99 and Related Isotopes" draft environmental impact statement (EIS) dated December 1995. I am making these comments as a public citizen, not in my professional capacity. However, so you may judge the value of my comments, I provide the following background.

I am a former nuclear submarine officer with almost seven years of active duty. I was a fully qualified nuclear engineering officer. Following separation from the Navy, I have worked in facilities management in the private sector for two and one-half years. For the last three and one-half years, I have been the leading radiological air quality engineer at Los Alamos National Laboratory (LANL). In this role, I have developed compliance strategies for LANL, reviewed all new LANL projects for regulatory compliance, assisted in the development of Environmental Assessments and EISs, and measured, analyzed, modeled and assessed all radiological air emissions from LANL. I was actively involved in the review and oversight of the Mo-99 program development at LANL prior to the Omega West Reactor (OWR) shutdown. Therefore, I am fairly familiar with most technical aspects of the project.

The attached list details all my questions, comments, and concerns in this draft EIS. Please contact me if you have any questions. Your attention is appreciated.

Sincerely,

Eric J. McNamara

Eric McNamara

COMMENTS ON MEDICAL ISOTOPES PRODUCTION PROJECT: MO-99 AND RELATED ISOTOPES DRAFT EIS

1 1) It is not at all clear why Sandia National Laboratory, New Mexico (SNL) was chosen as the preferred alternative. Almost nothing in the EIS, in terms of environmental impact, cost schedule, or organizational capabilities, supports SNL as the preferred alternative. The following items specifically listed in the EIS specifically indicate SNL as a non-preferable alternative:

2

- The collocated worker dose from normal operations is second highest of all alternatives (Table 3-1).
- The MEI dose from normal operations is second highest of all alternatives (Table 3-1).
- The population dose from normal operations is second highest of all alternatives (Table 3-1). In addition, as discussed later, the true population dose will be much higher than shown.
- The population dose to project workers is the highest of those calculated (Table 3-1).
- The annual incidence of illnesses and injuries to workers is the highest of the alternatives (Table 3-1).
- The dose to the public and the transportation crew from incident free transportation is the highest of all alternatives (Table 3-1).
- The population dose from the analyzed accidents for target irradiation from the inhalation/external pathway (the pathways of greatest concern because they cannot be controlled) is the highest of all alternatives (Table 3-1). In addition, as discussed later, the true population dose will be much higher than shown.
- The population dose from the analyzed accidents for target processing are the highest of all alternatives (Table 3-1). In addition, as discussed later, the true population dose will be much higher than shown.
- The resource usage for construction is the highest of all alternatives (Table 3-1).
- The usage of highly enriched uranium (HEU), stainless steel, and chemicals for operations is the highest of all alternatives (Table 3-1).

2 • The quantities of liquid waste is the highest of all alternatives (Table 3-1).

3 • The total cost for construction and operations is the highest of all alternatives after just two years of operation(Table 3-1).

• The most extensive facility modifications of all alternatives would be required, especially in the hot cells (Table 3-2 and §3.3.1.2).

4 • The least spent nuclear fuel (SNF) storage. In fact, the long-term requirements for SNF storage at SNL have specifically not been included in costs, schedule, etc. Only limited production requirements were included (Table 3-2 and §3.3.2.4).

5 • The current ventilation for the SNL hot cells is described as inadequate, and even the planned upgraded ventilation system is only a single stage HEPA and charcoal system as opposed to two stage systems at LANL (Table 3-2).

6 • The total schedule from record of decision (ROD) to full production capability is the longest of all alternatives (Table 3-2). Although it is true that SNL shows the shortest time to initial production, the stated intent of the project is to be able to produce 100% of the Mo-99 demand in the event Nordion shuts down. I do not believe that a quick turn-around to initial production, but a long turn-around to 100% production capability meets this intent.

7 • Low-level wastes must be shipped off-site (Table 3-2).

8 • SNL has no isotope production history or experience (Table 3-2, §3.3.1, and §13.3.2).

9 • SNL is in the highest (most restrictive) seismic zone of all the alternatives (§3.1.6, §3.2.6, §3.3.6, and §3.4.6).

10 • SNL does not and will not have a spare hot cell capability (§3.3.2.6).

• SNL does not have an existing capability to recycle fuel (§5.14.1.1).

11 • No other alternative would require transportation of targets before irradiation.

12 • SNL has less developed separations capabilities and knowledge (§3.1.2).

13 • SNL does not have target production capabilities that already exist elsewhere(§3.3.1.1).

14 • The planned configuration for the annular core research reactor (ACRR) is an unproved configuration. All other alternatives would operate in a configuration that has many years of proven service (§3.3.1.4).

15 • The potential exists to lose this facility to national defense needs. This alone seems to defeat the entire purpose of the program (§3.3.1.9).

16 • Other sites have waste compacting capabilities that SNL does not (§3.3.2.2).

17 • It has been stated in the afternoon public meeting in Albuquerque that SNL, as an operating reactor, would not have to "staff up" for this project, as would the other sites. Since SNL would have to transition from operating at something less than eight hours per day, five days per week to an operating schedule of twenty-four hours per day, seven days per week, it seems they also would require significant additional staffing.

18 This extensive list seems to raise significant questions regarding the preferred alternative. I grant that each alternative has advantages and disadvantages, but I don't believe the plethora of issues exists at any of the other sites as exists at SNL.

19 2) Page 3.4, §3.1.2 indicates a potential need to dispose of Mo-99 that couldn't be sold? With such a short half-life, why wouldn't it be stored until decayed and then disposed of as non-radiological trash?

20 3) Page 3.41, §3.3.3.4, states both "the reactor would be solely dedicated to the production of Mo-99" and "costs could be offset by sharing expenses with other users of its experimental facilities". These two statements seem to contradict each other.

21 4) Page 4.3, §4.1.1 says current SNL operations releases 218 Ci/yr of Ar-41. Page 4.11, §4.1.7.2 says 1993 releases were 3.2 Ci. These two statements do not coincide. In addition, neither of them particularly supports the contention that increased operations of ACRR (even with the removal of the air core) will result in 2.2 Ci/yr of Ar-41 release (Table 5-2).

22 5) Page 5.33, §5.14.1.1 refers to "high-activity, low-level liquid waste". Is it really high-activity or low-level?

23 6) Page 5.43, §5.15 states that "population" doses were only calculated for the most impacted sector. This in no way provides a true picture of total "population" dose. Neither is it an equitable comparison. Although I have no personal knowledge of Oak Ridge's environment, both LANL and Idaho Falls (INEL) have populations predominately in one sector and the given figures are reasonable. SNL however has large populations close to the facility in several sectors and the true total population dose is probably (almost certainly) much higher than what is shown. There is no valid technical

23 reason to calculate a "population" dose in only one sector. A true population dose should be calculated, analyzed, and reported for all sixteen sectors.

Responses to Comment Letter C077

1 The Department has not made a decision regarding if and where to conduct the proposed project. A preferred alternative is identified in an EIS, in essence, to tell the public which way the Department is leaning on a decision, but it does not mean that the decision has been made. Further, Council on Environmental Quality regulations require Federal agencies to identify the preferred alternative in a Draft EIS if the agency has one and to identify a preferred alternative in a Final EIS.

The Annular Core Research Reactor/Hot Cell Facility (ACRR/HCF) combination at SNL/NM is the preferred alternative for target irradiation and processing for the reasons stated in Section 3.3.1.1.

2 The comment restates results presented in the EIS summary table (Table 3-1), with reference to impacts of implementing medical isotope production at SNL/NM. The EIS presents information on the relative health consequences, risks, resource use, costs, and waste generation associated with each alternative, along with other pertinent factors, to assist the decision maker in making its decision on whether to undertake the proposed production of medical isotopes and at which site (if any) such a project should be located.

3 The Department recognizes that the estimated preparations costs for SNL/NM are the second lowest and that the estimated operating costs are the highest. The uncertainties associated with the estimated cost of the SNL/NM and LANL alternatives are lower than for the other alternatives. If the Department decides to proceed with the proposed action, the information presented in the EIS (including cost data), the operational readiness of facilities, and other programmatic factors will be considered in the final selection of facilities for Mo-99 production.

Regarding the necessary modifications for each alternative, the modifications to the SNL/NM Hot Cell Facility are recognized to be more extensive than the modifications required for the hot cells at the other alternatives.

4 All of the reactors currently have sufficient fuel to support initial operations at the low production levels proposed in this EIS. The schedule for replacement and storage of existing fuel would depend on the production requirements for Mo-99, which would be low unless DOE were called upon to replace the existing supply for an extended period. Even at full production levels, SNL/NM has enough existing spent fuel storage space for 6 years of operation, and this could be expanded. The costs associated with spent fuel storage were included in the cost of reactor operations to the extent possible and would not be expected to differ substantially between alternatives.

5 The ventilation system proposed for the hot cell facility at SNL/NM, or the ventilation systems for any of the alternative hot cells, would contain emission controls to remove both particulates and iodine from the airborne effluents and would meet all applicable Federal, state and local standards.

6 As shown in Table 3-2, the estimated time required to full production for the preferred alternative is second shortest, tied with the LANL alternative.

The ability to produce even a small amount of Mo-99 in a short period of time is important in that, if a Mo-99 shortage were to occur in the near future, the Department would be able to supply at least a fraction of the U.S. demand. The Department has proposed the Medical Isotopes Production Project to respond to a near term "window of vulnerability" in the Mo-99 supply situation; therefore, the ability to produce even a small amount of Mo-99 in a short period of time is an important factor and will be considered in the Department's decision on the proposed project.

7 The Department recognizes that "cradle-to-grave" waste management is a benefit of the INEL and LANL alternatives and will consider this factor in making its decision on the proposed project.

8 As shown in Table 3-2, the Department recognizes that all sites under consideration except SNL/NM have significant isotope production experience.

9 Although significant seismic activity at any alternative site is a relatively rare occurrence, differences in potential for facility damage are reflected in the seismic safety requirements for facility construction at each location. Because all facilities or modifications would meet the seismic safety requirements appropriate to their locations, the level of risk associated with potential seismic damage to medical isotope production facilities is expected to be similar for all EIS alternatives.

10 At full production, SNL/NM would have excess hot cell capability for certain Mo-99 production steps, but would not have as much spare hot cell capability as other alternatives. Currently, DOE does not plan to recycle any spent nuclear fuel that would be generated as a result of the proposed project. The capability to recycle uranium extracted from targets is currently available at LANL, but the technology could be implemented at any of the alternative hot cell facilities.

11 The commentor is correct, three of the four alternatives will fabricate targets onsite. The preferred alternative will utilize the target fabrication experience and expertise at LANL, although the option exists to fabricate targets at SNL/NM (see Section 3.3.1.3).

12 The Department recognizes that the isotope separation chemistry experience at SNL/NM is not as extensive as any of the other three alternatives. However, SNL/NM personnel are developing separation chemistry expertise by working with LANL in the verification of the Cintichem separation process and would continue to develop this expertise if SNL/NM were selected for the proposed project.

13 As discussed in Section 3.1, the preferred alternative would have targets fabricated at LANL. Also, as discussed in Section 3.1, the target fabrication process that is being validated by LANL would be transferrable to any of the alternative sites.

14 The ACRR proposed configuration is predicated on calculations. Significant testing activities will be conducted during the reactor startup and power escalation periods. Neutron flux levels, target irradiation zone power distributions, natural circulation cooling of the targets, and the dynamic effects between effectively two separate, neutronically coupled concentric cores must be verified through the planned testing activities.

15 It is possible that the ACRR, the preferred reactor for the proposed project, could be diverted to support defense-related missions in case of a national emergency. However, the Department has determined that the probability of needing the ACRR for defense purposes is sufficiently low to preclude disqualifying the reactor from consideration.

16 Comment noted.

17 The statement was that "Because it is a currently operating reactor, and it has the trained operators on board right now..." The commentor is correct that additional staffing would be required to reach a 24-hour, 7-day/ week capability. The objective of the statement was that SNL/NM could begin initial reactor operations for the proposed project quickly, to act as a backup to the existing supplier.

18 As with any project, there are uncertainties and issues associated with each of the alternatives considered in the EIS, including the preferred alternative. These issues are identified throughout the EIS.

19 Mo-99 and Tc-99m eventually decay to form Tc-99, which has a long half-life (about 216,000 years) but is still radioactive. The unsold Mo-99 would be allowed to decay before disposal to reduce the activity level, but the remaining Tc-99 would still be mildly radioactive and would be disposed of as low-level waste.

20 The term "solely dedicated" should not have been used. The commentor is correct. If ancillary programs are undertaken to offset the operating cost, then the facility is not solely dedicated to the production of Mo-99 and related isotopes. Some of the costs could be offset by sharing expenses with other users of its experimental facilities on a non-interference basis. Section 3.3.3.4 of the EIS has been revised to reflect this comment.

21 The estimated emissions for ACRR in Section 4.1.1 refer to hypothetical continuous operations with the current core configuration. Because the reactor did not operate continuously during 1993, the releases reported for that year (see Section 4.1.7.2) were lower. The estimated ACRR emissions for the EIS proposed action (Table 5-2) were based on historical operations, with adjustments for changes to the core configuration that would remove the major source of argon-41. This estimate is consistent with an SNL/NM analysis of projected emissions from the reconfigured reactor (Section 5.7.1).

22 The terminology used is correct.

23 Population dose estimates for routine (i.e., relatively continuous) emissions from facilities consider the total population within 80 km of the facility, accounting for the fraction of time the wind blows toward each sector.

Because accidents are short-term scenarios relative to normal operations and because the wind cannot blow in all directions simultaneously, the population impacts are typically evaluated for a bounding condition. For the purposes of this analysis, the wind was assumed to blow in one direction under minimum dispersion atmospheric conditions during the entire release, and the direction was chosen to maximize the population dose. If the wind direction were assumed to change during the course of the accident, a larger population might be affected, but the quantities of radioactive materials to which those populations are exposed would be lower, resulting in a smaller total collective dose and a lower average dose to the downwind individuals. The analysis in the EIS was designed to maximize the potential population dose for each accident by choosing a single wind direction, which is noted in the text and tables of Section 5.15.

February 1, 1996

I brought a special guest here to the meeting, this is my son Ian Todd Dempsey. I took Ian on a tour around the CMR building, and past the Omega West Reactor before we came here. Ian was too young to remember when he had Tc-99, but I explained to him that he was very sick and that it helped to save his life. Ian has a scar on his stomach from the two surgeries he had performed on him when he was six to eight weeks old. The first surgery was unsuccessful because the problem could not be identified with the barium x-ray diagnosis that was used. The second surgery relied on a Tc-99 diagnostic technique, and the Tc-99 was able to pinpoint the problem. Ian has affirmed his support for this project to me.

I have come here tonight to tell you that I read all the portions of the draft EIS for MIPP related to Los Alamos and Sandia and that I want the Medical Isotope Production Project to proceed. I find that the draft EIS is a thoughtful, well written,
1 comprehensive, and informative document. I do have one dissention, I find that the NO ACTION ALTERNATIVE is COMPLETELY UNACCEPTABLE!!! I want the project to proceed here in Los Alamos. I can see the Low Level Waste dump from the roof of my house in White Rock, and I want the project here. I drive past the spent fuel storage area everyday on my way to work, and I want the project here. The Omega West Reactor is behind McDonald's, where my children like to get Happy Meals, and I want the project here. But if some other site in the United States is deemed to be a better location, well so be it. Just as long as we again manufacture this medicine here in the USA.

My job as a contractor for LANL is in Radiation Protection, and I am completely confident that we can produce this medicine without incident. I would not have my family living here, working here, and going to school here if I thought it was unsafe. This is a special community and the people I work with are some of the smartest in the world. We can do this, we can do it safely, we can do it smart, and we can be proud of it, damn proud to be making medicine for our nation.

I heard some crap from protesters on the news from Albuquerque on Monday night (1/29/96), about how this was a pork barrel project, a secret plan to keep the nuclear weapons program alive at Sandia, and that how we should continue to buy our medical isotopes from Canada. I am sorry that some people are so misguided, so unhappy, so uninformed that they will tell and believe lies to support their positions. I don't want to rely on other countries for this vital medicine, and I want us to make the hard choices that keep us strong as a nation. This is a tremendously important project, and it must go forward in some fashion. If the controversy in Albuquerque will prevent or slow this project, then I must insist that the controversy be considered when selecting the site for the MIPP. The people against the project operating at Sandia or the against the project in any form, would sing a different tune if the medicine was needed to help save the life of one of their children. In 1989, when Taos county voted itself a nuclear free zone, they specifically exempted medical isotopes. Even these rabid anti-nukes saw the need for this medicine. If these people who are against the MIPP were faced with a real life need for this medicine, they would not give a damn where it was made, just so long as they had it.

2 We in Los Alamos are in a unique position, and can do so much for this project. We have all the required facilities, hot cells, reactor, fuel rods, spent fuel storage, process facilities, and high and low level waste facilities. We can have a cradle to grave operation with little or no dissention FROM THE RESIDENTS OF THE COUNTY. What some of less than objective neighbors think is not important because they have already affirmed their opinion on the necessity of medical isotopes.

At the last meeting related to this project I heard some comments about expense, about pursuing a liner accelerator or liquid reactor technology, and related issues. am not against these ideas, but I know that they are unproven and may require more time than remains before the Canadian reactor shuts down. We must go forward with this proven technology. In the future, if some other method proves more reliable, more cost effective, more efficient, then we will do as Americans have always done and embrace the new way. For the time being however, we must move forward, begin this project and produce this medicine for OUR country. Let us begin, now, here, in this county, doing more work to keep our nation strong, self sufficient, and proud.

Thank You,

Michael and Ian Dempsey
300 Connie Ave.
White Rock, NM 87544

(505) 672-3726

Responses to Comment Letter C078

1 Comment noted.

2 Comment noted.

GREATER IDAHO FALLS CHAMBER OF COMMERCE

February 9, 1996

Mr. Wade Carroll, MIPP-EIS Document Manager
U. S. Department of Energy
Office of Isotope Production and Distribution, NE-70
19901 Germantown Road
Germantown, Maryland 20874

SUBJECT: COMMENTS ON THE DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR THE MEDICAL ISOTOPES PRODUCTION PROJECT: MOLYBDENUM-99 AND RELATED ISOTOPES

Dear Mr. Carroll:

On behalf of the Idaho Falls Chamber of Commerce INEL Committee, we would like to make the following comments on the subject EIS:

1 1) INEL's mission includes medical uses of nuclear technology. The two New Mexico labs are Defense mission labs. DOE should be supporting the labs' assigned missions. INEL has the isotope experience and existing support functions that is not present at the New Mexico labs.

2 2) Earliest production of small amounts of Mo-99 should not be a requirement or the basis for DOE's selection decision. As stated in the EIS (pp iv), the Canadian source is not in question for at least 3-4 years. The need for a backup has existed for seven years! Now is not the time to make a time related decision when only an additional 12 months would be required to do it right. There is no race with time to make the wrong decision to get an inadequate backup. If the Canadian source were to fail it would most likely be a complete failure as stated in the EIS (pp v) and Sandia's backup capacity would not begin to meet the U. S. medical needs. Early capability to meet the full demand therefore appears to be more important than partial supply at an earlier date. **THIS IS OUR MOST IMPORTANT POINT AND WAS NOT ANSWERED AT THE PUBLIC HEARING.**

3 3) Given that 100% or more production requirement is necessary, it is clear that the INEL alternative is the best option. It is the best from a technical sense for medical isotope production, best from an environmental sense and least overall cost (even reduced from the EIS estimates with use of the Chem Plant hot cells, raising the PBF power from that used in the EIS which substantially reduces reactor

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Mr. Wade Carroll, MIPP-EIS Document Manager
Page Two

3 modification costs, the more detailed existing PBF estimates as well as the reduction in cost by cost sharing the operational cost with the concurrent BNCT treatment option).

4 4) The ability of the INEL to do the entire medical mission within site boundaries (no public highways) is also deemed to be a major advantage and reduces public and environmental risks.

5 5) The ACRR at Sandia is a reactor facility with a defense mission which would make commercialization very difficult and severely limits the reliability of it as a MO-99 backup even though there may not be any present DOD use (defense priority in time of need).

6 6) There is strong public support in Idaho for the medical mission. There was not a single statement in opposition of either of the two very well attended public hearings.

Sincerely yours,

Con Mahoney, Chairman
INEL Committee

cc: Secretary O'Leary
Idaho Congressional Delegation

Responses to Comment Letter C079

1 As stated in Table 3-2, the INEL, LANL, and ORNL sites all have significant isotope production experience.

2 To replace their single existing reactor, the Canadians plan to build two new reactors, each with the capability to produce 100% of the worldwide demand for Mo-99. They plan to have these two new reactors operating by the year 2000, so even if one of those reactors were to shut down, there would be adequate backup production capability at that time.

In the near term, with a single reactor producing 100% of the U.S. demand, a shutdown of that reactor for any reason would result in a Mo-99 supply shortage. The potential for such a shortage is why the ability to produce even a fraction of the U.S. demand in the near term is considered important. This would provide DOE with a Mo-99 extraction process which has met FDA approval requirements in the very near term and would be capable of providing up to 30% of the U.S. demand on an emergency basis. This early experience would also be an asset in the expansion to full-scale production capability.

3 All of the reactors evaluated as reasonable alternatives for the proposed project would (after necessary modifications) have the ability to produce at least 100% of the U.S. demand for Mo-99. Power Burst Facility (PBF) operation above the power level assessed in the EIS would incur additional costs and schedule ~~to~~ meet operational requirements for a higher power reactor. The existing PBF cost estimates were a source for some of the information required for this EIS, but were not all-inclusive. Additional cost information specific to the proposed Medical Isotopes Production Project was developed.

The Idaho Brain Tumor Center (IBTC) has informed DOE of its interest in coordinating its efforts with those of DOE; however, IBTC has not submitted any plans for coordinating reactor conversion activities, nor has it made a formal proposal to DOE. In addition, the Department understands that IBTC is investigating the possibility of using other facilities for boron neutron capture therapy (BNCT) and that other reactors under consideration for this project may be usable for BNCT. If the Department decides to proceed with a production alternative for this proposed project, it would welcome a proposal from IBTC for dual use of the reactor facility selected.

As discussed in Section 5, the environmental impacts of the proposed Medical Isotopes Production Project were found to be low and essentially the same for each of the reasonable alternatives.

4 The comment correctly notes that the operation at INEL would occur substantially within the site boundaries. Although the risks of some aspects of the project are lower at INEL than at other sites because of this, transportation of separated isotopes would require shipments to the Idaho Falls airport over public roads, and the risks associated with these shipments are comparable for all alternatives.

5 If the Annular Core Research Reactor (ACRR) is selected for the proposed project, its mission would be changed from a defense mission to an isotope production mission. The reason that the possible diversion of the ACRR for defense use is highlighted in the EIS is that, in an emergency, the ACRR is more likely than the other reactors considered in the EIS to be used for defense purposes. However, the Department has determined that the probability of needing the ACRR for defense purposes is sufficiently low to preclude disqualifying the reactor from consideration.

6 Comment noted.

February 7, 1996

Mr. Wade Carroll, MIPP-EIS Document Manager
U. S. Department of Energy
Office of Isotope Production and Distribution, NE-70
19901 Germantown, MD 20874

Subject: Comments on the DEIS for Medical Isotope Production Project

Dear Mr. Carroll:

I appreciate the opportunity to comment on the Draft Environmental Impact Statement for the Medical Isotopes Production Project: Molybdenum-99 and Related Isotopes. After reviewing the document I would like to submit the following comments for consideration.:

I am concerned that choosing the ACRR as the preferred alternative does not take into consideration several items:

1 1. The ACRR is currently located at a facility controlled by the military. If this facility were to be utilized, the military could reassume the facility at any time. This would seem a poor option if you were seeking to attract investors/venture capital.

2 2. The possibility of utilizing the PBF facility in conjunction with BNCT was not addressed. It would seem that dual usage would save considerable money.

3 3. If the ACRR is utilized, has the new core option been environmentally approved (EIS submitted and approved)?

Considering the above, I feel the decision to designate the ACRR as the preferred option has flaws.

Sincerely,

Robert L. Skinner

Responses to Comment Letter C080

1 The Annular Core Research Reactor (ACRR) is a DOE-owned facility. It is possible that the ACRR, the preferred reactor for the proposed project, could be diverted to support defense missions in case of a national emergency. However, the Department has determined that the probability of needing the ACRR for defense purposes is sufficiently low to preclude disqualifying the reactor from consideration and to significantly diminish its potential for privatization. It is expected that the Department will be able to maintain access to the site under all circumstances.

2 The Idaho Brain Tumor Center (IBTC) has informed DOE of its interest in coordinating its efforts with those of DOE; however, IBTC has not submitted any plans for coordinating reactor conversion activities, nor has it made a formal proposal to DOE. In addition, the Department understands that IBTC is investigating the possibility of using other facilities for boron neutron capture therapy (BNCT) and that other reactors under consideration for this project may be usable for BNCT. If the Department decides to proceed with a production alternative for this proposed project, it would welcome a proposal from IBTC for dual use of the reactor facility selected.

3 Modification of the ACRR for the Medical Isotopes Production Project and any associated environmental impacts are evaluated in this EIS.

Ruth F. Weiner
7336 Lew Wallace Drive NE
Albuquerque, NM 87109
(505) 856-5011

February 8, 1996

Wade Carroll
EIS Project Manager
NE-70
USDOE
19901 Germantown Rd.
Germantown, MD 20874-1290

Dear Mr. Carroll,

Please enter the following statement into the hearing record of the Mo-99 Draft EIS:

The radiation doses during incident-free transportation to people living and working along the
transportation routes were probably over estimated by about two orders of magnitude. The total
1 doses were presented, which included the stop dose (which was itself ridiculous in many cases).
The correct dose to cite is the off-link dose, which is usually about two or more orders of
magnitude smaller than the total that includes the stop dose.

Ruth F. Weiner

Response to Comment Letter C081

1 Comment noted. The assumptions were consistently applied for all alternatives.

IDAHO FALLS
MEDICAL
SOCIETY
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idaho falls, idaho 83404
(208) 524-6370

February 6, 1995

Wade Carroll, MIPP
EIS Document Manager
Office of Nuclear Energy, Science and Technology, NE 70
US Department of Energy
19901 Germantown Road
Germantown, Maryland 20874

Dear Sir:

1 The Idaho Falls Medical Society supports the production of medical isotopes at the Idaho National Engineering Laboratory near Idaho Falls.

2 We feel that the use of the power burst facility at the INEL would be superior and would be most cost effective and best in line with our national interests. These isotopes are medically necessary, and the advantages of doing them with the power burst facility are as follows:

3 1. The power burst facility reactor is the only one using the low enriched uranium which reduces waste generation and security requirements

4 2. PBF can dispose of low level waste generated on site, while an alternative would require packaging and shipping across state lines to the Nevada test site

5 3. The low cost of the operation of the PBF along with the spent fuel produced and the air quality impact are impotant factors

6 4. The PBF is the only choice which envisions the private sector taking over production

7 5. The reactor used for this would also be suitable for the cancer treatment mission if that is pursued

8 6. There is technical ability to produce 100% of the nation's demand for these medical isotopes with the PFB

9 7. The initial expenditure and operation expense is at least one-third lower than the alternatives, if done at the PBF site near Idaho Falls

On behalf of the Idaho Falls Medical Society, I am writing in support of this project.

Sincerely,

George Groberg, M.D.
President

GG:k

Responses to Comment Letter C082

1 Comment noted.

2 Comment noted.

3 The Power Burst Facility (PBF) is the only option currently using low enriched uranium fuel. All the other options evaluated in detail have designs for converting to low enriched uranium. The objective is not to build any more highly enriched uranium fuel bundles for any of the other options, but to use the fuel already on hand until the supply is exhausted or, in the case of the Annular Core Research Reactor (ACRR), until the burnup limit is reached (see Section 3.3.1.9). Two or three transition cores of both low enriched uranium and highly enriched uranium would be used during the conversion to all low enriched uranium fuel for these options. This is a long-term safeguards advantage, in that it depletes and irradiates the weapons grade material on hand.

It is not true that use of low enriched uranium fuel minimizes waste. More spent fuel bundles are generated per reactor full power year with the use of low enriched uranium bundles.

4 The INEL alternative and the LANL alternative both allow the small quantities of low-level waste to be stored onsite. The preferred SNL/NM alternative and the ORNL alternative would require some shipment of low-level waste to the Nevada Test Site (NTS).

5 The estimated operating costs of each alternative are presented in Section 5.22, the estimated fuel utilization of each alternative is presented in Table 3-2, and the air quality impacts of each alternative are discussed in Section 5.7. Each factor is important and will be given due consideration as the Department formulates its decision on the proposed project.

6 The Idaho Brain Tumor Center (IBTC) has informed DOE of its interest in coordinating its efforts with those of DOE. The Department is aware of this potential for the INEL alternative. Although the potential for privatization of the proposed action in this EIS is important, the process for privatization is not part of this proposed action. Each of the production alternatives has potential for privatization. DOE has solicited expressions of interest from the industrial community for the privatization of any isotope production activity conducted by DOE, including the proposed Medical Isotopes Production Project. If promising concepts are received, the Department would seek privatization proposals on a competitive basis.

7 As mentioned above, IBTC has informed DOE of its interest in coordinating its efforts with those of DOE; however, IBTC has not submitted any plans for coordinating reactor conversion activities, nor has it made a formal proposal to DOE. In addition, the Department understands that IBTC is investigating the possibility of using other facilities for boron neutron capture therapy (BNCT) and that other reactors under consideration for this project may be useable for BNCT. If the Department decides to pursue this proposed project, it would welcome a proposal from IBTC for dual use of the reactor facility selected for medical isotope production.

8 All of the reactors evaluated as reasonable alternatives for the proposed project would (after necessary modifications) have the ability to produce at least 100% of the U.S. demand for Mo-99.

9 The preparations costs for the INEL alternative, as shown in Section 5.22, are estimated to be about $2.4 million (or about 12%) less than for the preferred alternative. The operations costs for the INEL alternative are estimated to be about $4.4 million (or about 34%) less than for the preferred alternative. However, the uncertainties associated with the cost estimates for the INEL and ORNL alternatives are expected to be greater than for the LANL and the preferred alternative.

330 Hartert Dr.
Idaho Falls, ID 83404
February 9, 1996

Mr. Wade Carrol
MIPP EIS Document Manager
Office of Nuclear Energy
Science and Technology (NE-70)
U. S. Department of Energy
19901 Germantown Road
Germantown, Maryland 220874

Dear Mr. Carrol:

I am writing to comment on the draft EIS since I was unable to attend the public hearing held in Idaho Falls on January 17. I am employed at the INEL, but these are my comments as a private citizen.

1. It does not appear that the the correct distances were
used in estimating some radiological doses to the public.
1 The nearest public road to PBF is the state highway which
crosses through one edge of the site 11 km from PBF.

As I remeber my last visit to Sandia, the Lab is at th edge
of a military base and anyone can drive right up to the
2 front gate. The ACRR facility is right in the Lab complex
and not remotely located from the complex or the gate.

2. In assesing the possible radiological consequences, and
changes to the desigh of the ACRR reactor core and
internals, no basis was presented for some of the
assumptions. It appears to me that fuel melting has been
assumed to be a beyond design basis event for the ACRR
taking credit for the existing ACRR core design and
3 operation. I don't see any discussion as to how this will
be assured in the new core and internals design which will
employ a "TRGA" type fuel design without the retaining the
inherent reactivity feedback normally associated with TRIGA
fuel. The proposed operation includes a substantial
increase in the steady state power. No details were
provided on possible effects and required mitigating
features.

3. If PBF were to be chosen, there still exists a
consderable reservior of key technical and managment people
4 employed at the INEL who could form the nucleus of a project
team to modify and restart the facility.

4. Isotope prouction is consistant with a present mission
at the INEL and processing of the target material may be
5 compatible with remaining work at the Idaho Chemical
Processing Plant.

5. The INEL is noted for its abiliy to build and manage
large nucear facilities and to manage multidisciplinary
6 projects. The MIPP appears to particularly suited to
strengths at the INEL.

6. Work is formatively started to privately develope PBF as
a BNCT treatment facility. It should be possible to
7 integrate these two projects and cost share overlapping
work. This would produce cost saving to the taxpayer and
reduce BNCT patient teatment costs.

7. The time to restart PBF for istope production should be
very comparable or even faster than the time it will take to
complete the extensive modifications proposed for the long
term use of ACRR. It should be possible to make the near
term minor changes at ACCR to start istope production with
8 the existing ACRR core. At the same time start work on a
PBF istope production restart. This would provide
essentially the same schedule for istope production and
result in considerable savings to the government.

Thank you for your consideration.

Sincerly,

Brent J. Buescher

Responses to Comment Letter C083

1 The access point assumed for the Power Burst Facility (PBF) is actually a thermal luminescent dosimetry monitoring station at the area boundary. In the absence of more detailed information, it was assumed for purposes of the analysis that a member of the public could gain access to this location. The analyses presented in the EIS for consequences at the public access location following accidents at the PBF are therefore more conservative (i.e., estimate a higher dose) than if the highway location were chosen. In addition, the location evaluated for the offsite resident is about 12 km away, which would not differ substantially from the public access location on the highway. Changing the public access location would not substantially change the conclusions reached in the EIS because the accident risk associated with operation of any of the facilities is low.

2 The SNL/NM facilities are located throughout the Kirtland Air Force Base (KAFB). The area in which the Annular Core Research Reactor (ACRR) and the Hot Cell Facility (HCF) are located is remotely located and not near the Base boundary.

3 Although the ACRR would operate at increased power under the alternative proposed for the EIS, it would still employ convection cooling. Therefore, a flow blockage scenario similar to that evaluated for the other reactors would not represent a reasonably foreseeable accident. If it became necessary to modify the reactor core to accept a TRIGA-type low enriched uranium fuel, the existing safety basis for the facility would be re-evaluated to determine whether the conversion substantially increases the risk associated with its operation. The fuel damage scenario evaluated in the EIS for the ACRR is expected to bound the consequences of an accident after such a conversion.

4 Each of the alternative sites has the technical and managerial capability to execute the proposed project.

5 As stated in Table 3-2, the INEL, LANL, and ORNL sites all have significant isotope production experience.

6 Comment noted.

7 The Idaho Brain Tumor Center (IBTC) has informed DOE of its interest in coordinating its efforts with those of DOE; however, IBTC has not submitted any plans for coordinating reactor conversion activities, nor has it made a formal proposal to DOE. In addition, the Department understands that IBTC is investigating the possibility of using other facilities for boron neutron capture therapy (BNCT) and that other reactors under consideration for this project may be useable for BNCT. If the Department decides to proceed with a production alternative for this proposed project, it would welcome a proposal from IBTC for dual use of the reactor facility selected.

8 Comment noted.

JOHN R. HORAN
RADIATION PROTECTION CONSULTANT
1791 CORONADO ST.
IDAHO FALLS, ID 83401
[illegible]

February 8, 1996

Mr. Wade Carroll
MIPP-EIS Document Manager
USDOE, 20874.

Dear Sir,

I would like to make written comments on
the Draft EIS for the Medical Isotopes Production
Project: Mo 99 and Related Isotopes.

Incidentally I did attend the public hearing in
Idaho Falls on January 17, 1996 but I was very
disappointed in that the hearing had closed before
3 PM and the public recorder was not available. You
1 had advertised the hearing would be open until 4 PM.
There were about 6 of us who were told we could
make our statements on a tape cassette and they
would be included. I would like to be reassured that
this was actually acceptable since we went to the
trouble of attending and making our presentations on
a tape.

After a detailed reading of DOE/EIS-0249D I
concluded that the draft needs major revision since
2 the case for the preferred option has not been made.
I am convinced that DOE-HQ made its choice several
years ago and are now perverting the EIS process to

(over)

support their decision. This document contains 1
too many inaccuracies and is incomplete in too many
2 vital areas. A fair comparison has not been
made between the Sandia and the INEL proposals,
particularly from the cost and technical support
basis.

Idaho already has a medical technology program
and has produced medical isotopes since the 1950's
The PBF facility can produce 150% of the nations
3 needs for Mo-99 at Half its designed power level.
While the Sandia ACRR can produce 10-30% of
our needs if its power level is doubled.

Chairman Hazel O Leary at the International
Atomic Energy Agency in Vienna last year encouraged
other nations to convert from enriched uranium
4 fueled research reactors to using low enriched fuel.
Her interests are non-proliferation. The ACRR is
a DOD facility using highly enriched fuel while PBF
uses low-enrichment which reduces waste requirements
and security needs.

An honest analysis will reveal that the INEL
5 choice would be technically and economically superior
as well as the best choice in the long run for the USA.

Respectfully

John R. Horan, CHP

Responses to Comment Letter C084

1 Testimony from the public was taken for the majority of the advertised period of time, 1:00 pm through 4:00 pm. The meeting was recessed for a time when no one was interested in making a comment. However, representatives from the Department, the moderator, and the court reporter remained available to resume the meeting and take public comments until the meeting was adjourned at 4:00 pm. A "quiet room" with a tape recorder was available next to the meeting room throughout the entire 3-hour periods in the afternoon and evening. The comments made in the quiet room have been reproduced and responded to in this section as part of the transcript of the Idaho Falls public hearings. The commentor's oral comments are listed as IDB19.

2 The Department has not made a decision regarding if and where to conduct the proposed project. A preferred alternative is identified in an EIS, in essence, to tell the public which way the Department is leaning on a decision, but it does not mean that the decision has been made. Further, Council of Environmental Quality regulations require Federal agencies to identify the preferred alternative in a Draft EIS if the agency has one, and require that the agency identify a preferred alternative in a Final EIS.

The Annular Core Research Reactor/Hot Cell Facility (ACRR/HCF) combination at SNL/NM is the preferred alternative for target irradiation and processing for the reasons stated in Section 3.3.1.1.

3 All of the reactors evaluated as reasonable alternatives for the proposed project would (after necessary modifications) have the ability to produce at least 100% of the U.S. demand for Mo-99. As stated in Table 3-2, the INEL, LANL, and ORNL sites all have significant isotope production experience.

4 The Power Burst Facility (PBF) is the only option currently using low enriched uranium fuel. All the other options evaluated in detail have designs for converting to low enriched uranium. The objective is not to build any more highly enriched uranium fuel bundles for any of the other options, but to use the fuel already on hand until the supply is exhausted or, in the case of ACRR, until the burnup limit is reached (see Section 3.3.1.9). Two or three transition cores of both low enriched uranium and highly enriched uranium would be used during the conversion to all low enriched uranium fuel for these options. This is a long-term safeguards advantage, in that it depletes and irradiates the weapons grade material on hand.

It is not true that use of low enriched uranium fuel minimizes waste. More spent fuel bundles are generated per reactor full power year with the use of low enriched uranium bundles.

The ACRR is a Department of Energy Facility, not a Department of Defense facility.

5 Comment noted.

Office of the Governor

Telephone
(505) 869-3111
(505) 869-6333
Fax (505) 869-4236

PUEBLO of ISLETA
P.O Box 1270
Isleta, New Mexico 87022

February 9, 1996

Mr. Wade Carroll, MIPP-EIS Document Manager
U.S. Department of Energy
Office of Isotope Production and Distribution NE-70
19901 Germantown Road
Germantown, Maryland 20874

Re: Draft Environmental Impact Statement - Medical Isotopes Production Project: Molybdenum-99 and Related Isotopes

Dear: Mr. Wade Carroll:

The Pueblo of Isleta submits our comments regarding the **Medical Isotopes Production Project: Molybdenum-99 and Related Isotopes Draft Environmental Impact Statement** (EIS). Unfortunately, the Pueblo can only submit limited comments regarding this proposed project due to our limited environmental staff, their over committed time, and our very limited knowledge of the nuclear industry. However, we do have some specific concerns regarding locating this facility here in New Mexico.

1 Our first concern is that the EIS process does not take into consideration tribal ability to fully review, assess, and make informed decisions regarding the magnitude of this or any other project beyond our technical knowledge or capability. This greatly limits our participation in this process to determine for ourselves the degree of any potential impacts that may be associated with this project. There is an apparent need for technology transfer to occur on a more basic social level rather than on an overtly industry level. Perhaps then DOE's American Indian Tribal Government Policy could truly be effectively instituted.

2 The second concern is related to the last sentence of the first paragraph in **5.17 Unavoidable Adverse Environmental Impacts** of which refers to a scenario of supplying 100% of the current U.S. demand. Information we have received describes the Canada facility as having significant environmental pollution problems associated with it. Our concern is that if this facility had to supply 100% of future production for the U.S., what absolute assurances can be given that those same pollution impacts would not be relocated here?

3 Our third concern relates to how emergency planning and response has been coordinated with tribal governments and specifically Isleta Pueblo? If an accident occurred within tribal lands, who would respond and how would such accidents be mitigated? We are unaware of such communication with DOE in this area.

4 Lastly, we would like to make sure that those comments and/or questions presented by Mr. Blane Sanchez at the Albuquerque, NM public hearing were on behalf of Isleta Pueblo.

5 Based on Isleta's disadvantage to adequately review this proposed project and based on previous positions taken regarding radioactive waste disposal from DOE facilities, we are unable to support this project at this time. If you have any questions, please direct them to Blane M. Sanchez of our Environment Department, at 505-869-2710.

Sincerely,

PUEBLO OF ISLETA

for Alvino Lucero
Governor

Responses to Comment Letter C085

1 The Department is committed to actively involving the public, state and local governments and tribal governments. Based on the proximity of the preferred facility site to the Isleta Pueblo, the Department contacted the tribal government representatives during the public comment period to discuss the proposed project, and the Department has noted the tribe's concerns and recommendations. The Department has sought and received input from all entities on the proposed Medical Isotopes Production Project and would welcome any specific suggestions on how this interaction could be improved.

2 The environmental impacts of facility operation presented in this EIS are based on historical operation of reactor facilities and of Mo-99 production using the Cintichem process to produce 100% of the U.S. demand. The Nordion facility uses a different type Mo-99 production target and a different isotope separation process and generates higher levels of waste than the Cintichem process. DOE believes that the impacts as presented in the EIS are credible, but conservative, estimates of the consequences of the proposed alternatives.

The Department cannot provide "absolute assurances" that pollution problems would not arise as a result of this project. However, the Department would conduct all production and transportation activities in accordance with applicable and environmental, safety and health regulations. The Department would also implement appropriate environmental monitoring measures to minimize the probability and potential impacts of uncontrolled radiation release to the environment.

3 Any shipments of radioactive material that might occur as a result of the Medical Isotopes Production Project at SNL/NM would be conducted in accordance with Federal and state standards for transportation of radioactive materials. The shipment of radioactive wastes resulting from the proposed production of Mo-99 would be merged with the overall site shipments of waste to the waste site. Detailed planning for transportation, public interactions, and emergency response procedures for shipments are within the scope of site-level waste disposal environmental impact statements. Appropriate planning for routing of these shipments and contingencies for emergency response in cooperation with state, local, and tribal governments would be in place prior to removing materials related to this proposed project from the site.

4 Mr. Sanchez asked questions of the panel at the Albuquerque meeting and was provided responses at the meetings. Mr. Sanchez did not offer any formal comments for the Department to respond to in this document.

5 Comment noted.

State of Idaho
OVERSIGHT PROGRAM
IDAHO NATIONAL ENGINEERING LABORATORY • 800/232-4635
Department of Health & Welfare
PHILIP E. BATT
Governor
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1410 N. Hilton • Boise, ID 83706 • 208/334-0498 • (FAX) 208/334-0429
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February 8, 1996

Mr. Wade Carroll
EIS Project Manager
Medical Isotopes Production Project (NE-70)
U.S. Department of Energy
19901 Germantown Road
Germantown, Maryland 20874-1290

RE: State of Idaho Comments: Draft Environmental Impact Statement for the Medical Isotopes Production Project: Molybdenum-99 and Related Isotopes, DOE/EIS-0249D

Dear Mr. Carroll:

Thank you for the opportunity to comment on the above referenced document. Our comments are both general and specific. Attached is a copy of Governor Batt's testimony that was read into the record of the January 17th public meeting in Idaho Falls.

General Comments

1 Based on the information presented in the EIS, a strong case is made for the use of the Power Burst Facility at the INEL rather than the preferred alternative (target fabrication at LANL and isotope production at SNL/NM). The estimated preparation/facility modification cost is lowest at INEL among the proposed alternatives, and estimated annual operating cost is lowest at INEL (tab. 5-52, p. 5.100). "The planned facility modifications at SNL/NM are the most extensive required at any site..." (p. 5.2, para. 5). Also, the INEL has considerable isotope production experience; SNL/NM has none. Boron Neutron Capture Therapy development may also take place at the Power Burst Facility which could result in further cost savings that are not reflected in the cost analysis of the various alternatives.

2 As the isotope production described in this document will essentially start from scratch, DOE has the opportunity to build in a strong waste minimization component. Where possible, waste generation should be eliminated; where that is not possible, any waste produced should be capable of being reused or recycled. Any remaining waste should be of such a nature as to be easily treated and disposed of. As isotope production proceeds, additional opportunities for waste minimization should be examined as they are discovered.

Investigate • Evaluate • Report

3 As DOE's position is that domestic production of Mo-99 should, in the long term, be undertaken by the private sector, an effort should be undertaken by the Department to involve a private company or companies in Mo-99 production. A long-term goal of turning over Mo-99 production to the private sector using leased DOE facilities could also be incorporated. As pointed out in the first paragraph on page 3.48, early privatization might be easiest at the INEL if the BNCT project, also slated for the PBF reactor, is allowed to proceed.

Specific Comments

4 P. 4.57, para. 5

"The climate and meteorology of the (Oak Ridge) site are typical of a high desert plateau..." This is, of course, incorrect.

P. 4.73, para. 1

Idaho Falls should be added to the list of nearby communities.

P. 4.83, para. 1

"Neither INEL nor any of the surrounding counties is designated as a nonattainment area..." Portions of Bannock and Power Counties, within about 50 miles of INEL facilities, are designated as a nonattainment area for PM_{10}.

P. 4.90, para. 6

"Major utility systems serve the INEL site. These systems include water, sanitary sewer, and natural gas pipelines." The INEL site is not served by any municipal sewer lines, nor by natural gas pipelines.

P. 4.92, para. 1

The Experimental Breeder Reactor II is no longer operating, and, therefore, will no longer provide electrical power.

P. 4.92, para. 2 and 3

Annual electricity usages (217,000 at INEL and 31,500 for facilities in Idaho Falls) should be in units of megawatt-hours (MWh), not megawatts (MW).

P. 5.80, para. 5

5 The one paragraph included in this document concerning the mitigation measures that could be taken with regard to this project's impacts is inadequate. A greater effort could and should be made to identify and describe possible mitigation measures.

Should you have any questions regarding the State's comments you may contact Alan Merritt of this office at (208) 528-2600.

Sincerely

Robert N. Ferguson

Robert N. Ferguson
Administrator

enclosure

cc: Ann Dold, Manager
Alan Merritt, Environmental Scientist
Jerry Downs, Environmental Scientist
Kathleen Trever, Deputy Attorney General
Jeff Schrade, Special Assistant to the Governor
Senator Larry Craig
Senator Dirk Kempthorne
Representative Mike Crapo
Representative Helen Chenowith
Delbert Farmer, Chairman, Ft. Hall Business Council
File- 20.0 NEPA-EIS miscellaneous

OFFICE OF THE GOVERNOR

P.O. BOX 83720
BOISE 83720-0034

PHILIP E. BATT
GOVERNOR

(208) 334-2100

Governor Phil Batt

Testimony prepared for delivery
at the
U.S. Department of Energy
Idaho Falls, Idaho
hearing on the

Medical Isotopes Production Project: Molybdenum-99 and Related Isotopes Draft Environmental Impact Statement

January 17, 1995

To those gathered in Idaho Falls today, I regret that I cannot be there with you. I certainly extend my best wishes to you all.

Let me state my position clearly -- I fully support the effort to produce medical isotopes at the Idaho National Engineering Laboratory.

INEL has an available a reactor that is uniquely qualified to produce these important medical products -- the Power Burst Facility. I support bringing such production on line.

The Power Burst Facility can be started for significantly less cost than any other facility being considered in the Draft Environmental Impact Statement. For this reason and the others outlined in this testimony, PBF at INEL is clearly the facility the DOE should chose to begin the production of radioisotopes.

For far too long this nation has relied on Canada and, to a lesser extent, Europe, to supply the medical isotopes America needs. The time has come for this nation to take care of our own. I commend the Department of Energy for identifying this vital national need. I also commend the DOE for identifying INEL as a possible location for the production of these important products.

I am concerned, however, that the Draft Environmental Impact Statement indicates that the DOE is only looking for backup capability to provide 10 to 30% of the United States Molybdenum-99 (Mo-99) needs. In the final EIS, the DOE should revise the objective and raise the standard. The goal should be to provide 100% of American needs -- and maybe more.

The case for this position -- to provide for 100% of production needs -- is clearly made by the Draft EIS. The document plainly states that if the Canadian reactors were shut down, European sources could only provide "only a portion of U.S. demand." The statement also notes that until a backup production facility is brought on line which is capable of producing 100% of American needs, our nation is "vulnerable to an interruption in the supply of this important isotope." (Draft EIS Summary, page V.)

The case is clear. The United States needs to have the capability for full production of these important isotopes. PBF can fulfill that need.

As the DOE looks to meet the needs of our nation, the Department should also look beyond our nations' border. It is not enough to just satisfy the needs of American customers. The DOE should also begin searching out foreign markets for this important American product. Now is the time to begin.

Once again I commend the Department for identifying the need to produce medical isotopes in the United States. I certainly hope that the DOE will choose the Power Burst Facility at INEL for the production of these important materials.

Responses to Comment Letter C086

1 The Department recognizes that the estimated cost of the INEL alternative is lower than that of the preferred alternative; however, the uncertainties associated with the estimated cost of the INEL alternative are higher than for the preferred alternative. If the Department decides to proceed with the proposed action, the information presented in the EIS (including the cost data), the operational readiness of facilities, and other programmatic factors will be considered in the final selection of facilities for Mo-99 production.

As stated in Table 3-2, the INEL, LANL, and ORNL sites all have significant isotope production experience.

The Idaho Brain Tumor Center (IBTC) has informed DOE of its interest in coordinating its efforts with those of DOE; however, IBTC has not submitted any plans for coordinating reactor conversion activities, nor has it made a formal proposal to DOE. In addition, the Department understands that IBTC is investigating the possibility of using other facilities for boron neutron capture therapy (BNCT) and that other reactors under consideration for this project may be usable for BNCT. If the Department decides to proceed with a production alternative for this proposed project, it would welcome a proposal from IBTC for dual use of the reactor facility selected.

2 The Department agrees with the commentor and would establish strong waste minimization programs for the Medical Isotopes Production Project at any of the sites. Many of the sites already have strong waste minimization programs that the proposed project could be incorporated into.

3 Private U.S. production of Mo-99 could be accomplished by privatization of a DOE operation or by a separate initiative by the private sector. The process of privatization is not part of this proposed action. The Department published a Notice for Expression of Interest in the *Federal Register* in December 1995 to solicit concepts from private industry for privatization of DOE isotope activities. Businesses interested in pursuing Mo-99 production have been invited to respond to this solicitation. If the Department decides to implement the action proposed in this EIS and if concepts on privatization of Mo-99 production received from the private sector are promising, DOE would proceed with a request for proposals to facilitate privatization on a competitive basis.

4 Changes have been made to Section 4 as appropriate.

5 Mitigation measures are necessarily discussed in a generic fashion in the EIS because many aspects of the proposed action are not known in detail. After DOE makes its final decision on whether to implement the Medical Isotopes Production Project and at which site (if any) it should be located, a mitigation action plan would be developed if necessary to address site-specific environmental impacts of the project's construction and operational activities. Mitigation measures, if any, are not expected to be extensive, given the low level of environmental impacts of any type associated with the alternatives considered in this EIS.

COMMENT

ON THE
U.S. DEPARTMENT OF ENERGY
DRAFT ENVIRONMENTAL IMPACT STATEMENT
FOR THE
MEDICAL ISOTOPES PRODUCTION PROJECT

PLEASE PRINT CLEARLY

NAME: Steve Yanicak
STREET ADDRESS: RR 5 Box 394-B
CITY Espanola STATE NM ZIP CODE: 87532-9515
TELEPHONE: 455-1026

COMMENT: I think it's very important to
1 start up the production of these isotopes in the U.S.
-- With the downsizing and condensing of the DOE complex
it makes more sense to do the entire production at LANL.
There are certain environmental concerns with the CMR,
2 but with the Lab* currently cleaning up release sites
connected with its previous 50 yrs of operations —
If the lab can commit (and convince residents and activists
alike) to future operations having minimal impacts
on the environment* — honestly! — I don't think this
project would be such a hard sell to northern New Mexico —
Let's not continue to make the hung-up mistakes
of the past if LANL is chosen for this task along
with its' other future mission responsibilities —

* The EIS pretty much convinces me that there will be little
human health effects

SIGNATURE Stephen Yanicak
DATE 2/1/96

Responses to Comment Letter C087

1 Comment noted.

2 DOE believes the EIS addresses all required and significant types of potential environmental impacts associated with the proposed Medical Isotopes Production Project. The EIS analysis indicates that these potential impacts would be minimal for all categories of resources.

PO Box 1417
Los Alamos, NM 87544

February 1, 1996

Mr. Wade Carroll, MIPP-EIS Document Manager
U. S. Department of Energy
Office of Isotope Production and Distribution, NE-70
19901 Germantown Road
Germantown, Maryland 20874

Dear Mr. Carroll

The following questions/comments result from my review of the Draft Environmental Impact Statement for Medical Isotopes Production Project: Molybdenum-99 and Related Isotopes.

1 Will the record of decision address those actions that the DOE may take to encourage or facilitate commercial molybdenum-99 production beyond simply curtailing their own production when a domestic commercial supplier comes on-line?

2 On page C.2 is listed the site-specific parameters for the radiologic calculations. From this listing it is unclear whether the radiological calculations for the Omega West Reactor take into account that the reactor itself is in a canyon bottom and the MEI is located on the mesa-top?

3 From the information in table S-2 there appears to be a wide variation in the person-rem/yr dose estimates for target irradiation and processing from facility to facility. How does the principle of ALARA enter into the decision process for the recommended alternative or the record of decision?

4 The D&D of Omega West seems to be in planning stages at this time. Are constraints in place to prevent the initiation of D&D on Omega West pending the issuance of the record of decision?

The CMR upgrade EIS/no-EIS decision date on page 1.5 needs updating.

5 Is it anticipated that the sale of molybdenum-99 will be cover all operational costs of production or will a continuing subsidy of these costs by DOE be necessary? There may be some concern that if such a subsidy were reduced during the life of this project due to budget constraints that shortcuts of proper environmental, safety, and health procedures may result.

6 I recall that at one public meeting the possibility that the selected reactor may also be used in other capacities, such as neutron activation analysis services or non-medical isotope production, in parallel with its production of the indicated medical isotopes. Will the EIS or record of decision speak to this issue? If the EIS or record of decision fails to address these alternative uses, are such uses precluded without utilizing the NEPA process?

Sincerely yours,

Donivan Porterfield

Responses to Comment Letter C088

1 Private U.S. production of Mo-99 could be accomplished by privatization of a DOE operation or by a separate initiative by the private sector. The process of privatization is not part of this proposed action. The Department published a Notice for Expression of Interest in the *Federal Register* in December 1995 to solicit concepts from private industry for privatization of DOE isotope activities. Businesses interested in pursuing Mo-99 production have been invited to respond to this solicitation. If the Department decides to implement the action proposed in this EIS and if concepts on privatization of Mo-99 production received from the private sector are promising, DOE would proceed with a request for proposals to facilitate privatization on a competitive basis. Since privatization of Mo-99 production is not part of the proposed action for this EIS, the Record of Decision will not have any substantial discussion on privatization.

2 Although the Omega West Reactor (OWR) is located in a canyon, the stack by which air is exhausted from the facility actually sits on top of the adjacent mesa. The relative difference in height between the receptor and the top of the stack was accounted for in the dose estimates presented in the EIS.

3 The ALARA (as low as reasonably achievable) process implemented by DOE to minimize radiation exposures to workers and to the public is a mechanism by which the costs and availability of "reasonably achievable" measures to reduce such exposure are evaluated relative to the benefits of the lower exposure. The ALARA process would not necessarily require DOE to select an alternative that would result in the lowest radiological exposure. However, if DOE decides to proceed with the action proposed in the EIS, the ALARA program would be implemented at the selected site. DOE will consider potential radiological consequences along with other factors in making its decision.

4 The decontamination and decommissioning activities that were planned for OWR have been indefinitely stopped, pending the Record of Decision. The information in Section 4 on the Chemistry and Metallurgy Research Facility upgrade has been updated.

5 DOE plans to sell Mo-99 at prevailing world market prices; thus, the costs incurred may or may not be fully recovered, depending on the level of demand. Full recovery of operating costs is anticipated at about 30% to 40% of U.S. demand.

If the Department decides to pursue this project, it will operate the production facilities in accordance with all applicable DOE Orders and other environmental, safety, and health requirements.

6 The Department may recognize the potential for other uses in the Record of Decision for this EIS. However, additional NEPA review(s) may be necessary to implement such other uses.

G. Ross Darnell, 339 East 49th South, Idaho Falls, Idaho 83404

February 1, 1996

Mr. Wade Carroll, MIPP-EIS Document Manager
U.S. Debarment of Energy
19901 Germantown Road
Germantown, Maryland 20874

Dear Mr. Carroll:

My subject is: Medical Isotopes Production Project: Molybdenum-99 and Related Isotopes. Draft Environmental Impact Statement.

Thank you for bringing your team to Idaho Falls. The meeting was conducted in a highly professional manner throughout.

The EIS was essentially the same for all four potential sites. However, the Annular Core Research Reactor at Sandia National Laboratory in New Mexico is the "preferred alternative" site, even though it is more expensive.

There is one solid reason that it should be the "disqualified alternative." Specifically, the Department of Defense has first claim to the Sandia reactor. In reality, DOD can take-over the
1 Sandia reactor whenever it wants. If that happens, it would likely be disastrous for America for the following reasons: Canada supplies 100% of our Molly 99 today, but when we start creating our own, Canada will likely express little sympathy if we suddenly lose our capability to produce Molly-99. Also, Canada may establish other markets for their Molly-99 that will
2 logically receive priority over the U.S. Or Canada may shut down and buy from us. Thus, America must have the capability to continuously manufacture Molly-99 to *at least 100% of its needs*.

3 If the DOD will not officially release its hold on the Sandia reactor, then the Sandia reactor must be disqualified.

Even if the DOD does officially release its hold, it is a fact that military requirements will prevail in national emergencies and DOD can take over the reactor regardless of prior commitments. Therefore, there really is no logical alternative but to disqualify the Sandia reactor. Or, if essential to keep it an option for some legal reason, then classify it as the "least qualified alternative."

Since the Power Burst Facility (PBF) in Idaho could be used simultaneously for the Molly-99 effort and the Boron Neutron
4 Capture Therapy for treatment of tumors, PBF is obviously the best and least expensive medical choice for Americans.

Sincerely,

G. Ross Darnell
(208) 529-8699 or 456-2729

Responses to Comment Letter C089

1 The Annular Core Research Reactor (ACRR) is a DOE-Office of Defense Programs facility, not a Department of Defense facility. The Office of Defense Programs within DOE has no current or foreseeable need for the ACRR. That Office has requested that, if the ACRR is selected for this mission, the capability of the reactor to perform defense-related experiments be retained in case of an emergency. The reason the possible diversion of the ACRR for defense use is highlighted in the EIS is that, in an emergency, the ACRR is more likely than the other reactors considered in the EIS to be used for defense purposes. However, the Department has determined that the probability of needing the ACRR for defense purposes is sufficiently low to preclude disqualifying the reactor from consideration.

2 The Department is not proposing to replace the Canadian reactor or to compete with Nordion. Instead, the Department is proposing to establish a backup to the Canadian reactor, to act as an "insurance policy" in case that reactor unexpectedly shuts down. If the DOE decides to pursue this project, it will operate its Mo-99 facilities at full production capability only in the event of a Mo-99 supply shortage.

If it becomes apparent that the Canadians are going to be unable to build even one new production reactor, DOE will assess the world supply situation at that point and may investigate the possibility of meeting Mo-99 demands beyond the U.S. requirements.

3 If the ACRR is selected for the proposed project, its mission would be changed from a defense mission to an isotope production mission.

4 The Idaho Brain Tumor Center (IBTC) has informed DOE of its interest in coordinating its efforts with those of DOE; however, IBTC has not submitted any plans for coordinating reactor conversion activities, nor has it made a formal proposal to DOE. In addition, the Department understands that IBTC is investigating the possibility of using other facilities for boron neutron capture therapy (BNCT) and that other reactors under consideration for this project may be useable for BNCT. If the Department decides to proceed with a production alternative for this proposed project, it would welcome a proposal from IBTC for dual use of the reactor facility selected.

Feb. 7, 1996
1734 Horn Ave.
Richland, WA 99352-2314

Mr. Wade Carroll
EIS Project Manager
Office of Nuclear Energy, Science
and Technology (NE-70)
U.S. Department of Energy
19901 Germantown Road
Germantown, MD 20874-1290

Dear Mr. Carroll:

Thank you for the opportunity to comment on the draft Environmental Impact Statement "Medical Isotopes Production Project: Molybdenum-99 and Related Isotopes", DOE/EIS-0249D dated Dec. 1995. Comments on the EIS are listed below:

1 1. Pg. V and Sect. 3.0 (pg 3.1). Two rather than a single reactor should be made operational by DOE for Mo-99 production for the near term (where "near term" means production over the next five to ten-years according to the definition on page 2.2). The goal of a reliable supply will only be achieved if the U.S. has two reactors. As discussed in the Summary section and in Sections 3.0 and 2.0, the U.S. is subject to substantial risk of interruption of our Mo-99 supply since we are currently dependent on a single 40-year old Canadian reactor that will not be operated past the year 2000. Also, if the Canadian reactor were to develop a major problem the reactor would likely be permanently shut down terminating this supply (pg. 3.5) and leaving no other supply source capable of meeting U.S. needs (p. v).

No decision or funding has resulted from the current discussions by the Canadians on new reactors for Mo-99 production (pp IX and X). In addition, previous discussions by the Canadians on developing new supplies failed and were terminated. Thus, there is no guarantee that the Candians will build a replacement reactor in a timely manner or ever build a new facility. Consequently, the U.S. must have two operational facilities for Mo-99 production in

2

1 order to assure a reliable supply. Due to the lead time to make facilities operational, the decision to have two U.S. facilities for Mo-99 production must be made now.

2 2. Pg. XII and Sect. 3.1.1 (pg 3.1). The criterion that "Periodic scheduled maintenance outages must be reliably accomplished in ≤ 6 days" should be deleted. With two U.S. reactors available to produce Mo-99 (commercial-D) outage schedules can be coordinated, eliminating the need for a 6-day requirement. If the Canadians build a single new reactor and if the U.S. has only one reactor that is acting as a backup, the outage schedules can also be coordinated. If the single non-Canadian reactor had an unplanned outage, the U.S. reactor would start immediately to produce Mo-99 by virtue of being maintained in a mode of readiness for operation. Consequently the 6-day requirement should be deleted.

3 3. Pg xi and Sect. 3.4.1.6 (pg. 3.56). The reasons given for dismissal of FFTF are not valid: "Facility size (too large), lack of compatible missions, operating characteristics" (pg xi). It is true that FFTF is too large to economically produce Mo-99 as a single mission as stated on page 3.56. However, FFTF is undergoing formal DOE review to evaluate use of the facility to produce tritium and a private consortium has proposed using FFTF for both tritium production and making numerous isotopes. A formal decision is expected in the near future. These developments occurred subsequent to preparation of the draft EIS. Size is a positive factor for FFTF in that a number of missions can be compatible and carried out at the same time reducing costs.

With modification, Mo-99 could be produced continuously and removed from FFTF without reactor shutdown. FFTF has demonstrated high reliability and long periods at power. Planned outages can be coordinated with another Mo-99 production facility to avoid supply interruption.

Remaining facility lifetime significantly exceeds most
other available facilities and FFTF has many safety
3 features including a reactor containment building.
Considering all factors, FFTF is a good choice for
production of Mo-99 and other isotopes.

4. Sect. 3.1.1 (pg. 3.1). The minimum acceptable remaining
4 facility lifetime should be explicitly stated as one
of the criteria.

5. Sect. 3.3.1.4 (pg. 3.14), Sect. 3.3.2.4 (pg. 3.31), Sect. 3.3.3.4 (pg 3.40),
and Sect. 3.3.4.4 (pg 3.47). The remaining facility lifetime
5 should be stated for the ACRR, OWR, ORRR, and the PBF
in the applicable section.

6. Sect. 3.3.2 (pg. 3.29) and Sect. 3.3.2.9 (pg. 3.38). The leak
of primary cooling system water from the OWR due to
6 high sulfer content of the soil and repair of the leaking pipe
are discussed (pgs 3.29 and 3.38). However, corrective
action to prevent reoccurrence of the leak is not addressed.

7. Sect. 3.3.2 (pg. 3.29). The text discusses OWR restart
7 under DOE Order 5480.31 but the title of the order "Startup
and Restart of Nuclear Facilities" could not be located
in the text or the list of references. (Suggestion)

8. Sect. 3.3.2.4 (pg 3.31). The statement is incorrect that
"Until it was shutdown in 1992, the Omega West Reactor had
been operated by LANL since 1956 without an accident or
major operational incident." According to a letter from
Steven M. Blush of DOE Headquarters dated Dec. 15, 1992, the
8 OWR was shut down by DOE Dec. 1992 due to significant
safety problems (overpower incident, control rod mis-
activation incident, and aging). There have been eight
incidents of safety significance involving the OWR in
recent years, some of which were due to defective
design or aging. These incidents were: Reactor cooling
water leak due to corrosion or bad welds (Jan. 1993),
reactor overpower incident due to operator error and

4.

and inadequate design (December 1992), two instances in
which eight control rods dropped without an operator
command (August 1992), reactor overpower incident
due to an incorrectly calibrated instrument, an open
beam port during reactor operations which could have
8 resulted in significant personnel exposures, a radiation
detector alarm above the reactor was not turned on
while the reactor was operating, and a reactor start-
up was initiated with some of the control rod latches
not locked.

9. Sect. 3.3.2.9 (pg 3.38). Have all design-related corrective
actions to prevent reoccurrence of previous incidents
involving or related to design been addressed in
the required facility modifications for the OWR?

10. Sect. 4.1K (pg. 4.1) and Sect. ~~4.8~~ 4.1.6.3 (pg. 4.8). The statement is
made that statistical studies show that a damaging
9 earthquake occurs in the Albuquerque area every 100 years.
What is the seismic design of the ACRR?

11. Sect. 5.15.2.2 (p. 5.55) and Sect. 5.15.1.3 (pg. 5.48). Table 5-29
10 on page 5.55 for the OWR radionuclides does not include
a number of the radionuclides that are shown in
Table 5-22 on page 5.48 for the ACRR.

12. Sect. 5.15.2.2 (pg ~~5.54~~ 5.56). The offsite doses are given in
Table 5-30 (page 5.56) at 1300 m; however, due to the
11 45 m stack the peak doses would occur at a larger
distance. Was this effect taken into account in
reporting the maximum doses?

13. Sect. 6.0 (pg. 6.1). DOE Orders 5480.28 "Natural Phenomena
12 Hazards Mitigation" and DOE 5480.30 "Nuclear Reactor Safety Design
Criteria" should be addressed in Sect. 6.0 and elsewhere in the EIS.

It is hoped that the above comments will be helpful in prepar-
ing the Final EIS.

Sincerely,
James N. Paglieri
James N. Paglieri

Responses to Comment Letter C090

1 The Department is not proposing to replace the Canadian reactor or to compete with Nordion. Instead, the Department is proposing to establish a backup to the Canadian reactor, to act as an "insurance policy" in case that reactor unexpectedly shuts down. If the DOE decides to pursue this project, it would operate its Mo-99 facilities at full production capability only as necessary to address a Mo-99 supply shortage.

At this time, it appears that the Canadians will ultimately proceed with their project to construct two new reactors for Mo-99 production. If it becomes apparent that the Canadians are going to be unable to build even one new production reactor, DOE will assess the world supply situation at that point and may investigate the possibility of meeting demands beyond the domestic requirements.

2 The Department is proposing to establish a production source that could, if necessary, produce the entire U.S. supply of Mo-99 on its own. The production facility would operate at full capacity only when the Canadian reactor was shut down or the Canadian supply was otherwise unavailable. Therefore, reactor shutdowns could not be coordinated. The 6-day requirement is necessary to ensure that the Department's production facility could, on its own, provide a reliable, continuous supply of Mo-99.

3 As discussed in Section 3.4.1.6, the Fast Flux Test Facility (FFTF) cannot meet the selection criteria for a Mo-99 production facility. If the FFTF is restarted in response to the proposal from Advanced Nuclear and Medical Systems (ANMS), the private consortium may wish to produce Mo-99 in the FFTF, and DOE would review its Mo-99 production plans and modify them if appropriate, recognizing that the FFTF cannot provide a continuous supply of Mo-99.

4 The Department is proposing to meet a near-term "window of vulnerability" in the supply of Mo-99. The near term has been defined in the EIS as 5 to 10 years. Each of the alternative facilities is expected to have a remaining lifetime of at least 10 years, as discussed below. The oldest of the four reactors under consideration, the Omega West Reactor (OWR), has had a lifetime study performed. The OWR study indicated that the facility could operate for at least an additional 10 years. The other facilities have not had lifetime studies performed. Unlike commercial reactors, which generally have lifetimes of about 40 years, lifetimes on open pool research reactors (such as the four reactors under consideration) are somewhat undefined. Lifetimes for commercial facilities are dictated by two general issues, those being fast fluence embrittlement of the pressure vessel and insulation degradation of the major safety-related electrical cables. Fast neutron fluence on steel will embrittle the metal and make the pressure vessel no longer capable of possessing the design safety margins required for pressure vessels. This problem does not exist in a pool or tank type reactor that is not pressurized. The water distances between the core and the pool or tank walls are such that very little fast flux reaches them, greatly assuaging, or completely abating the embrittlement problem. Small research reactors have small pumps and motors; generally, the current required for their operation does not generate the heat that degrades the cable insulation. Also, cables in small research reactors are seldom laid close together in trays; thus, the cables can be cooled by circulating air. Commercial reactor cables carry large currents and are closely bundled and therefore degrade much more rapidly.

5 Please see response to C090-4 above.

6 Aggressive remediation activities have been undertaken. The repair of the pipe is not considered to be a technical obstacle to reactor restart. The work was included in the Omega West Reactor (OWR) budget and schedule and the Department believes the figures are reasonable. Two studies have been conducted by LANL that review and analyze the OWR leak cause and remediation. These reports are: *Phase I: OWR Reactor Coolant Loss, Diagnosis, and Surveillance*, and *Stress-Assisted, Microbial-Induced Corrosion of Stainless Steel Primary Piping and Other Aging Issues at the Omega West Reactor*.

7 The reference has been added to the reference list. (DOE Order 5480.31 has been updated to Order 425.1).

8 Most of these items are not major incidents. The overpower incident was the result of a slow period which resulted in a reactor overpower scram. The reactor behavior was in accordance with design and was not a major operational incident. Unplanned control rod drop is unusual but safe. During the open beam port occurrence, no one was exposed. If someone had been, it would have been a major incident. This did not happen. Startup without the control rod latches locked causes the reactor to remain shut-down, again a safe situation.

9 Although significant seismic activity at any alternative site is a relatively rare occurrence, differences in potential for facility damage are reflected in the seismic safety requirements for facility construction at each location. Because all facilities or modifications would meet the seismic safety requirements appropriate to their locations, the level of risk associated with potential seismic damage to medical isotope production facilities is expected to be similar for all EIS alternatives. The Annular Core Research Reactor (ACRR) High Bay was constructed in the 1960's and satisfied building criteria at that time. Modifications to the structure in 1978 also satisfied the Uniform Building Code (UBC) current at the time. Modifications to the ACRR facility will be designed and constructed in compliance with the current UBC and DOE Order 420.1.

10 The difference in estimated releases for the two reactors reflects the different scenarios assumed for the design basis accidents at these facilities. The ACRR core design is substantially different from the other reactors, resulting in different types of fuel damage assumed for the maximum reasonably foreseeable accidents. In some cases, the OWR releases group radionuclides by class, and the consequences were modeled using a representative radionuclide that would maximize the dose from the entire group. For ACRR, the individual radionuclides are identified to a greater extent; however, this is not expected to change the conclusions in the EIS regarding the relative safety of the facilities.

11 Dispersion of emissions from the OWR during a maximum reasonably foreseeable accident did account for the 45-m facility stack height. This receptor location was consistent with that used by LANL for evaluating maximum impacts at this facility. It should be noted that the OWR is situated in a canyon, which changes the expected dispersion in the case of a radioactive release.

12 Section 6.1 of the EIS lists the more significant DOE requirements that would apply to facilities utilized in any of the alternatives, including DOE Order 5480.30. Section 6.1 has been revised to include DOE Order 5480.28.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 6
1445 ROSS AVENUE, SUITE 1200
DALLAS, TX 75202-2733

February 9, 1996

Mr. Wade Carroll
MIPP-EIS Document Manager
U.S. Department of Energy
Office of Isotope Production
and Distribution, NE-70
19901 Germantown Road
Germantown, Maryland 20874

Dear Mr. Carroll:

In accordance with our responsibilities under Section 309 of the Clean Air Act, the National Environmental Policy Act (NEPA), and the Council on Environmental Quality Regulations (CEQ) for Implementing NEPA, the U.S. Environmental Protection Agency (EPA) Region 6 office in Dallas, Texas, has completed its review of the U.S. Department of Energy (DOE) Draft Environmental Impact Statement (DEIS) for Medical Isotopes Production Project for the purpose of establishing a domestic source to produce molybdenum (Mo)-99, a medical isotope used thousand of times daily in medical diagnostic procedures in the United States.

The DOE is pursing the Medical Isotopes Production Project in order to ensure a reliable supply of Mo-99 to the United States (U.S.) medical community as soon a practicable. The near term goal is to provide over the next 10 years a backup capability to production in Canada by supplying a baseline production level of 10 to 30 percent of the current U.S. demand. Under the preferred alternative, the Chemistry Core Research Reactor and Hot Cell Facility at Sandia National Laboratory at Albuquerque, New Mexico, would be used for the production of the medical isotopes.

According to the DEIS analysis, under the proposed operating procedures, radiological doses to the public and to involved and uninvolved workers caused from the fabrication, product processing and transport of the isotopes would be well within regulatory limits established to protect human health. The analysis in the DEIS indicate no significant difference in the environmental impacts among the alternatives considered. Community impacts from project employment are projected to be minimal. Impacts to cultural, ecological and other natural environmental features would be negligible for any of the alternatives because existing facilities would be used. Accordingly, the DEIS concludes that no health impacts are anticipated for any reasonable duration of the project.

The following comment is offered for your consideration in the preparation of the Final EIS:

1 For the Annular Core Research Reactor alternative, at Sandia National Laboratories in Albuquerque, doses from air emissions of radionuclides were estimated to the maximum exposed individual, who is identified as being located 5.4 km north of the facility (Sec. 5.7.1 on p. 5.10). However, an application for approval to modify the facility by constructing this project was submitted to EPA as required by 40 CFR 61, Subpart H. In that application, dated March 30, 1995, the maximum exposed individual was identified as being located at 1,610 meters north-west (NW) of the facility. The respective estimated annual maximum doses are 0.17 millirem, and 5.2 millirems effective dose equivalent. The Final EIS should clarify this discrepancy between the DEIS and the March 1995 application and, if applicable, explain whether or not the individual located at 1,610 meters NW of the facility was considered in the analysis. If so, the Final EIS should discuss the effect on the level of anticipated impacts as discussed in the DEIS.

EPA classifies your DEIS and proposed action as "LO," i.e., EPA has "Lack of Objections". However, we are requesting some additional information for clarification. Our classification will be published in the Federal Register according to our responsibility under Section 309 of the Clean Air Act, to inform the public of our views on proposed Federal actions.

We appreciate the opportunity to review the DEIS. We request that you send our office one (1) copy of the Final EIS at the same time that it is sent to the Office of Federal Activities (2251A), EPA, 1200 Pennsylvania Avenue, N.W., Washington, D.C. 20460.

Sincerely yours,

Michael P. Jansky, P.E.

Michael P. Jansky, P.E.
Regional 309 Review Coordinator

Responses to Comment Letter C091

1 The distance used for the offsite receptor evaluation at SNL/NM represents the location of a full-time resident who receives the highest potential exposure to facility emissions. In some cases, meteorological conditions result in the maximum offsite receptor location being other than the nearest possible access point. Also, other locations to which the public has access may not be residential areas, and the exposures at these locations would be substantially lower than at a permanent residence because they are not continuously occupied.

The location typically used for permitting and compliance calculations at SNL/NM (1610 m NW) is within the Kirtland Air Force Base boundary. This location is not a full-time residence and would not be accessible to the general public and, therefore, was not used in this EIS as the location of the maximally exposed individual. The 1610 m NW location was, however, used in the EIS to calculate the dose for an onsite worker (see Table 5-3 and Table C-1 in Appendix C).

Richard Taylor
1052 Atlantic St.
Idaho Falls, Idaho
83404

I would like to state to you
1 That I support the medical Isotope
Production Project and I believe that
this project should be at the PBF
Facility at the INEL.

The proposed dual use and
2 the fact that the PBF Reactor is
under a private sector I believe out
weigh the differences in start-up dates

please consider the INEL PBF
facility as the prime Location for
molybdenum-99 Production

Thank You,
Richard L Taylor
1/17/96

Responses to Comment Letter C092

1 Comment noted.

2 Private U.S. production of Mo-99 could be accomplished by privatization of a DOE operation or by a separate initiative by the private sector. The process of privatization is not part of this proposed action. The Department published a Notice for Expression of Interest in the *Federal Register* in December 1995 to solicit concepts from private industry for privatization of DOE isotope activities. Businesses interested in pursuing Mo-99 production have been invited to respond to this solicitation. If the Department decides to implement the action proposed in this EIS and if concepts on privatization of Mo-99 production received from the private sector are promising, DOE would proceed with a request for proposals to facilitate privatization on a competitive basis.

BEAUTY FOR ALL SEASONS.

John V. Galazin
President/CEO

January 17, 1996

Department of Energy
Moly 99 Hearing
Idaho Falls, Idaho

To whom it may concern;

1 Beauty For All Seasons, Inc., wholeheartedly endorses and supports the DOE's selection of the Idaho Falls PBF Facility for the future production of Moly 99 medical isotopes. Since the DOE cutbacks over the last few years, the city of Idaho Falls has experienced a significant decrease in economic purchasing power of residents in Idaho Falls and neighboring communities. This translates into lower purchases of cosmetics and skin care for Beauty For All Seasons products.

While the company has experienced an increase in sales due to market expansion in 36 countries worldwide, Idaho Falls, the headquarter city for our business has experienced a decrease in sales in the local market that coincides with DOE job cutbacks.

2 The selection of Idaho Falls PBF Facility for medical isotope production will increase employment opportunities, improve economic base not only directly through people employed at the facility, but also through the ripple effect of increased visitors for technical and medical purposes.

Beauty For All Seasons strongly endorses DOE's selection of Idaho Falls for Moly 99 production in order to help counterbalance the negative economic impact experienced by the community due to DOE layoffs and cutbacks in Eastern Idaho.

Sincerely,

John

John V. Galazin
President, CEO

P.O. Box 51810
360 B Street
Idaho Falls, ID 83405-1810
Telephone # (208) 525-7800
FAX # (208) 525-7880

Responses to Comment Letter C093

1 Comment noted

2 The anticipated socioeconomic impacts of the proposed project are presented in Section 5.3. The number of technical and medical visitors to the region as a result of the Mo-99 mission is expected to be small at any of the alternative sites. All sites have the possibility of additional missions.

EASTERN IDAHO ECONOMIC DEVELOPMENT COUNCIL

January 17, 1996

Testimony for the Public Hearing on the Proposed Medical Isotope Production Project
January 17, 1996
Shilo Inn
Idaho Falls, Idaho

Good evening. My name is Daniel Cudaback. I am President and Chief Executive Officer of the Eastern Idaho Economic Development Council. The Council is a non-profit, community based economic development organization supported by nearly 300 for-profit/government contributors and partners throughout eastern Idaho. The Department of Energy has recognized the Council as the single voice for economic development in the region, and has designated it as the community reuse organization for eastern Idaho.

The Council's Board of Directors and various committees are made up of over 30 business and government leaders from around the region, from Pocatello to Rexburg, from the Teton Valley to Arco. The Council's programs are designed both to promote maximum and diversified commercial use of INEL resources, as well as promote diversification of the regional economy away from heavy dependence on the traditional government-driven mission of the site. The proposed isotope production facility under discussion this evening makes sense for INEL on both counts.

1 The INEL and eastern Idaho community can meet or exceed the standards for the four critical factors necessary for isotope supplier success: reliability of supply; product quality; cost competitiveness; and continuous improvement. Existing, as well as readily developable, facilities at the INEL offer unmatched radioisotope capability. Major assets of the INEL include its reservoir of scientific knowledge, its long history of successful radiopharmaceutical production, its in-place professional network, and its environmentally-sensitive "inside the fence" production capability. Yet as important is the community's virtually unanimous support of the project and its ability to effectively address the proposed facility's fundamental location requirements, now and in the future.

EASTERN IDAHO ECONOMIC DEVELOPMENT COUNCIL, INC.
653 NORTH CAPITAL AVENUE · IDAHO FALLS, IDAHO 83402 · PHONE (208) 52?-9914 · FAX (208) 522 3824

1 The Eastern Idaho Economic Development Council strongly supports the Department's Medical Isotope Production Initiative. Further, the Council strongly encourages the Department's close consideration of the INEL as an integral element of Project implementation.

Sincerely,

Daniel Cudaback
President

Response to Comment Letter C094

1 Comment noted.

CITY OF IDAHO FALLS
Office of the Mayor
City Hall
Idaho Falls, Idaho 83405

Linda Milam
Mayor

Testimony for the Public Hearing on the Proposed Medical Isotope Production Project
January 17, 1996, Idaho Falls, Idaho

Good evening. I am Linda Milam, Mayor of the City of Idaho Falls. I appreciate the opportunity to comment on the Draft Environment Impact Statement for the Medical Isotope Production Project which will produce Molybdenum-99 and related medical isotopes.

Each year 13 million medical procedures, 100 million laboratory tests, and 50,000 therapies using molybdenum and related isotopes are conducted in the United States. Each year, 80% of the world's supply of radioisotopes are consumed in the United States. Each year, the availability of radioisotopes becomes more crucial tot he diagnosis and treatment of disease in the United States. The fastest growing segment of the medical isotope market is therapeutic radiopharmeceuticals, including treatment for ovarian, prostate, leukemia, and lymphoma cancers and pain relief for bone cancers. The United States has, by far, the most advanced medical care system in the world.

And yet, this country is subject to the vagaries of commercial, political, geological and weather conditions of other countries to supply the material which is crucial to this sophisticated
1 system. This country does not produce but is an importer of radioisotopes. We must establish this capability in the United States.

The Department of Energy Complex offers unmatched radioisotope production capability. The Idaho National Engineering Laboratory brings a unique mix of scientific
2 knowledge, isotope production experience, facility availability, and an established professional and university network.

I would encourage the Department of Energy to:

1) consider the social benefits of establishing a Molybdenum-99 production capacity in this country;

3 2) consider the economic benefits of building that capacity around established strengths;

3) consider the environmental, economic, and technological benefits of investing in the development of advanced technologies to produce radioisotopes more effectively and efficiently;

4) consider the environmental and economic benefits of building upon the existing isotope production capability, including facility and human resources, such as exist at the INEL;

P.O. Box 50220 • 308 Constitution Way, Idaho Falls, Idaho 83405 • (208) 529-1235 • FAX (208) 529-1148

3 5) consider the environmental benefits of "inside the fence" productions capability, such as exists at the INEL.

4 The decisions to be made on this project will impact all of us, directly or indirectly. Each of us will suffer, either personally or with a loved one, from a cancer or other condition that can be eased or treated with the isotopes produced by a U.S. production facility. The commitment should be made, linkages with private industry and universities should be expanded, and production should begin as quickly as possible.

Responses to Comment Letter C095

1 The Department of Energy is a producer of many radioactive isotopes, including isotopes for use in industrial, medical, and research applications. Regarding the supply of Mo-99, the problem is not that the supply is from Canada (or from any other foreign country, for that matter). The problem is that the entire U.S. supply comes from a single source. It should also be noted that this single source accounts for about 85% of the world supply of Mo-99. If this source were to become unavailable, production facilities in other countries would most likely focus on meeting their own needs first and, in any case, would not be able to meet even half of U.S. demand for Mo-99. Given this supply situation, the Department has proposed establishing a domestic production source to ensure that a reliable supply of Mo-99 is available to the U.S. medical community. If the Department decides to pursue this project and at some later date a reliable domestic supply could be ensured by foreign suppliers, then the Department would phase out its production of Mo-99.

2 In making its decision on the proposed project, the Department will consider factors such as those cited.

3 If the Department decides to proceed with the proposed action, the Department will consider the existing isotope production capabilities and potential environmental impacts arising from medical isotope production at each site. Regarding new technologies for isotope production, all of the production alternatives propose to use the Cintichem process. Research and development of advanced technologies is not within the scope of this proposed action.

4 If the Department decides to pursue this project, work will begin as soon as a Record of Decision is issued.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
New Mexico Ecological Services Field Office
2105 Osuna NE
Albuquerque, New Mexico 87113
Phone: (505) 761-4525 Fax: (505) 761-4542

February 13, 1996

Memorandum

To: Regional Director, Region 2, Albuquerque, New Mexico

From: Field Supervisor, New Mexico Ecological Services Field Office, Albuquerque, New Mexico

Subject: Comments for ER #96-0056, DEIS for the Medical Isotopes Production Project.

This responds to ER 96/0056 requesting comments on the *Draft Environmental Impact Statement* (EIS) *for the Medical Isotopes Production Project* (MIPP): Molybdenum-99 and Related Isotopes (DOE/EIS-0249D). This letter has been sent to Roy Perez by electronic mail under the file name "MIPPDEIS.WPD." The U.S. Fish and Wildlife Service New Mexico Ecological Services Field Office (Service) has reviewed the EIS and offers the following comments:

GENERAL COMMENTS

Four alternatives were presented along with the "no action" alternative. The preferred alternative involves target fabrication at the Los Alamos National Laboratory Chemistry and Metallurgy Research Building in New Mexico and subsequent shipment to Sandia National Laboratories in New Mexico (SNL/NM) for testing, processing, and distribution. The second alternative involves the fabrication, testing, processing, and distribution of medical isotopes entirely from Los Alamos National Laboratory. The third alternative entails a similar process at the Oak Ridge National Laboratory in Knoxville, Tennessee. The forth alternative entails a similar process at Idaho National Engineering Laboratory in Idaho Falls, Idaho. We have restricted our comments to the alternatives proposed in New Mexico.

The natural resources of Sandia National Laboratories were inadequately and
1 inaccurately characterized to sufficiently evaluate the impacts anticipated under the
preferred alternative. The preferred alternative was not rigorously explored and
2 objectively evaluated. The affected environment on or near SNL/NM lands was not
described accurately or with equivalent detail necessary to characterize the
3 environment as were the other sites evaluated. Detailed information about SNL/NM
lands is available (see below) and should be incorporated into the final EIS so that an
environmentally preferable alternative can be identified.

4 The Service concurs that any proposed SNL/NM Annular Core Research Reactor modifications could likely have minimal impact to the local environment. However, other environmental risks associated with the proposed action, including any effluents released into the air, soil, or water, or from vehicular transportation of isotopes should be evaluated relative to potential effects upon natural resources (including nearby wetlands, wildlife habitats) and on surrounding lands managed by Kirtland Air Force Base.

On November 16, 1995, the EIS Project Manager sent a letter requesting a list of endangered, threatened, or candidate species for the project area in New Mexico. Our response was delayed until January 9, 1996, because of the government-wide furlough. We have the following questions:

5 - What new permits will be required for the management of wastes generated?
6 - What is the likely dispersion pattern from discharged effluents and from accident scenarios? Can you quantify (by alternative) the amount of natural resources (wetlands, sensitive species, refuges, national parks, etc.) within the area of concern? Does any alternative have the majority of vulnerable natural resources?
- What injuries might occur to wildlife species exposed to radioactive air emissions and from accident scenarios? How would these potential injuries be measured and mitigated?

SPECIFIC COMMENTS

7 Page 4.13, Section 4.1.9.1 Terrestrial Resources
The cited reference ("U.S. Department of Energy, 1993b"), for wildlife diversity and abundance on lands managed by SNL/NM, does not appear, by title, as though it would provide an adequate source of site-specific information on this subject. If we are in error about this report, please forward photocopies of those sections that detail the timing of wildlife surveys, methods used, and results of the surveys.

Page 4.13, Section 4.1.9.2 Aquatic Resources
The cited reference ("U.S. Department of Energy, 1995d"), for surface water bodies found on SNL/NM, does not appear, by title, as though it would provide an adequate source of site-specific information about surface water bodies on SNL/NM. If we are in error about this report, please forward photocopies of those sections that detail the methods, timing, and results of these surveys.

8 The statement, "[a]rroyos carry water during heavy precipitation, but no natural aquatic communities of organisms develop in the brief time water is present," is unsupported by appropriate reference materials citing any surveys completed. Amphibians and reptiles are species adapted to and that may depend upon habitats influenced by cycles of wet and dry weather. Arroyos, washes, and ephemeral streambeds provide valuable

8 routes of migration, resting, and feeding habitat for these and other animal species. Therefore, the ecological value of these habitats should receive consideration during planning and reasonable care should be taken to protect these habitats from avoidable adverse impacts.

Page 4.13, Section 4.1.9.3 Wetlands
The statement, "[n]o wetland inventories have been performed for SNL/NM, and no National Wetland Inventory maps have been published," is inaccurate. National Wetland Inventory (NWI) maps are available for SNL/NM and photocopies are attached. Unfortunately, our office does not have all of the maps necessary to provide complete coverage of the project area. However, the additional wetland maps of New Mexico can be purchased by calling the NWI State Distribution Center (413-545-0359) located in the Earth Sciences Information Office at the University of Massachusetts in Amherst.

9 Wetland surveys also have been conducted (or are currently underway) by the U.S. Air Force in conjunction with the Integrated Natural Resources Management Plan (Mr. H. Davidson, Chief, Natural Resources Branch, Kirtland Air Force Base, written communication, Consultation #2-22-95-I-244, dated March 20, 1995). The EIS could be prepared concurrently and integrated with environmental analyses and surveys and studies conducted by Kirtland Air Force Base. Direct, indirect, and cumulative impacts of the proposed action including the effects of any effluents released into the air, soil, or water, and from transportation accidents should be evaluated for any wetlands (e.g., Tijeras Arroyo, Arroyo del Coyote) potentially affected by the proposed action.

10 Page 4.14, Section 4.1.9.4 Threatened and Endangered Species
The statement, "[n]o federally listed threatened or endangered species are known to occur on SNL/NM," was not cited. Several studies of sensitive species and their habitats were conducted near the project area in 1992 and 1993 for SNL/NM (Mr. T.A. Wolff, Team Leader, Risk Management and NEPA Department, Sandia National Laboratories) and the New Mexico Natural Heritage Program. The EIS should integrate the recent environmental analyses and related surveys and studies required by the Endangered Species Act.

11 Page 5.13, Section 5.9, Ecological Resources
The environmental consequences section states, "[n]o ecological impacts are anticipated under any alternative, because activities associated with medical isotope production would occur in previously developed areas of the sites." However, environmental consequences to air quality within a 50-mile radius of each alternative and along transportation routes identified only human receptors in the affected environment. Certainly, other vulnerable and valuable natural resources are likely to occur within a 50-mile radius or along the transportation route and the potential injuries to these resources are foreseeable. Direct, indirect, and cumulative impacts to threatened, endangered, candidate species, or other wildlife and their habitats should be evaluated. This should include the risks to natural resources associated with any effluents released into the air, soil, or water, and from vehicular transportation accidents for each alternative.

4

Perhaps a generic ecological receptor could be identified for the proposed alternatives and concurrently evaluated along with the human exposure scenarios. The parameters for a maximally exposed individual could be altered to reflect a generic mammal and
11 evaluated using your computer models (including the dose-thresholds for humans). For example, the maximally exposed mammal could weigh any where from 0.01 kilograms (weight of a mouse) to 50 kilograms (weight of a deer), breathe the contaminated plume all year, spend all year on contaminated soil, and consume locally grown foods.

Finally, the proposed transport route for the preferred alternative is found on state lands and on several tribal lands. We suggest you contact the New Mexico Department of Game and Fish and the New Mexico Energy, Minerals and Natural Resources
12 Department for information concerning fish, wildlife, and plants of state concern. We also suggest you contact the Pueblos of Pojoaque, San Felipe, Sandia, Santo Domingo, and Tesuque for information concerning fish, wildlife, plants, and cultural areas of tribal concern.

SUMMARY
The EIS does not contain sufficient ecological information as it pertains to the affected environment of Sandia National Laboratory. The environmental consequences section should quantify the risks to wildlife and their habitats attributable to the discharge of effluents and in transportation accident scenarios. Without additional information, an environmentally preferable alternative cannot be identified.

If you have any questions concerning these comments, please call Joel D. Lusk of my staff at (505) 761-4525.

R. Mark Wilson
for/ Jennifer Fowler-Propst

Attachment

cc: (wo/attch)
Geographic Manager, New Mexico Ecosystems, U.S. Fish and Wildlife Service, Albuquerque, New Mexico
Director, New Mexico Department of Game and Fish, Santa Fe, New Mexico (Attention: R. Wilson)
Director, New Mexico Energy, Minerals and Natural Resources Department, Forestry and Resources Conservation Division, Santa Fe, New Mexico
Water Resource Scientist, DOE Oversight Bureau, New Mexico Environment Department, Albuquerque, New Mexico (Attn: J. Hostak).
Environmental Officer, Pueblo of Pojoaque, Santa Fe, New Mexico
Environmental Officer, Pueblo of Sandia, Bernalillo, New Mexico
Environmental Officer, Pueblo of San Felipe, San Felipe, New Mexico
Environmental Officer, Pueblo of Santo Domingo, Santo Domingo, New Mexico

5

Environmental Officer, Pueblo of Tesuque, Santa Fe, New Mexico
EIS Project Manager, Battelle Pacific Northwest Laboratories, Richland, Washington
(Attn: M. McKinney)
NEPA Coordinator, Sandia National Laboratories, Albuquerque, New Mexico
(Attn: T. Wolf)

6

References Cited

U.S. Department of Energy. 1993b. *Nonnuclear Consolidation Environmental Assessment, Volume 1: Nuclear Weapons Complex Reconfiguration Program.* DOE/EA-0792, U.S. Department of Energy, Office of Defense Programs, Deputy Assistant Secretary for Weapons Complex Reconfiguration, Washington, D.C.

U.S. Department of Energy. 1995d. *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement, Volume 1, Appendix F.* DOE/EIS-0203-F, U.S. Department of Energy, Office of Environmental Management, Idaho Operations Office, Idaho Falls, Idaho

Responses to Comment Letter C096

1 The affected environment descriptions in the EIS were intentionally limited to information that is important in evaluating relative impacts of the alternatives, and they were therefore restricted to those resources that are likely to be affected by the proposed action. These descriptions were also reviewed to ensure that they present a comparable level of detail for each alternative. DOE believes the information included in the EIS is presented at a level of detail appropriate to the level of risk associated with the proposed action, which is very low for all alternatives.

2 DOE believes that it has explored all of the alternatives in a fair manner, with equal rigor and objectivity applied to each alternative. DOE believes the EIS adequately describes the impacts that might result from implementing the proposed action at any candidate site.

3 Please see response to C096-1 above.

4 The nature of the activities proposed in the EIS is such that the opportunity for impact on natural resources is minimal. Air emissions consist largely of short-lived noble gases, which ultimately decay to nonradioactive or lower activity isotopes and do not tend to accumulate in the environment. Effluent releases to soil or surface water are not expected from any of the processes other than waste disposal activities, which would take place in engineered facilities permitted by Federal and state agencies.

Transportation associated with the medical isotopes project would utilize existing infrastructure at all sites, therefore no sensitive habitats would be affected by construction of roads or other utilities. Emissions from vehicle traffic associated with the proposed action would be minimal and do not represent a measurable increase over current levels. Therefore, no mechanism by which project activities could extensively affect natural resources or sensitive species or habitats has been identified.

5 Management of radioactive wastes generated by medical isotope production would occur in existing facilities that also manage wastes from other operations. In the INEL and LANL alternatives, these facilities are onsite, whereas SNL/NM and ORNL would transport their radioactive waste to the Nevada Test Site (NTS) for disposal. Because these facilities already exist, addition of the relatively small quantities of medical isotope production waste would not require new permits. If necessary, existing permits for these facilities would be updated to include the types of waste resulting from medical isotope production.

6 Dispersion of air emissions would depend on atmospheric conditions at the time of the release. The probability that the wind would blow in any given direction is reflected in the wind rose diagrams presented in Appendix D of the EIS and in the joint frequency data used to estimate dispersion of facility emissions (see Appendix C). In the case of routine emissions from facilities, which are assumed to be nearly continuous, the dispersion patterns would correspond closely to the frequencies of annual average wind directions. For accidental releases that occur over a relatively short period of time, dispersion could occur over a much narrower area. For purposes of the EIS accident analysis, the wind was assumed to blow in the same direction for the entire duration of the event, and the direction was chosen to maximize consequences to the potentially affected population.

Sensitive natural resources such as threatened or endangered species and habitats, wetlands, and aesthetic and scenic areas are identified in Section 4 of the EIS for each of the alternatives. The types, relative number, and locations of such resources are identified in the appropriate sections for each site. Because the impacts of the proposed activities are very low for all types of resources, the potential for adverse effects on any of the above-mentioned resources is extremely unlikely.

The consequences of radioactive air emissions from medical isotope production were evaluated for onsite non-involved workers, who are among the most sensitive of onsite biota, and were found to be very small for both routine operations and accidents. Therefore, exposures to other types of biota would not be expected to result in adverse consequences. Although it would not be possible to entirely rule out potential impacts on some individuals of other biotic species following an accident, the relatively low human risk provides reasonable assurance that large populations of other onsite biota would not be subjected to detrimental effects. Estimating the environmental impacts to such individuals or populations would likely be of little value in forming a basis for making decisions among the alternatives.

7 The first reference in question, *Nonnuclear Consolidation Environmental Assessment, Volume 1: Nuclear Weapons Complex Reconfiguration Program*, contains a section (4.1.5.5) on biotic resources of SNL/NM and Kirtland Air Force Base (KAFB). This section cited the following references:

Sandia National Laboratories Albuquerque, Environmental Baseline Update, 301182-56-01, prepared by IT Corporation and Consensus Planning, Inc./Zephyr Design, 1992.

Revision of the Species Inventory Checklists for Sandia National Laboratories, Albuquerque, Bernalillo County, New Mexico, Final report, SAND90-7098, prepared by N.T. Fischer, IT Corporation, Albuquerque, NM, 1990.

Section 4.1.9.2 of the EIS describing aquatic resources has been revised and contains an additional reference.

8 Section 4.1.9.2 has been rewritten to reflect more accurate information about surface water resources at SNL/NM. In *Revision of Species Inventory Checklists for Sandia National Laboratories, Albuquerque, Bernalillo County, New Mexico: Final Report*, (Fischer 1990), Fischer states that there are three springs on KAFB which provide small areas of natural wetlands. He reports areas of shallow standing water and permanently moist soils. The *Draft Environmental Assessment of the Environmental Restoration Project at Sandia National Laboratories/New Mexico* DOE/EA-1140 (DOE 1995h), states that there are two perennial springs in the Arroyo del Coyote drainage: Coyote Springs and Sol se Mete Spring. These springs provide limited and localized wetland habitat at the site.

9 The discussion of wetlands in Section 4.1.9.3 has been revised. A wetland inventory of SNL/NM has been conducted by KAFB. Some riparian woodland and riparian scrubland is found in some arroyos and canyons with permanent or intermittent surface water sources. Species found in these areas include cottonwoods, saltcedars, cattails, rushes, and wetland grasses. Some artificial ponds also provide wetland-like habitats. These ponds may be used by migratory waterfowl in the spring and fall.

10 The reference in question is "DOE 1993a." In addition, *Revision of the Species Inventory Checklists for Sandia National Laboratories, Albuquerque, Bernalillo County, New Mexico, Final Report* also states that no federally listed threatened or endangered species are known to occur on KAFB. The citation has been added to Section 4.1.9.4.

11 The nature of the activities proposed in the EIS is such that the opportunity for impact on natural resources is minimal. Air emissions consist largely of short-lived noble gases, which ultimately decay to nonradioactive or lower activity isotopes and do not tend to accumulate in the environment. Effluent releases to soil or surface water are not expected from any of the processes other than waste disposal activities, which would take place in engineered facilities permitted by Federal and state agencies.

Transportation associated with the medical isotope project would utilize existing infrastructure at all sites, therefore no sensitive habitats would be affected by construction of roads or other utilities. Emissions from vehicle traffic associated with the proposed action would be minimal and do not represent a measurable increase over current levels. Therefore, no mechanism by which project activities could affect natural resources or sensitive species or habitats has been identified.

The consequences of radioactive air emissions from medical isotope production were evaluated for onsite non-involved workers, who are among the most sensitive of onsite biota, and were found to be very small for both routine operations and accidents. Therefore, exposures to other types of biota would not be expected to result in adverse consequences. Although it would not be possible to entirely rule out potential impacts on some individuals of other biotic species following an accident, the relatively low human risk provides reasonable assurance that large populations of other onsite biota would not be subjected to detrimental effects. Estimating the environmental impacts to such individuals or populations would likely be of little value in forming a basis for making decisions among the alternatives.

12 The nature of the activities proposed in the EIS, and their relatively low impacts as described in Section 5 of the document, is such that the likelihood for impact on natural resources is minimal. Both the New Mexico Department of Game and Fish and the New Mexico Minerals and Natural Resources Department were contacted for information on species of concern. Information on these resources was incorporated into the affected environment description for the SNL/NM site as appropriate.

Transportation associated with the medical isotopes project would utilize existing infrastructure at all sites, therefore no sensitive habitats or species would be affected by construction of roads or other utilities. Emissions from vehicle traffic associated with the proposed action would be minimal and do not represent a measurable increase over current levels. The relatively low impacts of incident free transportation, or of transportation accidents, on humans indicate that impacts on other types of biota (which are generally less sensitive than humans) would be minimal. Therefore, no mechanism by which project activities could extensively affect natural resources or sensitive species or habitats has been identified.

Transportation activities associated with medical isotope production would be undertaken in consultation with agencies governing potentially affected areas along the transportation routes. Routes would be chosen according to established guidelines to minimize risk, and emergency response plans would be developed in conjunction with local agencies as appropriate before shipments of radioactive materials commence.

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February 15, 1996

Michael J. Zamorski
Acting Area Manager
Kirtland Area Office
Albuquerque Operations Office
U.S. Department of Energy
P.O. Box 5400
Albuquerque, N.M. 87115

Dear Mr. Zamorski:

RE: MEDICAL ISOTOPES PRODUCTION PROJECT: MOLYBDENUM-99 AND RELATED ISOTOPES; DRAFT ENVIRONMENTAL IMPACT STATEMENT; DOE/EIS-0249D; U.S. DEPARTMENT OF ENERGY, OFFICE OF NUCLEAR ENERGY, SCIENCE AND TECHNOLOGY, WASHINGTON, D.C.; DECEMBER 1995

The following provides New Mexico Environment Department (NMED) staff comments concerning the above-referenced Draft Environmental Impact Statement (DEIS).

A. DEIS ASPECTS RELATED TO SANDIA NATIONAL LABORATORIES (SNL).

1 1) Radioactive Waste Management Issues: Cit. §3.1.2, *Molybdenum-99 Separation Facility Needs*. It is indicated that during periods of uninterrupted ^{99}Mo supply from the current Canadian producer (Nordion, Ltd.), that all ^{99}Mo produced in the planned continuous USDOE operation would be disposed of as waste. I.e., although the medical market would not absorb the excess radionuclide, full production would continue. It is unclear from the DEIS how the addition of this radionuclide (and particularly its daughter product, ^{99}Tc, with a half-life of 21,300 years) to the waste stream would impact estimates of low level radioactive waste (LLW) generation rates in terms of volume, activity, or cost to the program. It is also unclear what the fate of ^{131}I and ^{133}Xe (additional medical isotopes that would be produced in the irradiation process) would be in the event that the medical market could not absorb them. Annual volumetric waste estimates in the DEIS range variously from 42 m^3 to 56.3 m^3 (Cit. §3.3.1.8 and 5.14.1.1.). In a supporting document: "Environmental Assessment for Sandia National Laboratories/New Mexico Offsite Transportation of Low-Level Radioactive Waste" §2.1.2 (917ER), projections of future LLW generation are based solely on past generation rate at:

Michael J. Zamorski
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37 m^3/year. Hence, the Transportation EA estimates would not
include the impacts of the proposed MIPP. The DEIS estimate of
1 70.8 m^3 LLW produced annually by SNL (Cit. §4.1.13.3) is apparently
contradicted by the estimate in the supporting LLW Transportation
EA.

Cit. §3.3.1.9, *Hot Cell Facility Modifications*. The Hot Cell
Facility (HCF) has a history of use for destructive testing of
irradiated fuel elements and other radioactive materials. In that
operational mode, radioactive contamination of HCF components would
2 be expected. Modifications to the HCF to permit medical isotope
processing may include demolition and decontamination activities
which are not discussed in the DEIS. Such activities would likely
increase the initial radioactive waste inventory beyond that
projected for medical isotope processing.

Cit. §4.4.14.4, *Low-Level Mixed Waste*. The section indicating
that mixed wastes may be generated at SNL as a result of <u>weapons
tests</u> requires clarification. We are unaware of nuclear weapons
tests being performed in New Mexico with the exception of the
3 historic AEC Trinity Site detonation, and historic ERDA detonations
of nuclear devices at the Gnome Site (Carlsbad) and Gasbuggy Site
(Four Corners) under Project Plowshare.

2) Structural Seismic Safety Issues: Cit. §3.3.1.9, *Required
Modifications - Annular Core Research Reactor Modifications at
SNL/NM*. This section does not indicate any structural
modifications necessary to bring the ACRR High Bay structure to
current seismic safety building requirements. The ACRR High Bay
is an unreinforced masonry (URM) structure (Draft Environmental
Assessment, Gamma Irradiation Facility at Sandia National
Laboratories, September 1995 - DOE/EA-0973), which is not
considered seismically sound under the 1991 Uniform Building Code
4 (UBC) for Seismic Hazard Zone 2B that includes Albuquerque, NM.
This also holds for subsequent editions of the UBC. The USDOE
Defense Programs Information Letter 95-03 advises re-evaluation of
URM structures for natural phenomena hazards including earthquakes.
The President's Executive Order 12941 mandates adoption of ICSSC
Standards as minimum safety standards; ICSSC RP-4 (National
Institute of Standards) and DOE Order 5480.28 trigger seismic risk
evaluation of any building where a major change in function,
building modification, or change in consciousness of risks occur.
The change in operation mode of the ACRR from occasional pulsed
operation for testing purposes to continuous, around-the-clock
production of irradiated targets, as well as conversion of the HCF
to isotope processing, implies a major change in facilities
function. It is not clear from the DEIS whether a site specific
seismic risk evaluation has been performed for the ACRR or other

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Page 3

4 DOE Performance Category 3 nuclear facilities at SNL Technical Area V (TA V).

5 Cit §4.1.6, *Geologic Resources*, §4.1.6.1, *General Geology*, and §4.1.6.3, *Site Stability*. These sections of the DEIS refer to a supporting document "SNLA (1993d)", which was not included in the list of references.

6 Cit §4.1.6.3 *Site Stability*. This section refers to a range of horizontal accelerations due to seismic events in units of "*grams*". This should be corrected; the unit "g" refers to an acceleration value equivalent to the acceleration of *gravity* on earth (9.8 m/s^2). The unit gram refers to mass which is, by definition, independent of the force of gravity. The numerical values for horizontal acceleration (0.07 *g* to 0.3 *g*) derived from the 1991 UBC are not accurate for the Albuquerque area and thus underestimate potential seismic risks for the proposed MIPP facility. Predicted maximum vertical and horizontal accelerations in the Albuquerque region are 0.3 *g* and 0.5 *g*, respectively (Algermissen-USGS, 1990). Based on the extents of the Tijeras-Cañoncito fault system and the Sandia accommodation zone located within a mile of the site, a maximum credible temblor of 7.5 Richter magnitude is indicated. This value is greater than that indicated by the DEIS, and greater than values associated with the recent destructive earthquakes at Northridge, CA and Kobe, Japan. Recent evidence indicates that the region between Socorro, NM, and Albuquerque, NM, may produce a temblor with Richter magnitude as high as 6.4 within the next 25 years, with a probability of 0.15 to 0.3 (Sanford, NMIMT 1995). This information is available in the juried literature, constitutes a change in the consciousness of risk, and should be updated for all alternatives considered in the DEIS.

7 3) **Biological Resources Issues: Cit. §4.1.9.4, *Threatened and Endangered Species*.** This section refers only to special status species, indicating that poor quality habitat at KAFB renders occurrence of endangered species unlikely. This statement is not apparently supported by any local survey efforts, which should be completed before such a conclusive statement is made. The endangered peregrine falcon (*Falco peregrinus*) is known to nest in the nearby Sandia Mountains, and 44 migratory peregrine falcons were noted in 1995 by Raptor Watch at the Manzano watch area adjacent to KAFB. Foraging ranges of up to 10 miles are expected for the peregrine falcon. Potential impacts to special status species and their prey species, including any potential for bioaccumulation of radioactive materials from MIPP airborne or waterborne effluents, are not discussed under §5.0 *Environmental Consequences* which summarily dismisses "substantial effects" to any ecological resources.

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Page 4

8 4) **Radiological Air Effluent Impacts:** Cit. §4.1.12.1, *Current Radiological Environment*. This section correctly identifies the Maximally Exposed Individual (MEI) for radiological air emissions dispersion modelling under 40 CFR 61 Subpart H (NESHAP) at 1600 m northwest of TA V. However, this MEI was disregarded in the discussion of potential radioactive air emissions impacts under §5.7, *Air Impacts*, using instead an MEI at 5400 m north, in the region of SNL Technical Area I. The effect of using this MEI, and emissions estimate data (Table 5-4) which do not agree with that used by SNL Air Quality in reporting to the USEPA, is to underestimate the potential radiation dose equivalent impact as 0.17 mREM/y. SNL reporting to USEPA and Albuquerque Environmental Health (AEH) indicates a radiation dose equivalent estimate to the MEI of 5.2 mREM/y, over half of the USEPA allowed standard. Dispersion modelling performed by SNL was repeated by NMED using the emissions estimates supplied to USEPA and AEH, the meteorological data used for 1994 NESHAP reporting to USEPA, and estimates of target production from the DEIS. The resulting value found was 8.6 mREM/y for production of 100% of the United States medical community's demand for ^{99}Mo. While this modelling result nearly approaches the NESHAP standard of 10 mREM/y, supplying 200% of the current demand to meet projected future needs would result in emissions that are clearly not in compliance with the regulatory standard. USDOE and SNL have been advised of these findings.

9 Cit. §5.15.1.3, *Facility Accidents for Target Irradiation at the Annular Core Research Reactor*. This section refers to modelling performed in the Draft Environmental Assessment for the MIPP which preceded the DEIS. This modelling was performed to predict the results of an accident scenario involving an acute, high level exposure with limited or no emissions controls. The model used again was the EPA's CAP88PC, which is specifically designed to model chronic, long-term, low-level exposure to radioactive effluents from normal facility operations. Using CAP88PC to model an accident scenario is therefore inappropriate, and will underestimate the resultant acute radiation dose to members of the public.

B. DEIS ASPECTS RELATED TO LOS ALAMOS NATIONAL LABORATORY (LANL).

10 1) **Cit. §3.3.2.9, Page 3.38, *Required Modifications*.** While it is true that the cooling water leak at the Omega West Reactor (OWR) reactor has been stopped, it is unclear what remediation activities have taken place since the leak was discovered. A comprehensive report of the extent of surface and subsurface contamination and the remediation activities completed to date should be included in the DEIS in order to make a reasonable determination concerning the

Michael J. Zamorski
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re-starting of the reactor. Additionally, for the Omega West
Reactor/Chemistry and Metallurgy Research Facility Alternative, the
NMED staff recommends that OWR safeguards be installed to prevent
10 future releases from underground piping--such as water flow rate
instrumentation with alarms that would detect water loss and notify
process control technicians. Other reactor hardware upgrades
described in the DEIS should be clarified further.

2) Cit. §4.2.6.3, Page 4.29, *Site Stability*. The text mentions that
the Pajarito Plateau is dominated by three prominent fault zones,
but fails to acknowledge that the trace of the Guaje Mountain Fault
11 passes directly through the cooling towers of the OWR at TA-2. Has
the Guaje Mountain Fault been sufficiently characterized--in the
event OWR is re-started--to remove it as a contaminant transport
mechanism for perched ground water systems below the facility
during the proposed accelerated OWR operations?

3) Cit. §4.2.8.1, Page 4.35, *Surface Water*. The first paragraph is
incorrect, permanent perennial surface waters are found at LANL in
Cañon de Valle, Twomile Canyon, and Pajarito Canyon (Dale and
12 Yanicak 1995, in review). We should also note that NMED staff
observed perennial surface water flow in Threemile Canyon and upper
Water Canyon during 1994 and 1995. In addition, there are springs
in many of the canyons on the eastern border of the Pajarito
Plateau which supply perennial surface water flow to the Rio
Grande, notably Frijoles, Anchb, and Pajarito Canyons.

It would be appropriate to display the summer storm runoff data mentioned in paragraph two.

It is not well understood how surface water flow affects the perched ground water (alluvium) in Los Alamos Canyon (e.g., infiltration and percolation rates have not been characterized near the OWR).

The LANL ER Project has shown that there is radionuclide contamination in the perched ground water (alluvium) east of the OWR from past operational releases, but little data have been collected to evaluate how other potential release sites (PRS) in the Los Alamos Canyon and DP Mesa area contribute to the overall contaminant and radionuclide inventory down-gradient of the OWR. NMED staff recommends for the Omega West Reactor/Chemistry and Metallurgy Research Facility Alternative that snow-melt and storm water events be continuously monitored to pinpoint and assess all PRS sources to Los Alamos Canyon. A storm water pollution plan should then be designed and implemented to prevent all contaminants from leaving the site.

Surface waters fed by the Los Alamos reservoir often reach and

Michael J. Zamorski
February 15, 1996
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extend beyond the OWR.

4) Cit. §4.2.8.2, Page 4.35, Groundwater. It should be noted that an intermediate perched ground water zone probably exists in the subsurface below the OWR, and it is unknown whether there is a connection between the upper shallow alluvium aquifer and this deeper perched zone that would allow for the transport of contaminants. NMED staff recommends that an adequate characterization of these aquifers be performed for the Omega West Reactor/Chemistry and Metallurgy Research Facility Alternative.

13 The existence of perched alluvium ground water in Los Alamos Canyon beneath the OWR was brought to Department staff attention by LANL ER Project personnel. In order to relieve pressure caused by upwelling of ground water in the canyon alluvium, it was necessary to drill holes in the basement floor of the OWR equipment room.

NMED staff believe that there is an inadequate site-wide ground water monitoring system at LANL. Department staff recommend that an intermediate perched and deep regional aquifer monitoring system in Los Alamos Canyon be funded and implemented if the USDOE is seriously considering the Omega West Reactor/Chemistry and Metallurgy Research Facility Alternative. The recommended ground water monitoring system could be addressed in a timely manner by implementing the LANL Ground Water Protection Management Program Plan (GWPMPP).

14 5) Cit. §4.2.14.2, Page 4.46, *Low-Level Wastes*. Has there been a performance assessment of TA-50's current and future low-level radionuclide waste treatment capabilities (with all proposed upgrades) to address the Omega West Reactor/Chemistry and Metallurgy Research Facility Alternative? TA-50 is currently experiencing problems with the present site-wide radionuclide waste stream it processes. Will TA-50, a facility that still utilizes "sixties technology", be able to adequately address the increased waste stream from Moly-99 target preparation and target dissolution?

We appreciate the opportunity to comment on this document. Please let us know if you have any questions.

Sincerely,

Gedi Cibas, Ph.D.
Environmental Impact Review Coordinator

NMED File No. 958ER

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February 16, 1996

Michael J. Zamorski
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Dear Mr. Zamorski:

RE: MEDICAL ISOTOPES PRODUCTION PROJECT: MOLYBDENUM-99 AND RELATED ISOTOPES; DRAFT ENVIRONMENTAL IMPACT STATEMENT; DOE/EIS-0249D: U.S. DEPARTMENT OF ENERGY, OFFICE OF NUCLEAR ENERGY, SCIENCE AND TECHNOLOGY, WASHINGTON, D.C.; DECEMBER 1995

We discovered an error and would like to amend two sentences in our February 15, 1995, comments on the document referenced above. The last two sentences (i.e., sentences (6) and (7)) of the first paragraph of section A(4), entitled Radiological Air Effluent Impact, should be changed as follows:

Sentence (6): the "100%" should be replaced with "200%".

Sentence (7): the entire sentence should be deleted and replaced with the following: "This modelling result nearly approaches the NESHAP standard of 10 mREM/y."

The remainder of our comments is otherwise unaffected. We regret the inadvertent inaccuracy. Please let me know if you have any questions.

Sincerely,

Gedi Cibas, Ph.D.
Environmental Impact Review Coordinator

NMED File No. 958ER

Responses to Comment Letter C097

1 If the Department decides to pursue this project, it would only produce Mo-99 at full capacity in the event of a Mo-99 supply shortage. At all other times, it would operate under its normal backup mode and would only produce enough Mo-99 to maintain the capabilities of the facilities and staff to respond to a Mo-99 shortage.

In this backup mode, the Department would attempt to sell all of the Mo-99 and related isotopes (xenon-133 and iodine-131) that it produced. There may be times, however, when the Department would be unable to sell all of the isotopes and would have to dispose of them as waste. If Mo-99, iodine-131, and xenon-133 were disposed of as waste, they would not add substantially to the volume, activity, or cost of waste disposed. All are short-lived radionuclides that decay to nonradioactive or very low activity isotopes and could be incorporated into the normal process waste streams. The waste generation figures presented in Section 5.14 take into account the potential need to dispose of unsold isotopes.

Although the SNL/NM low-level waste transportation EA apparently did not account for disposal of medical isotope project waste, this waste disposal effort is analyzed as part of the transportation analysis in Section 5.11 of this EIS.

2 The impacts from modification to the facility are considered in the EIS. Cleanout of the facility to remove contamination from previous programs is an ongoing process and is not considered part of proposed activities for the SNL/NM alternative.

3 The text has been clarified to eliminate any confusion (see Section 4.1.14.4).

4 As noted in the comment, the Annular Core Research Reactor (ACRR) High Bay is an unreinforced masonry structure which does not satisfy current Uniform Building Code (UBC) requirements for a seismic Hazard Zone 2B. The ACRR High Bay was constructed in the 1960s and satisfied building criteria at that time. Modifications to the structure in 1978 also satisfied the UBC current at that time. In the safety documentation for the ACRR, it has been demonstrated that the High Bay structure is not a safety class item. As noted in the comment, major changes in the facility's function is a potential trigger to performing a seismic safety evaluation. This has recently been completed for the ACRR and is being reviewed as potentially an Unreviewed Safety Question (USQ) both by Sandia Reactor Safety committees and by DOE. This USQ identifies the Performance Category for all safety-related systems, subsystems and components (SSCs) for the ACRR. The USQ proposes that all safety-related SSCs for the facility are Performance Category 2 (PC-2). As a PC-2 structure, the high bay satisfies the criteria stated in DOE Order 5480.28 and the corresponding DOE Standards 1020 through 1023. Modifications to the ACRR facility would be designed and constructed in compliance with the current UBC and DOE Order 5480.28.

The Hot Cell Facility (HCF) Safety Analysis Report, which is currently being reviewed by DOE, includes a seismic safety evaluation based on DOE Order 5480.28. In the evaluation, safety-related SSCs are identified as Performance Category-2 and Performance Category-3 (PC-2 and PC-3) systems consistent with the definitions of these categories.

5 The reference section has been revised to add supporting document SNLA (1993a).

SNLA. 1993a. *Site-Wide Hydrogeologic Characterization Project, CY 1992 Annual Report*. Sandia National Laboratories, Environmental Restoration Programs, Albuquerque, New Mexico.

6 The seismic requirements for the nuclear facilities at SNL/NM are derived from DOE Order 5480.28 "Natural Phenomena Hazards Mitigation" and corresponding DOE Standards 1020 through 1023. The order and standards set forth a probabilistic, rather than deterministic, evaluation for seismic risks that is based on three factors: 1) the magnitude and probability of seismic activity, 2) the local seismic response curves, and 3) the performance category of safety-related SSCs. The criteria stated in the order and standards are derived from Uniform Building Code (1991) and UCRL 53582, Rev 1, 1984 (*Natural Phenomena Hazards Modeling Project: Seismic Hazard Models for Department of Energy Sites*, University of California Research Laboratory, Livermore, California). The updated safety documentation for the ACRR and HCF, which is currently being reviewed by SNL/NM and DOE, identifies safety-related equipment by performance category for evaluation to the following criteria:

Performance Category	Probability of Activity (1/yrs)	Maximum Horizontal Ground Acceleration (g)
PC-1	2×10^{-3}	0.17
PC-2	1×10^{-3}	0.22
PC-3	5×10^{-4}	0.28
PC-4	1×10^{-4}	0.47

For the ACRR, the proposed performance category for all safety-related SSCs is PC-2; and for the HCF, the proposed performance category of safety-related SSCs is PC-3 and PC-2.

The seismic magnitudes and probabilities cited in the comment are single points in a continuous seismic risk curve which has been incorporated in the DOE Orders and Standards.

7 The Department requested location-and species-specific lists for each alternative from the Department of Interior Fish and Wildlife Service and from each state. In addition, surveys of Kirtland Air Force Base (KAFB) have been conducted recently by N.T. Fischer of IT Corporation, *Revision of the Species Inventory Checklists for Sandia National Laboratories, Albuquerque, Bernalillo County, New Mexico, Final Report*, SAND90-7098, (Fischer 1990). This report states that no federally listed threatened or endangered species is known to occur on KAFB. DOE believes that any airborne or waterborne effluents are not likely to affect nearby biotic resources because of the low-level of chemical and radiological releases.

8 The distance used for the offsite receptor evaluation at SNL/NM represents the location of a full-time resident who receives the highest potential exposure to facility emissions. In some cases, meteorological conditions result in the maximum offsite receptor location being other than the nearest possible access point. Also, other locations to which the public has access may not be residential areas, and the exposures at these locations would be substantially lower than at a permanent residence because they are not continuously occupied.

The location typically used for permitting and compliance calculations at SNL/NM (1610 m NW) is within the KAFB boundary. This location is not a full-time residence and would not be accessible to the general public and, therefore, was not used in this EIS as the location of the maximally exposed individual. The 1610 m NW location was, however, used in the EIS to calculate the dose for an onsite worker (see Table 5-3 and Table C-1 in Appendix C).

The maximum production level for the EIS was assumed to replace 100% of the U.S. supply, rather than the 200% assumed in earlier SNL/NM documentation. Other assumptions used for the EIS analysis account for proposed modifications to the reactor and hot cell facility and rely on a long-term meteorological data set appropriate for this type of prospective analysis. These assumptions are listed in Appendix C as well as in Section 5.7.1 of the EIS.

9 The facility accident analyses performed for the EIS did not use CAP-88 results from the earlier environmental assessment prepared by SNL. Only the descriptions of the design basis accident and the estimated releases were used; the consequences of these events were re-evaluated for the EIS analysis.

The atmospheric dispersion and food chain models in the GENII code, which was used for the EIS analysis (see introduction to Section 5.15), were specifically designed to be appropriate for short-term accidental releases and generally provide conservative estimates for the consequences of such events.

10 Aggressive remediation activities have been undertaken. Repair of the pipe is not considered to be a technical obstacle to reactor restart. The work was included in the Omega West Reactor (OWR) budget and schedule and the Department believes the figures are reasonable. Two studies have been conducted by LANL that review and analyze the OWR leak cause and remediation. These reports are: *Phase I: OWR Reactor Coolant Loss, Diagnosis, and Surveillance*, and *Stress-Assisted, Microbial-Induced Corrosion of Stainless Steel Primary Piping and Other Aging Issues at the Omega West Reactor.*

It is unclear how flowrate instruments could detect a leak, other than a very major leak. Flowrate instruments are rarely better than 1% accurate at full span, and the accuracy decreases as the square of the ratios of the flows, making flowrate instruments poor for leak detection purposes. Normally leakage is detected through a mass balance, basically tracking makeup versus letdown plus evaporation rate. This type of procedure currently exists at the OWR, but an adequate procedure was not in place to perform this mass balance when the leakage occurred. The DOE has confidence that LANL has and will take actions to assure that a second leak would not go undetected.

11 Groundwater contamination is not expected to be a significant problem with operation of the OWR, regardless of the location of the fault referred to in the comment. The cooling tower would not normally contain radioactive materials because its water inventory is separated from the primary cooling loop in the reactor, and no other radioactive liquid effluent is associated with normal operation of the OWR.

A reasonably foreseeable accident scenario for liquid releases from the reactor cooling system assumed transport conditions much more direct than leaching into the groundwater via a fault and resulted in minimal impact on any potentially exposed individuals. Therefore, presence of the fault is not expected to increase the risk of operating the OWR beyond those presented in the EIS. The geologic characteristics of the area would be accounted for in a comprehensive safety analysis before the OWR is restarted.

12 DOE policy prohibits the citation of documents currently in review. All material must be available in approved released documents. Section 4.2.8.1 has been rewritten to agree with the recently developed surface water information found in the DARHT EIS (see Section 4.2.8.1 for the complete reference citation).

13 Groundwater contamination is not expected to be a significant problem with operation of the OWR. The cooling tower would not normally contain radioactive materials because its water inventory is separated from the primary cooling loop in the reactor, and no other radioactive liquid effluents are associated with normal operation of the OWR.

A reasonably foreseeable accident scenario for liquid releases from the reactor cooling system assumed transport conditions much more direct than leaching into the groundwater, and it resulted in minimal impact on any potentially exposed individuals. Therefore, the potential communication between groundwater aquifers is not expected to increase the risk of operating the OWR beyond those presented in the EIS.

The geologic characteristics of the area would be accounted for in a comprehensive safety analysis before the OWR was restarted. The need for additional groundwater monitoring would be addressed as part of permitting the facility restart by Federal, state, and local authorities, as applicable.

14 The aqueous waste volume from the Chemistry and Metallurgy Research (CMR) building would not be increased significantly from the proposed target preparation and target processing. There would be a small volume of aqueous waste going to TA-50 from the target fabrication line, but the metal concentrations are quite low and below discharge limits. There would be no aqueous waste from target processing. It would all leave CMR as low-level radioactive solid waste.

DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Food and Drug Administration
Rockville MD 20857
2094 Gaither Road

Mr. Wade Carroll, EIS Project Manager
Medical Isotopes Production Project
US Department of Energy
19901 Germantown Road
Germantown, MD, 20874-1290

February 7,1196

Dear Mr Carroll:
In response to the letter to Dr Bruce Burlington,Director CDRH/FDA by Ms Carol M. Borgstrom, Director of NEPA Policy and Assistance, dated December 13,1995 in relation to DOE's Draft " Medical Isotopes Production: Molybdenum-99 and Related Isotopes Environmental Impact Statement (DOE/EIS - 0249D), we are happy to submit the following general comments:

1. The Environmental Impact Statement (DOE/EIS 0249D) is quite thorough and provides adequate information in relation to possible radiation emergencies concerning public health safety. We will not respond to technical aspects of the statement. All alternatives are capable of adequate production of Mo-99 and meet radiation protection standards.

2. Budgetary considerations and time constrains are solely DOE's concern. However other priorities should not interfere and become obstacles to the Medical Isotope Production Project.

1

3. The single Canadian source of Mo-99 cannot indefinetely be assumed to produce without interruptions medical radioisotopes to satisfy the needs for 38,000 daily nuclear medicine procedures in the USA. Any nuclear reactor based production facility could have regular or emergency shut downs. We believe that the time is ripe for a goverment supported production facility of Medical Radioisotopes in USA.

4. The need for uninterrupted availability of Mo-99 is obvious. Most of the nuclear medicine diagnostic procedures are perfomed with Tc-99m tagged radiophamarceuticals. Some of these procedures are essential for proper diagnosis,others offer preferable not invasive or cost effective alternatives. This is a well known fact and need not to be further emphasized. The concern of the medical community for a back-up production facility is serious and well justified. We are glad you are taking positive steps to materialize a satisfactory response to such concerns.
We hope and expect a successful conclusion of this project.

Finally we would like to thank you for the opportunity to offer our comments.

Sincerely

Peter Paras Ph.D., FACNP
Assistant Director for Nuclear Medicine
Center for Devices and Radiological Health

Response to Comment Letter C098

1 Comment noted.

CORAR

Council on Radionuclides and Radiopharmaceuticals, Inc.
3911 Campolindo Drive
Moraga, CA 94556-1551
510/253-1850
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Henry H. Kramer, Ph.D., FACNP
Executive Director

20 February 1996

Mr. Wade Carroll
MIPP-EIS Document Manager
U.S. Department of Energy, NE-70
19901 Germantown Road
Germantown, MD 20874

CWS/011/96

Dear Mr. Carroll:

The Council on Radionuclides and Radiopharmaceuticals* (CORAR) has reviewed the Department of Energy's (DOE) draft Environmental Impact Statement (EIS) and the implementation plan for the medical isotope production project: Molybdenum-99 and related isotopes. We would like to first commend Secretary O'Leary and her staff for all their efforts on this matter, as well as their support of the nuclear medicine community.

As you know, we have been working with DOE for more than six years in an effort to
address the Mo-99 supply situation, to ensure the success of the DOE's Isotope
Production and Distribution Program (IPDP), and meet the needs of the nuclear medicine
community. Last January members of CORAR attended a workshop at the Sandia
National Labs to seek to develop a plan that would address the vulnerability of the Mo-99
supply and allow DOE, in spite of delays, to ensure a return on their investment. Our
recommendation then, which remains our position, was for DOE to enter into a
cooperative effort with the nuclear medicine community and the current Canadian
1 supplier of Mo-99. Under this plan DOE would ultimately supply "raw or semi-
processed" Mo-99 to Nordion International for final processing, which would solve the
nuclear medicine community's need for a back-up supplier of Mo-99, and allow DOE to
enter the marketplace and see a much earlier return on its investment.

The potential supply shortage is not a new problem and the radiopharmaceutical manufacturing industry is hopeful that other efforts to address the lack of a secondary North American reactor to supply Mo-99 will be successful. One such effort is the program of the Canadian government and Nordion International to build two new reactors to supply Mo-99. These reactors are expected to be fully operational by the end of the decade. Assuming that the Canadian effort is successful, there still remains a critical need until these new reactors are on-line for a secondary reactor to supply Mo-99 in North America. The current North American supplier of Mo-99, Nordion, depends on an aging reactor at Chalk River, which may need maintenance or repairs that could cause it to go off-line at any time.

*CORAR is an industry of manufacturers of radiopharmaceuticals, radionuclides, radiochemicals and other radioactive products primarily used in medicine and life science research. The member companies of CORAR supply vitally important radiopharmaceuticals and radioactive material to physicians and research facilities throughout the world. Radiopharmaceuticals are used in over 10 million medical diagnostic and therapeutic procedures per year in the U.S.

CWS/011/96
Page 2

The current DOE project at Sandia will not likely produce finished Mo-99 as a pharmaceutical raw material until 1998, especially in light of the length of the EIS process. Further still, once the Sandia reactor is on-line DOE will have to file a DMF with the Food and Drug Administration (FDA) and the manufacturers will still have to validate three routinely manufactured lots, adding from one to two years from that point until the Mo-99 produced at Sandia could be used by manufacturers. In light of the delays in the DOE program and the time needed to obtain FDA approval, the IPDP program must refocus its sights and seek to come up with a way to supply material sooner. It is our view that this can only be accomplished by providing "raw, or semi-processed" Mo-99 to Nordion for final processing. This would allow the manufacturers to use the Mo-99 without having to undergo the time consuming validations required by the FDA or the filing of a DMF by the Sandia reactor facility. It would also allow routine maintenance to be done on the current Chalk River reactor in a more deliberate and effective basis.

We hope that you will find these comments useful to the EIS process. Please let us know if you require any further information.

Sincerely,

Carl W. Seidel (NO)

Carl W. Seidel
Chairman, CORAR

CWS:npb

cc: R. Brown - Mallinckrodt
W. Ehmig - Amersham/Medi-Physics
H. Kramer - Executive Director
J. Massie - Alpine Group

Response to Comment Letter C099

1 Information for this option is presented in Section 5 and Appendix B of the EIS. The Summary has been revised to clearly indicate this option, and shipping container information has been added to Section 5.11.

Monday, February 19, 1996

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Mr. Wade Carroll, NEPA Document Manager
Office of Isotope Production and Distribution, NE-70
U. S. Department of Energy
19901 Germantown Road,
Germantown, Maryland 20874-1290 REF: DOE/EIS-0249D

Dear Mr Carroll:

1 After reviewing DOE/EIS-0249D, Draft EIS for the Mo-99 reactor, I feel my letter of January 1st is not addressed. I request my comments be included in your final document, and an appropriate response.

2 I also would like to ask for your evaluation of another difference some of us have with the DOE on radiation and public health. Your reviews always come to the conclusion there is no immediate danger to the public from the present radiological hazards and therefor more is allowable. Of course, some of us feel we have gone past the safe limit already. The problem Is much of this is not easily provable, either way.

So, I would like for the DOE, EPA, or the appropriate agency, to produce a study estimating from the present radionuclide and toxic hazards present at Sandia National Lab and Los Alamos National Labs (and all other DOE nuclear facilities) and expected future increases from increases operations when we would cross a threshold to which pubic health would be endangered. Please include what expected consequences such a crossing would cause and how it would appear in the public and environment.

Sincerely,

Robert L. Anderson

Responses to Comment Letter C100

1 The January 1 letter referred to and reproduced as comment letter C003 in this document, was received after publication of the Draft EIS. That letter has been considered in the preparation of the Final EIS.

2. The risk of radiation-induced health effects has been exhaustively studied over many years by the International Commission on Radiological Protection (ICRP), an international group of experts that does not represent the interests of DOE or any other particular government agency. In its latest set of recommendations, the ICRP estimated risks for many types of radiation-induced health effects, based primarily on studies of Japanese survivors of the atomic weapons detonations at Hiroshima and Nagasaki (ICRP 1991). Other types of radiation exposure, largely for medical purposes, were also considered where they were appropriate for evaluating a specific type of health effect. One difficulty with this analysis is that the study populations were exposed at doses and dose rates much higher than those observed in any environmental setting. However, because of the large size of these populations and the fact that they represent actual exposures of humans of all ages and both genders, these data are the best available for estimating potential human health effects from environmental exposure levels as well. Studies of humans at environmental radiation exposure levels have not produced any direct evidence of radiation-induced health effects, even in populations where the environmental exposure levels are much higher than average. The ICRP concluded that its risk estimates for human health effects of radiation exposure at environmental levels, based on available data from Japanese survivors and medical exposures, "are unlikely to underestimate the risks" (ICRP 1991).

Latent cancer fatalities are most commonly used as an indicator of potential radiation health effects because they are estimated to occur at lower doses than other types of effects and therefore represent one of the most sensitive indicators of any potential effects. The ICRP (1991) study estimated that the lifetime risk of all latent fatal cancers following radiation exposure to the general population is 4×10^{-2} per Sv (or 4×10^{-4} per person-rem). This means that a large population consisting of all ages would be expected to experience, at most, 1 latent fatal cancer during the lifetimes of all exposed individuals following a collective radiation dose of 2000 person-rem. As noted previously, this estimate is expected to be conservative (i.e., to overestimate the actual risk rather than to underestimate it). However, it is generally accepted by most U.S. and international agencies as the standard for radiation protection purposes at the exposure levels experienced in environmental and occupational settings. The uncertainties associated with this estimate are such that the risks of radiation exposure from medical isotope production, which are reported in this EIS as a finite probability of experiencing cancer fatalities, may actually be zero.

The average individual in the U.S. receives a radiation dose of approximately 300 mrem per year from natural background sources and another 60 mrem per year from artificial sources, largely medical exposures. The collective radiation dose to the U.S. population is therefore about 95 million person-rem per year from these sources. In contrast, air emissions from all DOE facilities in the U.S. currently result in collective doses to the surrounding population of about 100 person-rem per year. Based on the ICRP (1991) estimate, this represents a dose 20 times lower than that required to produce, at most, 1 fatal cancer in the entire U.S. population. Air emissions from the proposed Medical Isotopes Production Project could increase the cumulative total radiation dose from all DOE facilities by 0.7 to 15%, depending on the alternative chosen. Any potential increase in cancer death rates from these exposures would never be observable within the existing U.S. cancer fatality rate of over 500,000 per year. These small potential risks must also be balanced with the very real and immediate risk of not having a reliable supply of widely used medical isotopes which substantially improve the quality of health care in the U.S.

NEI
NUCLEAR ENERGY INSTITUTE

Felix M. Killar, Jr.
DIRECTOR, MATERIAL
LICENSEES PROGRAMS

February 22, 1996

Mr. Wade Carroll
MIPP-EIS Document Manager
U.S. Department of Energy, NE-70
19901 Germantown Road
Germantown, Maryland 20874

SUBJECT: Medical Isotopes Production Project:
Molybdenum-99 and Related Isotopes
Draft Environmental Impact
Statement 60 *Federal Register* 66542

Dear Mr. Carroll:

The Nuclear Energy Institute (NEI)* has reviewed the draft Environmental Impact Statement (EIS) and the implementation plan for the medical isotope production project: Molybdenum-99 and related isotopes. NEI endorses the underlining
1 Department of Energy (DOE) concept of providing Mo-99 if the Canadian source becomes unavailable.

We do, however, have some reservations with DOE's approach to addressing this potential problem. The DOE has indicated that it would like to be a Food and Drug Administration (FDA) approved supplier of Mo-99. An important omission in the
2 draft EIS is the timing of the FDA's approval of a new source of Mo-99. Our best estimate would be at least one year to 18 months following full production. The draft EIS is silent on this time-sensitive point. As proposed, the DOE program, with FDA approval, will only be coming into full production in the 1998 time period.

The draft EIS correctly noted that a reliable source will only be available with two operating reactors. It is feasible to have one in the United States and one in Canada, or perhaps two in Canada. Until then the medical community is at risk.

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* NEI is the organization responsible for establishing unified nuclear industry policy on matters affecting the nuclear energy industry, including the regulatory aspects of generic operational and technical issues. NEI's members include all utilities licensed to operate commercial nuclear power plants in the United States, nuclear plant designers, major architect/engineering firms, fuel fabrication facilities, materials licensees, and other organizations and individuals involved in the nuclear energy industry.

Mr. Wade Carroll
February 22, 1996
Page 2

3 We are concerned with the potential supply gap between now and 1998 when either the first new Canadian reactor comes on line or DOE receives its FDA approval for Mo-99. The supply of Mo-99 continues to be vulnerable with a single reactor as its source. We believe that the DOE can address this concern about a reliable Mo-99 source during the 1996 to 1998 time period by pursuing the alternative outlined below.

We would propose that DOE enter into an agreement with AECL or Nordion to be the backup supplier of irradiation service. The intent would be that the DOE program would irradiate targets (either DOE or Nordion supplied), process the irradiated target and return the raw Mo-99 to AECL/Nordion for final processing which would use Nordion's FDA approval for getting the Mo-99 to the market. As proposed in the EIS, DOE could irradiate the targets in the Annular Core Research Reactor, process the irradiated targets at Sandia National Laboratories and return the raw Mo-99 to AECL/Nordion for final processing.

4 We agree with DOE that the Annular Core Research Reactor is the best alternative for producing the Mo-99. First, it is the only alternative that utilizes an operating reactor. Second, it has a potential defense mission that helps assure that it will be operable during the 1996 -1998 time period. Finally, the Annular Core Research Reactor would have the least lag time to provide this service. We would like to be assured that at a minimum an irradiation facility and initial processing of target facility is available.

5 In parallel with supplying raw Mo-99 to Nordion, DOE, with the industry's support, should be proceeding with its FDA approval. This dual approach would address the near term issue of having a second reactor to supply irradiated targets in the event the Canadian reactor were to be forced off line, and it would address the longer term issue of a second source in the event of continuing delays in the Canadian program. It has the added benefit of providing an outlet for the raw Mo-99 which will be produced at some nominal level during the FDA approval process and therefore provide revenue to offset some of the expenses during this time period.

In summary, we agree with DOE's intent to increase the reliability of supply of Mo-99. We believe, however, that this goal could be better accomplished by pursuing the dual path alternative describe in these comments as opposed to the alternatives contained in the draft EIS. If you have any questions concerning NEI's comments or would like assistance from the industry pursuing the alternative proposed in this letter, please contact me at (202) 739-8126.

Sincerely,

Felix M. Killar, Jr.

Responses to Comment Letter C101

1 Comment noted.

2 The Department has been in contact with the FDA regarding the time necessary to gain approval of its Mo-99 production process. Considering that the Department proposes to use a previously approved process for Mo-99 production, the FDA has indicated that the necessary time to obtain approval could be less than a year. The production schedules for the alternatives include the time estimated to be required to obtain FDA approval.

3 Information for this option is presented in Section 5 and Appendix B of the EIS. The Summary has been revised to clearly indicate this option, and shipping container information has been added to Section 5.11.

4 Comment noted. If the Annular Core Research Reactor (ACRR) is chosen for Mo-99 production, its mission would be changed from defense programs to medical isotope production.

5 Please see response to comment C101-3 above.

1 Let me state my position clearly. I fully support the effort to produce medical isotopes at the Idaho National Engineering Laboratory.

2 The Power Burst Facility can be started for significantly less cost than any other facility being considered in the Draft EIS.

For too long this nation has relied on Canada and, to a lesser extent, Europe to supply the medical
3 isotopes America needs. The time has come for this nation to take care of our own. I commend
the Department of Energy for identifying this vital national need.

I am concerned, however, that the Draft EIS indicates that the DOE is only looking for back-up capability to provide 10% to 30% of the U.S. Mo-99 needs. In the Final EIS, the DOE should revise the objective and raise the standard. The goal should be to provide 100% of American needs, and maybe more.

The case for this position, to provide for 100% of production needs, is clearly made by the Draft
EIS. The document plainly states that if the Canadian Reactors were shut down, European sources
could only provide a portion of U.S. demand. The statement also notes that until a back-up
4 production facility is brought on line which is capable of producing 100% of American needs, our
nation is vulnerable to an interruption in the supply of this important isotope.

The case is clear. The U.S. needs to have the capability for full production of these important isotopes. PBF can fulfill that need.

As the DOE looks to meet the needs of our nation, the Department should also look beyond our nation's border. It is not enough to just satisfy the needs of American customers. The DOE should also begin searching out foreign markets for this important American product. Now is the time to begin.

Responses to Transcript IDA01

1 Comment noted.

2 Please see response to comment C017-2.

3 Comment noted.

4 Please see response to comment C017-4.

The INEL has already made contributions to medical research. For instance, using the Power
Burst Facility for Boron Neutron Capture Therapy, a break-through treatment for brain tumor
1 patients with minimum patient trauma and cost. The production of medical isotopes, continuously
needed in the U.S., offers the INEL another opportunity to play an important medical role for the
nation.

Because of the INEL's critical nuclear expertise developed over 50 years, the INEL is the perfect
2 and most logical location to produce these most important medical isotopes many patients in our
nation need. Our country would benefit significantly from this vital program.

At present, the U.S. has only one source of supply of Mo-99. That source is Nordion International,
which produces it at the aging NRU Reactor at Chalk River, Ontario. This reactor is just two years
away from completing its 40-year design life. NRU not only supplies the entire U.S. market for
Mo-99, it supplies 85% of the entire world market. The future of medical isotope production from
NRU is in serious jeopardy. This threat is so serious I understand a company has obtained a
license to upgrade a 45 megawatt reactor in the Netherlands, clearly a result of the uncertainty
3 about the Canadian supply. This country obviously needs a domestic supply of these important
medical isotopes.

Although there may be other Canadian reactors coming on line in the future for medical isotope production, it is vitally important that our nation have the capability to produce medical isotopes on our own. We cannot afford to continue our current vulnerability.

As noted in this Draft Environmental Impact Statement, our goal is to meet initial domestic
4 production of only 10% to 30% of the nation's need. I believe we must move forward to assure we
can produce 100% of our nation's medical isotope needs.

5 Today I will speak in support of the alternatives discussed in the Draft EIS that uses the facilities of
the INEL.

6 The INEL offers the potential dual use of an existing reactor for medical isotope production and
cancer therapy.

INEL offers unsurpassed expertise in reactor operations, existing reactors, and complete infrastruc-
7 ture support, Hot Cells and remote handling capabilities, expertise in handling and shipping spent
nuclear fuels, among others, that can be adapted to the production of these isotopes.

I am perplexed that the Advanced Test Reactor is not considered in this DEIS. I suggest DOE
8 consider ATR in their Final EIS. I understand also that advances are being made in accelerator-
based alternative technology research, and DOE may want to consider this alternative in the Final
EIS, as well.

INEL offers an experienced, effective reactor operations management. However, in keeping with Congress' insistence that federal dollars are used as wisely as possible, the INEL management is actively evaluating the privatization of reactor facility operations to assure effective use of tax dollars.

9 The Idaho Brain Tumor Center has offered to coordinate its reactor conversion plans for the PBF with the DOE, potentially saving millions of dollars.

Isotopes USA and the Idaho State University have offered private management and operation for the production of Mo-99.

One of the partners in the INEL management team, Thermo Technology Ventures, is actively researching alternative technologies for isotope production.

10 INEL offers the lowest cost alternative for isotope production. We can simply not afford to pursue any alternative but the most cost-effective means to meet isotope production needs.

11 The PBF Reactor is the only alternative in the DEIS that uses low-enrichment uranium at the onset of operations, reducing the waste generated and the security requirements inherent in using highly-enriched uranium.

12 I believe the DOE has moved far too quickly with far too little data in recommending a preferred alternative for isotope production. I strongly encourage DOE to take another look at INEL and assemble detailed costs for a wide array of alternatives in the Final EIS.

Responses to Transcript IDA02

1 Please see response to comment C015-1.

2 Please see response to comment C015-2.

3 Comment noted.

4 Please see response to comment C015-4.

5 Comment noted.

6 Please see response to comment C015-1.

7 Please see response to comment C015-7.

8 Please see response to comment C015-8.

9 Please see response to comment C015-9.

10 Please see response to comment C015-10.

11 Please see response to comment C015-11.

12 Please see response to comment C015-12.

1 I want to offer my enthusiastic support to the local effort to use the Power Burst Facility and the Idaho Brain Tumor Facility for the production of Mo-99. In my view, it makes great sense to couple the Boron Neutron Capture Therapy (BNCT) program with the production of important medical isotopes.

2 To begin with, according to the technical experts I have consulted, the Power Burst Facility is the ideal reactor for the production of medical isotopes.

3 At the same time, the PBF can be prepared for this mission in less time and at less cost than any other option being considered by the Department of Energy.

4 The Idaho Brain Tumor Center is an excellent example of this new private enterprise expansion and the production of Mo-99 and the PBF Reactor would complement this effort.

Responses to Transcript IDA03

1 Comment noted.

2 Please see response to comment C014-2.

3 Please see response to comment C014-3.

4 Please see response to comment C014-4.

1 I believe the PBF facility demonstrates the most efficient, technologically compatible and environmentally sound facility for production of the supply of Mo-99 for the U.S. medical industry and I suggest its designation as such.

2 The Idaho PBF Reactor can supply 100% of the domestic demand for Mo-99 and still have excess production capacity for the exportation of Mo-99.

3 Further, the PBF, the humanitarian aspects of the combined National Center for BNCT and the isotope production project makes the INEL's PBF the clear choice for the production of the nation's supply of medical isotopes.

Responses to Transcript IDA04

1 Comment noted.

2 Please see response to comment C016-2.

3 Please see response to comment C016-3.

1 The Board of Directors and administrative staff of the Idaho Falls Symphony is in support of the production of medical isotopes for cancer and heart disease screening and therapy at the Idaho National Engineering Laboratory.

2 We believe the Power Burst Facility is technically the superior facility for the project. In addition the location would eliminate the need for shipment of low-level waste across state lines.

3 We also believe the Idaho Falls community would provide the necessary infrastructure, including medical, educational and cultural facilities to support the project and its personnel.

Responses to Transcript IDA05

1 Comment noted.

2 Please see response to comment C010-2.

3 Please see response to comment C010-3.

1 We [the INEL Committee of the Chamber of Commerce] certainly back the facility which is covered in the EIS.

2 The PBF Reactor is the only one using low enriched uranium fuel, which reduces the weight generation and the security requirements.

3 The PBF can dispose of the low-level waste generated on the Site, while the preferred alternative would require packaging and shipping across state lines to the Nevada Test Site.

4 Currently the PBF is the only choice which envisions the private sector taking over production.

5 . . .we have half again that that we can sell as excess to the rest of the world or to whoever.

6 Sandia can only produce 30% at the max of the U.S. requirement at this time,

7 . . .we are probably ten years away from an accelerator which could be used for this type of operation.

Responses to Transcript IDA06

1 Comment noted.

2 The Power Burst Facility is the only reactor currently using low enriched uranium fuel. All the other reactors evaluated in detail have designs for converting to low enriched uranium. The objective is not to build any more highly enriched uranium fuel bundles for any of the other reactors, but to use the fuel already on hand until the supply is exhausted or, in the case of the Annular Core Research Reactor, until the burnup limit is reached (see Section 3.3.1.9). Two or three transition cores of both low enriched uranium and highly enriched uranium would be used during the conversion to all low enriched uranium fuel for these options. This is a long-term safeguards advantage, in that it depletes and irradiates the weapons grade material on hand.

It is not true that use of low enriched uranium fuel minimizes waste. More spent fuel bundles are generated per reactor full power year with the use of low enriched uranium bundles.

3 The Department recognizes that "cradle-to-grave" waste management is a benefit of the INEL and LANL alternatives.

4 The Idaho Brain Tumor Center (IBTC) has informed DOE of its interest in coordinating its efforts with those of DOE. The Department is aware of this potential for the INEL alternative. Although the potential for privatization of the proposed action in this EIS is important, the process for privatization is not part of this proposed action. Each of the production alternatives has potential for privatization. DOE has solicited expressions of interest from the industrial community for the privatization of any isotope production activity conducted by DOE, including the proposed Medical Isotopes Production Project. If promising concepts are received, the Department would seek privatization proposals on a competitive basis.

5 If the decision is made to pursue this project, the Department would act as a backup to the existing Canadian supplier. The goal of the proposed project is to ensure that a reliable supply of Mo-99 is available to the U.S. medical community, thus, 100% of the U.S. demand would be produced only during times when the Canadian supply was unavailable. While each alternative could produce at least 100% of U.S. demand and export of Mo-99 could help offset operating costs, it is not the goal of the proposed project to produce Mo-99 for export and compete in the worldwide market for Mo-99.

6 As stated above, all of the reactors evaluated as reasonable alternatives for the proposed project would (after necessary modifications) have the ability to produce at least 100% of the U.S. demand for Mo-99. However, the SNL/NM facilities are the only ones that could produce a fraction of the U.S. demand within 6 months following a Record of Decision to proceed with the proposed action. The ability to produce a fraction of the U.S. demand in a short period of time is important because, if a Mo-99 shortage were to occur in the near future, the Department would be able to supply at least part of the U.S. needs. In the near term, with a single reactor producing 100% of the U.S. demand, a shutdown of that reactor for any reason would result in a Mo-99 supply shortage. The potential for such a shortage is why the ability to produce even a fraction of the U.S. demand in the near term is considered important. This would provide DOE with a Mo-99 extraction process which has met FDA approval requirements in the very near term and would be capable of providing up to 30% of the U.S. demand on an emergency basis. This early experience would also be an asset in the expansion to full-scale production capability.

7 Use of accelerators is discussed in Section 3.4.1.7.

1 . . .the information we were given was that there really was not that much in the way of core modifications that needed to be done, so we kind of feel like that is an unfair statement.

2 PBF has been, on a yearly basis, updating their costs for getting the plant started ever since, I think, it was 1987, because we have been wanting the Boron Neutron Capture Therapy. So they are detailed, and they are accurate.

3 We have heard that their initial estimates were kind of gross and that when they heard how detailed ours was, they were given an extra month to change theirs. So if theirs was so good, why were they given the extra month?

4 Then like has already been mentioned, the Boron Capture Therapy is willing to share the costs. They have got an investor that probably would be able to handle the whole thing by himself, so seems like it would be a lot cheaper just to look at us.

5 . . .if it is going to be up and operating anyway, why not do the Mo-99?

Responses to Transcript IDA07

1 The required Power Burst Facility (PBF) modifications are discussed in Section 3.3.4.9. The estimate for the required modifications is approximately $450,000. The cost estimates in Section 5.22 have been modified to include this cost.

2 The Department has used the best available information for all of its analyses and comparisons, including the cost information. Information on restart of the PBF was fairly thorough and was probably a result of the efforts to estimate costs and schedules for conversion of PBF for boron neutron capture therapy (BNCT). However, reactor conversion and operation is only a portion of the cost and schedule information requested. Hot cell modification, process line fabrication, target fabrication facility modification, and general processing operational costs also are reflected in Section 5.22 of the EIS. Additional information on the estimated cost of the INEL alternative was obtained subsequent to the publication of the Draft EIS and was used in the preparation of the Final EIS; however, the amount of supporting material associated with these estimates was less detailed than that received from some of the other sites. Thus, the EIS contains statements that indicate the margin of error for both the INEL and ORNL estimates are considered larger than for LANL and SNL/NM.

3 All sites were notified of the request for cost and schedule information at the same time and were provided the same deadline. No site was given an extra month to prepare cost estimates. Following the deadline and internal reviews, issues at each of the sites were identified regarding the proposed costs and schedules. Each site, including INEL, was contacted and these issues were discussed and resolved.

4 The Idaho Brain Tumor Center (IBTC) has informed DOE of its interest in coordinating its efforts with those of DOE; however, IBTC has not submitted any plans for coordinating reactor conversion activities, nor has it made a formal proposal to DOE. In addition, the Department understands that IBTC is investigating the possibility of using other facilities for BNCT and that other reactors under consideration for this project may be useable for BNCT. If the Department decides to proceed with a production alternative for this proposed project, it would welcome a proposal from IBTC for dual use of the reactor facility selected.

5 As stated above, IBTC is also investigating other facilities for use in conducting BNCT. It is not evident that IBTC will take the PBF to an operational state.

1 It is pretty obvious that if the takeover of the Mo-99 production occurs in America, that the source would probably dry up in Canada and possibly elsewhere. And so if the Defense Department is able to take over the New Mexico operation at its whim and fancy, mind you, I am an old Air Force man, so I fully support the defense initiative. But if they were to take it over, then we would no longer be producing the Mo-99 And if we do not have the Mo-99? We are in trouble.

So I think that very one fact alone should disqualify New Mexico.

Response to Transcript IDA08

1 The Annular Core Research Reactor (ACRR) is a DOE-owned facility, not a Department of Defense facility. It is possible that the ACRR, the preferred reactor for the proposed project, could be diverted to support defense missions in case of a national emergency. However, the Department has determined that the probability of needing the ACRR for defense purposes is sufficiently low to preclude disqualifying the reactor from consideration.

1 From the figures that I have been shown here locally and, again, we seem to have some discrepancy with what you have got in your figures, I think I have seen the same figures as Mr. White has seen. It appears that it makes no financial sense to put this facility anywhere but Idaho Falls.

Response to Transcript IDA09

1 The Department recognizes that the estimated cost of the INEL alternative is lower than that of the preferred alternative; however, the uncertainties associated with the estimated cost of the INEL alternative are higher than for the preferred alternative. If the Department decides to proceed with the proposed action, the information presented in the EIS (including the cost data), the operational readiness of facilities, and other programmatic factors will be considered in the final selection of facilities for Mo-99 production.

1 . . .our endorsement of the DOE Project for the Production of Medical Isotopes for the screening and therapy of cancer and heart disease; and our endorsement of the project being located at the Power Burst Facility at the Idaho Falls Engineering Laboratory.

We believe the PBF is technically and economically superior among the four DOE sites being considered for the Isotope Production Project

2 . . .this project offers both the Isotope Production Project and the Boron Neutron Therapy - - Concentration Therapy Mission certainly at reduced cost to both of them. And we feel that is a very strong point.

3 In summary, we believe that coupling the Isotope Production Project with the BNCT Mission will be the most cost effective, saving millions of dollars;

4 will produce on the order of 120 new jobs, technical jobs, high compensation rates for the Southeast Idaho area economy,

5 and will provide for the desired technology transfer to the private sector, which has been supported in the past.

Responses to Transcript IDA10

1 Comment noted.

2 The Idaho Brain Tumor Center (IBTC) has informed DOE of its interest in coordinating its efforts with those of DOE. The Department is aware of this potential for the INEL alternative. Although the potential for privatization of the proposed action in this EIS is important, the process for privatization is not part of this proposed action. Each of the production alternatives has potential for privatization. DOE has solicited expressions of interest from the industrial community for the privatization of any isotope production activity conducted by DOE, including the proposed Medical Isotopes Production Project. If promising concepts are received, the Department would seek privatization proposals on a competitive basis.

3 As stated above, the IBTC has informed DOE of its interest in coordinating its efforts with those of DOE; however, IBTC has not submitted any plans for coordinating reactor conversion activities, nor has it made a formal proposal to DOE. In addition, the Department understands that IBTC is investigating the possibility of using other facilities for boron neutron capture therapy (BNCT) and that other reactors under consideration for this project may be useable for BNCT. If the Department decides to proceed with a production alternative for this proposed project, it would welcome a proposal from IBTC for dual use of the reactor facility selected.

4 The socioeconomic impacts of the proposed project are evaluated in Section 5.3 of the EIS.

5 Possible technology transfer activities, as well as treatment facilities that might operate concurrently yet independently of the Mo-99 mission (such as boron neutron capture therapy), are not part of the Department's proposed action or stated purpose and need.

1 I am here in support of locating the production of medical isotopes and the Boron Neutron Capture Therapy Project, otherwise known as BNCT at the INEL.

2 The PBF Reactor is the only reactor using low enrichment uranium fuel which reduces waste generation and security requirements.

3 The PBF can dispose of the low-level waste generated on site while the preferred alternative would require packaging and shipping across state lines to the Nevada Test Site.

4 One reactor suitable for both the Isotope Production and Cancer Treatment Mission. The PBF can produce 100% of the nation's demand for medical isotopes.

5 PBF can accomplish this at the lowest possible cost.

6 PBF, to my knowledge, is the only choice which envisions a private sector taking over production, a good way to demonstrate technology transfer and create jobs here in Southeast Idaho.

Responses to Transcript IDA11

1 Comment noted.

2 Please see response to comment C013-2.

3 Please see response to comment C013-3.

4 Please see response to comment C013-4.

5 Please see response to comment C013-5.

6 Please see response to comment C013-6.

1 . . .a reactor like that, is it a defense laboratory? If it has a defense mission, it has a hold on it by the Defense Department. It has to have special fuel used for that purpose. Different kinds of fuel has to be made to use it for Mo-99 production. It does seem to run counter to the prime purpose that DOE has in coming up with an isotope production mission.

2 I believe that, in fact, the commercial industry, in looking over what they will want and what they can support, would certainly reject anything that would have that kind of stipulation necessarily put on it.

Responses to Transcript IDA12

1 The Annular Core Research Reactor (ACRR) is an Office of Defense Programs facility within DOE, not a Department of Defense facility. It is possible that the ACRR, the preferred reactor for the proposed project, could be diverted to support defense missions in case of a national emergency. However, the Department has determined that the probability of needing the ACRR for defense purposes is sufficiently low to preclude disqualifying the reactor from consideration.

2 The Department believes that the probability of the ACRR being diverted for defense use is sufficiently low that it would not significantly diminish this alternative's potential for privatization.

1 It also seems to me that Tc-99 is one of the most used medical commodities there is. It is used, what, I have heard 36,000 times a day all across the country, and the only source is a foreign country whose interests are not necessarily the same as ours.

Thus, it seems obvious to me that we need a way to make the substance here.

2 Thus, I am in favor of this project. I also live here, and I am in favor of seeing it here. Certainly the BNCT should be here. We have all the facilities; we have been waiting for it. Local physicians have been involved in getting it started. We do not see it yet, but it is very important that we do see it.

So I encourage, number one, the DOE to get active to do something. Do not wait six to 12 months to get on the ball.

Number two, have it here. It is the cheapest; the easiest; we have all the resources here.

Responses to Transcript IDA13

1 The Department is proposing to establish a domestic production source of Mo-99 to ensure that a reliable supply is available to the U.S. medical community. The Department's concern is not that the current source of supply is a foreign source. If the Department decides to pursue this project and at some later date a reliable domestic supply could be ensured by foreign suppliers, then the Department would phase out its production of Mo-99.

2 Comment noted.

1 As far as the defense hold on the reactor down there, to a facility like ours, and for all the other ones across the country, that alternative is just as scary as staying with Canada and having that source be abolished.

Defense, of course, you know, is number one, but if the Defense Department should take over that reactor, what is to happen to all the patients, all the out-patient facilities and even the hospitals that use this every day and rely on it?

Responses to Transcript IDA14

1 The Annular Core Research Reactor (ACRR) is an Office of Defense Programs facility within DOE, not a Department of Defense facility. It is possible that the ACRR, the preferred reactor for the proposed project, could be diverted to support defense missions in case of a national emergency. However, the Department has determined that the probability of needing the ACRR for defense purposes is sufficiently low to preclude disqualifying the reactor from consideration.

1 . . .why is the DOE looking to replace one reactor with one reactor? We are getting essentially back into the same scenario.

Response to Transcript IDA15

1 The Department is not proposing to replace the Canadian reactor. Instead, the Department is proposing to establish a backup to the currently operating Canadian reactor. Nordion International, the Canadian Mo-99 supplier, intends to build two new reactors to replace the current aging Canadian Mo-99 production reactor, which is planned to be shut down in 2000. If the DOE decides to pursue this project, it will operate its Mo-99 facilities at full production capability only in the event of a Mo-99 supply shortage.

1 I clearly have a concern that there is no advantage to Sandia over Idaho. In listening to the comments we have heard today, it is very clear that in terms of cost, safety, production capability, the PBF is clearly the most advantageous site that DOE should choose.

Response to Transcript IDA16

1 The SNL/NM option was selected as the preferred alternative for the reasons stated in Section 3.3.1.1.

The Department recognizes that the estimated cost of the INEL alternative is lower than that of the preferred alternative; however, the uncertainties associated with the estimated cost of the INEL alternative are higher than for the preferred alternative. If the Department decides to proceed with the proposed action, the information presented in the EIS (including the cost data), the operational readiness of facilities, and other programmatic factors will be considered in the final selection of facilities for Mo-99 production.

1 This country does not produce, but is an importer of radioisotopes. We must establish this capability in the U.S..

2 The Idaho National Engineering Laboratory brings a unique mix of scientific knowledge, isotope production experience, facility availability, and an established professional and university network.

3 Considering that the no-action alternative is an alternative, I would suggest that you positively consider the social benefits of establishing a Mo-B production capability in this country; that you positively consider the economic benefits of building that capacity around established strength; that you positively consider the environmental, economic and technical benefits of investing in the development of advanced technologies to produce radioisotopes more effectively and efficiently; and, that you positively consider the environmental and economic benefits of building upon the existing isotope production capacity, including facility in human resources such as already exists at the INEL; and, that you consider the environmental benefits of inside defense production capability, such as also exists at the INEL.

4 . . .and that production begin as quickly as possible.

Responses to Transcript IDB01

1 Please see response to comment C095-1.

2 Please see response to comment C095-2.

3 Please see response to comment C095-3.

4 Please see response to comment C095-4.

1 The Idaho National Engineering Laboratory's Power Burst Facility Reactor has recently been listed as the potential site of the United States' sole source of Mo-99 isotope production. I believe that the PBF represents the most technologically compatible, economically efficient and environmentally sound facility for domestic Mo-99 production and urge its designation as such.

2 Idaho is proud that the PBF will soon focus the world's attention on the implementation of Boron Neutron Capture Therapy at the Idaho Brain Tumor Center. The technological partnership between DOE and IBTC is a credit to Idaho and the nation. It is my hope the victims whose maladies will be treated from here, whether from Idaho, the other U.S. or around the world, will come to understand, as you and I do, the broad advantages to our lives this government/private sector relationship creates.

3 The production of medical isotopes and the practice of BNCT are technologically compatible projects which can be carried out more efficiently and more cost effectively at the INEL's PBF reactor than at other facilities currently under evaluation by DOE.

4 Initial engineering studies show that the Idaho PBF facility can be ready for medical isotope production in less time and for $5 million less than any of the other three finalists being considered for the project.

5 High product quality and consistency of supply are the two most important ingredients when considering a facility for the production of medical isotopes. The Advanced Test Reactor, also located at the INEL, has been producing specialty isotopes for many years. The expertise is presently in place to produce isotopes to the highest quality standards. With the PBF serving as the main isotope production facility, the ATR can fill in and maintain a constant production schedule when the PBF is down for routine maintenance and refueling. Idaho offers a twin reactor concept that assures consistency of supply for many years to come.

6 The U.S. currently has no domestic supply of the most widely-used medical isotopes. The Idaho PBF Reactor can supply 100% of the domestic demand for Mo-99 and still have excess production capacity for the exportation of Mo-99

7 DOE intends to privatize the Isotope Production Program. IBTC's present 30-year lease of the PBF Reactor puts the privatization plan into effect immediately.

8 No other federal missions will interfere with the operation of Mo-99 production at the PBF, unlike some of the other sites under review.

9 After considering the lower start-up costs, mission compatibility and technological superiority, it is clear that INEL's PBF is the logical home of the U.S. Mo-99 production source.

Responses to Transcript IDB02

1 Comment noted.

2 Comment noted.

3 Please see response to comment C037-3.

4 Please see response to comment C037-4.

5 Please see response to comment C037-5.

6 Please see response to comment C037-6.

7 Please see response to comment C037-7.

8 Please see response to comment C037-8.

9 Comment noted.

1 We have modified our plans to allow for a dual medical mission, which really seems to make the most sense for this facility, one project practically guaranteeing the success of the other.

2 DOE has stated that the goal is to eventually privatize the production of medical isotopes and turn over to the private sector and let the free market enterprise forces dictate the price of supply of these products.

3 The selection of the preferred site virtually guarantees that this will never happen, at least at that location. IBTC wonders what company would normally enter into a privatization effort, given the fact that situations in the world could force a mission to be returned to a military mission and, thereby, terminate or severely curtail production at that facility.

IBTC believes that a few months of schedule is a small price to pay for the assurance of a truly dedicated facility that could be brought on line and satisfy all production requirements for 100% of U.S. demand with excess capacity potential for export to other countries and to fill dual medical mission roles for one facility that cannot be impacted by changes in Defense policy.

4 INEL has had 35 year's experience in the production of isotopes, meeting the critical needs of customers, their demands for quality and a reliable schedule. The other sites have had no experience in this area.

5 IBTC questions the wisdom of selecting a site that seems to fall short of DOE's goals from the beginning.

Responses to Transcript IDB03

1 The Idaho Brain Tumor Center (IBTC) has informed DOE of its interest in coordinating its efforts with those of DOE; however, IBTC has not submitted any plans for coordinating reactor conversion activities, nor has it made a formal proposal to DOE. In addition, the Department understands that IBTC is investigating the possibility of using other facilities for boron neutron capture therapy (BNCT) and that other reactors under consideration for this project may be usable for BNCT. If the Department decides to proceed with a production alternative for this proposed project, it would welcome a proposal from IBTC for dual use of the reactor facility selected.

2 The Department would prefer that the private sector assume responsibility for ensuring that a reliable supply of Mo-99 is available to the U.S. medical community; however, private industry has thus far been unwilling to do so. Therefore, DOE has proposed to conduct the Medical Isotopes Production Project. If private industry is able to ensure a reliable supply of Mo-99 on its own, the Department would phase out its production activities.

Private U.S. production of Mo-99 could be accomplished by privatization of a DOE operation or by a separate initiative by the private sector. The process of privatization is not part of this proposed action. The Department published a Notice for Expression of Interest in the *Federal Register* in December 1995 to solicit concepts from private industry for privatization of DOE isotope activities. Businesses interested in pursuing Mo-99 production have been invited to respond to this solicitation. If the Department decides to implement the action proposed in this EIS and if concepts on privatization of Mo-99 production received from the private sector are promising, DOE would proceed with a request for proposals to facilitate privatization on a competitive basis.

3 It is possible that the Annular Core Research Reactor (ACRR), the preferred reactor for the proposed project, could be diverted to support defense missions in case of a national emergency. However, the Department has determined that the probability of needing the ACRR for defense purposes is sufficiently low to preclude disqualifying the reactor from consideration.

All of the reactors evaluated as reasonable alternatives for the proposed project would (after necessary modifications) have the ability to produce at least 100% of the U.S. demand for Mo-99 and would also be capable, to varying degrees, of conducting synergistic activities. If the decision is made to pursue this project, the Department would act as a backup to the existing Canadian supplier. The Department would operate its facilities to produce only as much Mo-99 as is necessary to maintain the capabilities of the facility and staff to produce 100% of U.S. demand in response to an interruption of the existing supply. In essence, the project would act as an "insurance policy" for the U.S. against a Mo-99 supply shortage. The goal of the proposed project is to ensure that a reliable supply of Mo-99 is available to the U.S. medical community, not to compete in the worldwide market for Mo-99.

4 As presented in Table 3-2, LANL and ORNL also have significant experience in the production and distribution of isotopes.

5 The Department has not made a decision regarding if and where to conduct the proposed project. A preferred alternative is identified in an EIS, in essence, to tell the public which way the Department is leaning on a decision, but it does not mean that the decision has been made. Further, Council on Environmental Quality regulations require Federal agencies to identify the preferred alternative in a Draft EIS if the agency has one, and require that the agency identify a preferred alternative in a Final EIS.

The Annular Core Research Reactor/Hot Cell Facility combination at SNL/NM is the preferred alternative for target irradiation and processing for the reasons stated in Section 3.3.1.1.

1 I support the medical isotope being here in Idaho.

Response to Transcript IDB04

1 Comment noted.

1 You mentioned on privatization as being off in the future. I am associated with a privatization action here at the Site. It is very real. The pressure is there, and I do not understand how in your office in D.C. you somehow are not getting the sense that it is in the now. If the private sector can do the job, we have the pressure on us that that is the way it is supposed to be done. And so we are doing that actively out at the Site right now. I suggest that you reconsider your criterion and get that more in focus that if you can have that option of a privatization in the now term, that you have that as a consideration compared to the others, because where many other things are equal, I would think then that it automatically starts rolling into that bin, if you understand what I mean.

2 Now with the PBF being an option, and the only way that is basically happening is in this lease arrangement at IBT, then you are under an NRC license situation. Section 6.1 in your EIS works in terms of DOE orders. Most all the DOE orders would not be applying in this case, because you would be under the license-type of arrangement.

3 And on the Sandia Reactor, I do not know what the state is on their SAR to the latest requirements.

4 I would think that with the distance we have where the reactor and the other facilities relative to site boundary, which nobody lives at, is that this inherently is a difference, albeit, I think it can be safe anywhere. It is a matter of just doing it, but there are certain things to me that just make a little more sense of doing it where you have more distance to where the public is in case something does go wrong.

5 BNCT does get a stronger basis economically to occur, if you can work with this other situation, you know, the medical isotope. I think the government should give that a certain extra weight, too. It is multiple use of a facility of our assets as taxpayers of how to put this to more effective use. And it is a good machine. So please, give this due consideration.

Responses to Transcript IDB05

1 The Department would prefer that the private sector assume responsibility for ensuring that a reliable supply of Mo-99 is available to the U.S. medical community; however, private industry has thus far been unwilling to do so. Therefore, DOE has proposed to conduct the Medical Isotopes Production Project. If private industry is able to ensure a reliable supply of Mo-99 on its own, the Department would phase out its production activities.

Although the potential for privatization of the proposed action in this EIS is important, the process for privatization is not part of this proposed action. Each of the production alternatives has potential for privatization. DOE has solicited expressions of interest from the industrial community for the privatization of any isotope production activity conducted by DOE, including the proposed Medical Isotopes Production Project. If promising concepts are received, the Department would seek privatization proposals on a competitive basis.

2 The Idaho Brain Tumor Center (IBTC) has not made a formal proposal to the Department regarding the dual use of the Power Burst Facility (PBF). Therefore, the Department cannot say for certain whether operation of the PBF for the production of Mo-99 would be conducted privately (by IBTC) or by DOE. In developing the EIS, the Department assumed that if the PBF were selected for the isotope production mission, DOE would operate the reactor under DOE regulations.

3 The Annular Core Research Reactor (ACRR) safety analysis report (SAR) was recently revised to conform to the DOE Order 5480.23 "Requirements for Safety Analysis Reports" and is adequate for initial Mo-99 production activities. However, a future SAR update would be required to address the core and fuel design changes anticipated for full production at the ACRR.

4 The EIS considers the potential impacts to individuals and communities from operations and potential accidents in Section 5. Regional geographic and meteorological conditions, as well as area population, all are factors that were included in the evaluation of the potential impacts of the proposed project.

5 The IBTC has informed DOE of its interest in coordinating its efforts with those of DOE; however, IBTC has not submitted any plans for coordinating reactor conversion activities, nor has it made a formal proposal to DOE. In addition, the Department understands that IBTC is investigating the possibility of using other facilities for boron neutron capture therapy (BNCT) and that other reactors under consideration for this project may be useable for BNCT. If the Department decides to proceed with a production alternative for this proposed project, it would welcome a proposal from IBTC for dual use of the reactor facility selected.

1 Beauty For All Seasons, Inc. wholeheartedly endorses and supports the DOE's selection of the Idaho Falls PBF Facility for the future production of Mo-99 medical isotopes.

2 The selection of Idaho Falls PBF Facility for medical isotope production will increase employment opportunities, improve economic base not only directly through people employed at the facility, but also through the ripple effect of increased visitors for technical and medical purposes.

3 We are a nation that is suffering a balance of payments problem. We are buying everything from the Japanese, the Germans and the Canadians. That causes a weaker dollar. Here is a chance for us to put 100% of the Mo-99 production in this country for us to make the product here and serve it, and we certainly need it. We have got to buy it from somebody. Let us buy it from ourselves. Let us get jobs here. We have got the technical skills, better skills than the Canadians have. Let us bring the business here; let us employ the people here; let us help the balance of payments come into this country. Let us have Canadians and Europeans buy Mo-99 production from us. We need to think about this business not just in terms of is Sandia going to give us 10% production? Is it going to satisfy the medical isotope people that need to throw a bone out? What is important is we have got to think about the nation, too. And in my mind, that is as important to me as to think about Idaho Falls as a community.

Responses to Transcript IDB06

1 Comment noted.

2 The anticipated socioeconomic impacts of the proposed project are presented in Section 5.3. The number of technical and medical visitors to the region as a result of the Mo-99 mission is expected to be very small at any of the alternative sites. All sites have the possibility of additional missions.

3 The Department is proposing to establish a domestic production source of Mo-99 to ensure that a reliable supply is available to the U.S. medical community. The Department's concern is not that the current source of supply is not a domestic source. If the decision is made to pursue this project, the Department would act as a backup to the existing Canadian supplier. The Department would operate its facilities to produce only as much Mo-99 as is necessary to maintain the capabilities of the facility and staff to produce 100% of U.S. demand in response to an interruption of the existing supply. In essence, the project would act as an "insurance policy" for the U.S. against a Mo-99 supply shortage. The goal of the proposed project is to ensure that a reliable supply of Mo-99 is available to the U.S. medical community, not to compete in the worldwide market for Mo-99.

1 I agree with others here that Idaho seems to be, from a radiological consequence consideration, the logical choice, and when compared with the cost analysis and in light of measures that could be taken to reduce the potential for transportation-related accidents, certainly by far is arguably the best choice.

2 The fact that I went to prototype here in 1984 and 1985 has nothing to do with that, but I do agree that this is a very good center of highly qualified and skilled technical and engineering people that are very well capable and ready to do these sorts of projects.

Responses to Transcript IDB07

1 Comment noted.

2 The INEL and each of the other alternative sites have available the highly qualified and skilled technical and engineering staff necessary to conduct the proposed project.

1 I would just like to go on record that I do support this program,

Response to Transcript IDB08

1 Comment noted.

1 | It would be smartest to allow the INEL to take on the project.

2 | It is the cheapest available to operate the project, and it is technically the best suited.

3 | . . .the private company to run the facility is also here at the INEL,

Responses to Transcript IDB09

1 Comment noted.

2 The Department recognizes that the estimated cost of the INEL alternative is lower than that of the preferred alternative; however, the uncertainties associated with the estimated cost of the INEL alternative are higher than for the preferred alternative. If the Department decides to proceed with the proposed action, the information presented in the EIS (including the cost data), the operational readiness of facilities, and other programmatic factors will be considered in the final selection of facilities for Mo-99 production.

3 The Idaho Brain Tumor Center (IBTC) has informed DOE of its interest in coordinating its efforts with those of DOE. The Department is aware of this potential for the INEL alternative. Although the potential for privatization of the proposed action in this EIS is important, the process for privatization is not part of this proposed action. Each of the production alternatives has potential for privatization. DOE has solicited expressions of interest from the industrial community for the privatization of any isotope production activity conducted by DOE, including the proposed Medical Isotopes Production Project. If promising concepts are received, the Department would seek privatization proposals on a competitive basis.

1 If the Cancer Treatment Center gets this project, it virtually assures both of them will succeed, whereas certain people have voiced some opinion that maybe the Cancer Treatment will not be viable by itself.

I think that if it got this project, it makes one of the two have zero cost, basically, or half the cost of the other one.

Response to Transcript IDB10

1 The Idaho Brain Tumor Center (IBTC) has informed DOE of its interest in coordinating its efforts with those of DOE; however, IBTC has not submitted any plans for coordinating reactor conversion activities, nor has it made a formal proposal to DOE. In addition, the Department understands that IBTC is investigating the possibility of using other facilities for boron neutron capture therapy (BNCT) and that other reactors under consideration for this project may also be useable for BNCT. If the Department decides to proceed with a production alternative for this proposed project, it would welcome a proposal from IBTC for dual use of the reactor facility selected.

1 I want to state why it makes economic sense to locate this facility in Idaho Falls. In looking over the Draft Environmental Impact Statement, there are certain obvious differences, but the most obvious one to me as a businessman here in Idaho Falls, is the economic difference.

There is $2 million that will be saved in construction costs; $4 million per year in operating costs;

2 Secondly, there is the possibility that even if that production came up in six months, that those medical isotopes could not be used because of contractual obligations between Nordion and pharmaceutical companies. So we do not even know for sure that the six months would even result in any net benefit.

Responses to Transcript IDB11

1 The Department recognizes that the estimated cost of the INEL alternative is lower than that of the preferred alternative; however, the uncertainties associated with the estimated cost of the INEL alternative are higher than for the preferred alternative. If the Department decides to proceed with the proposed action, the information presented in the EIS (including the cost data), the operational readiness of facilities, and other programmatic factors will be considered in the final selection of facilities for Mo-99 production.

2 The ability to produce even a small amount of Mo-99 in a short period of time is important in that, if a Mo-99 shortage were to occur in the near future, the Department would be able to supply at least a fraction of the U.S. demand. The Department has proposed the Medical Isotopes Production Project to respond to a near-term "window of vulnerability" in the Mo-99 supply situation. With a single reactor currently producing 100% of the U.S. demand, if that reactor were to be shut down, it would result in a Mo-99 supply shortage. The potential for such a shortage is why the ability to produce even a fraction of the U.S. demand in the near term is considered important. This would provide DOE with a Mo-99 production and extraction process which would met FDA approval requirements in the very near term and would be capable of providing up to 30% of the U.S. demand on an emergency basis. This early experience would also be an asset in the expansion to full-scale production capability.

1 This gives us a unique opportunity to produce a medical product in Idaho that we can sell elsewhere.

Response to Transcript IDB12

1 The Medical Isotopes Production Project would provide the same unique opportunity at any of the proposed sites. The INEL already has an active medical isotope program. The proposed project would add to this established capability.

1 The ACRR says that they will have to replace their fuel with brand new fuel to transition. Has this fuel been purchased? Has it been designed. Has any safety analysis been done running the core with this new fuel? How much is it going to take to be able to change over to a brand new fuel?

2 PBF is listed as having a six-inch test space, when it actually is eight and a quarter and it says that we can handle at least 19 targets when we can handle probably at least 27 targets. It says we can put only one target in out transient rods. The physical space would allow anywhere from two to three additional targets.

3 If you look at the figures for PBF at 2400 curie days of Mo-99, and you add the additional targets that can be put into our core without any modifications, which the EIS says is required, and it is not, then we end up almost doubling the amount of Mo-99 to well over 3,000 curie days, to well over, which is a heck of a lot more than Sandia can make, because they are struggling to reach 100%, whereas we can go well over 100%.

Responses to Transcript IDB13

1 No new fuel has been purchased. The price has already been determined by General Atomics, which will be the same price as a normal TRIGA bundle. The new fuel has been designed. Calculations have been performed on the new fuel and core design, but the safety analysis report would require updating to include these descriptions and calculations. Since the core was originally designed to run with normal TRIGA fuel, the design change to fuel (that is mechanically identical to fuel already used) is not very expensive.

2 The 6-inch diameter is a typographical error, and Section 3.3.4 was changed to correct this error. Using a standard geometric spacing configuration to attempt to keep the thermalization of neutrons consistent among the targets would dictate use of a 37-target arrangement as the step beyond the 19-target configuration. A 27-target configuration would probably not work very well because differences in the targets' thermal flux fields will produce different power levels. An adequate water space between the targets is required for both cooling and moderation.

Increasing the number of targets reduces moderation and hence reduces fission rate and Mo-99 production rate per target. This increases the waste per curie of product.

3 The Department has performed calculations that indicate the Power Burst Facility (PBF) can produce 20 kW per target in the 19-target configuration. These calculations indicated that the PBF could conduct a full production Mo-99 mission, even though the PBF's flux is lower than the other facilities. Using the pulse rod receptacles for ancillary irradiation locations seems to be adequate to assure full production could be reached, even if full production were not capable in a central irradiation cavity. The Department agrees that pulse rods could probably accommodate two targets. Three could be inserted, but they would run at lower power levels because of the decrease in moderation, impacting waste as discussed above.

1 I hope it is here. If it is not, that is okay, as long as it was based on good, sound logic.

Response to Transcript IDB14

1 The rationale for the Department's decision will be documented in a Record of Decision that will be issued following completion of the Final EIS.

. . .my comment is in the EIS there is some statements that says that the data provided by the INEL was - - I do not want to use the word suspect, but not as much detail as some of the other sites.

1 I just wanted to make it clear that when we received the notice to provide the data, we had about a month to a six-week period of time to compile all of the data, and there was, you know, some best engineering practices used to come up with that data.

However, to eliminate those uncertainties, it is very easy and within the realm of what we can do to provide better data on any uncertain areas you might have any question.

Response to Transcript IDB15

1 The EIS project team identified the Power Burst Facility (PBF) as a possible reasonable alternative for Mo-99 production. The INEL had proposed use of the Advanced Test Reactor and had not mentioned the PBF in previous studies and analyses. Thus, when cost and schedule information was requested, the INEL did not have the existing data that other alternatives had prepared for the previous studies.

The level of information provided for cost estimates by INEL was considered appropriate to the purpose of an EIS. Although it is believed that the uncertainties associated with the INEL estimates are higher than those of other alternatives, the estimates have sufficient accuracy to demonstrate that costs for any of the alternatives is not a major discriminator and is not a basis to disqualify any of the alternatives from consideration within the EIS. Because INEL has not been identified as a preferred alternative for this proposed project in the past as the LANL and SNL/NM alternatives have or even as an alternative in the past as ORNL has, the amount of detail available in support of the proposed project at INEL is less, but what has been developed in support of this EIS is considered appropriate. Additional cost information has been obtained and included in Section 5.22 of the EIS, and cost and schedule information will continue to be developed for the Department's eventual decision on this proposed project.

1 | I am in favor of the Medical Isotopes Production Project being in Idaho Falls.

Response to Transcript IDB16

1 Comment noted.

I want to go on record strongly supporting the Medical Isotopes Production Project. I am one of
the past Presidents of the Chamber of Commerce here in the greater Idaho Falls area. In the last
1 three years we have gone through a tremendous downsizing of our economy, and this community
has gathered together in a major coalition effort to look at new industries and to look at new
application at the Idaho National Engineering Laboratory, and I can not think of a better one than
the BNC Project of which these hearings are conducted for.

Response to Transcript IDB17

1 The potential socioeconomic impacts of the proposed project are presented in Section 5.3. The Boron Neutron Capture Therapy initiative under investigation by the Idaho Brain Tumor Center is not part of the Department's proposed action.

1 I am in support of the Medical Isotopes Production Project. I think Idaho Falls is the ideal location for it. We have the technology, background, and I believe the support of the community for this project.

Response to Transcript IDB18

1 Comment noted.

1 But what is proposed by DOE as the preferred alternative is a Band-Aid approach. In my own mind, I consider the New Mexico choice to be a political statement which was determined before the Environmental Impact Study was even started and does not judge alternatives on their merit. The selection process does not judge alternatives on their merits. I do not consider the investing of millions of dollars in temporary use of a reactor dedicated to military programs as a reasonable solution to our country's needs for medical radioisotopes.

2 I propose we use a reactor already dedicated to medical applications and which could be privatized as a superior long-term concept. Of course, I am referring to the Power Burst Facility at the former National Reactor Testing Station in Idaho. This alternative is not marginally equal as stated in the Environmental Impact Statement. It is superior in almost all of the technical and environmental issues.

3 . . .the INEL, has also had more experience in the safe shipments of radioisotopes than any other location, because of the over 40 year's experience of the test reactors program.

4 . . .it would be more economical in the long run. To me as a taxpayer, this is the overriding consideration.

Responses to Transcript IDB19

1 The Department has not made a decision regarding if and where to conduct the proposed project. A preferred alternative is identified in an EIS, in essence, to tell the public which way the Department is leaning on a decision, but it does not mean that the decision has been made. Further, Council on Environmental Quality regulations require Federal agencies to identify the preferred alternative in a Draft EIS if the agency has one, and require that the agency identify a preferred alternative in a Final EIS.

The Annular Core Research Reactor/Hot Cell Facility combination at SNL/NM is the preferred alternative for target irradiation and processing for the reasons stated in Section 3.3.1.1. The rationale for the Department's decision will be documented in a Record of Decision that will be issued about 30 days after the Final EIS is issued.

2 The advantages and disadvantages of each site are shown in Table 3-1 and Table 3-2. The Idaho Brain Tumor Center (IBTC) has informed DOE of its interest in coordinating its efforts with those of DOE; however, IBTC has not submitted any plans for coordinating reactor conversion activities, nor has it made a formal proposal to DOE. In addition, the Department understands that IBTC is investigating the possibility of using other facilities for boron neutron capture therapy (BNCT) and that other reactors under consideration for this project may be usable for BNCT. If the Department decides to proceed with a production alternative for this proposed project, it would welcome a proposal from IBTC for dual use of the reactor facility selected.

3 As presented in Table 3-2, LANL and ORNL also have significant experience in the production and distribution of isotopes.

4 The Department recognizes that the estimated cost of the INEL alternative is lower than that of the preferred alternative; however, the uncertainties associated with the estimated cost of the INEL alternative are higher than for the preferred alternative. If the Department decides to proceed with the proposed action, the information presented in the EIS (including the cost data), the operational readiness of facilities, and other programmatic factors will be considered in the final selection of facilities for Mo-99 production.

1 . . .the airport has adequate capacity and capability to support the proposed action without the expenditure of any funds for any expansions, modifications, or other such expenditures.

Response to Transcript IDB20

1 The Department does not anticipate that any of the airports discussed in the EIS would require expansions or modifications to support the proposed project.

1 I think it very important to bring this project here, because the people who are very knowledgeable are on site. Many buildings are on site, and the medical community here is already very familiar with this, and I think it would be a very important thing for the economic climate of this city and area.

Response to Transcript IDB21

1 INEL and the other alternative sites have the personnel and facilities necessary to conduct the proposed project.

1 I would like to express my support for choosing Idaho Falls as the location for the Medical Isotope Production Project.

2 We have the expertise, the technology, and many of the necessary facilities needed for such a project in Idaho Falls.

Responses to Transcript IDB22

1 Comment noted.

2 The INEL and the other alternative sites have the nuclear technology expertise and facilities necessary to conduct the proposed project.

1 We do endorse the Idaho National Engineering Laboratory in regards to its continued research on the Boron Neutron Capture Therapy as well as expanding the production of medical radioisotopes for medical use, in particular the Mo-99 project as involved in the current EIS statement as released.

2 We believes that the IBTC with their research, with their ability and the personnel they have in the ionics connection, that they can accomplish this in an excellent fashion and, in fact, they, as opposed to other groups you have suggested as primary alternatives, will have the best chance of providing additional financial resources for a medical, bio-medical process of this nature.

And we think they are in large measure the best prepared to accomplish this.

3 And when you factor in the economics of the issue regarding the Boron Neutron Capture Therapy and the economics of providing that manufacture here at PBF, now when you couple that with the Mo-99 project and that manufacturing effort, and if you take the economics of both of those bio-medical engineering complexes together, we believe that the INEL is not only the preferred site, but economically it is far less expensive to create Mo-99 here when you look at the total picture and included within that the privatization.

The long-term goal is for the private industry, and let me stress this once more, to handle that production, and given the privatization that is currently existing with IBTC, that this pioneering agreement with the DOE, do we not get to that area of privatization quicker by utilization of the IBTC?

Responses to Transcript IDB23

1 Comment noted.

2 Comment noted.

3 The Idaho Brain Tumor Center (IBTC) has informed DOE of its interest in coordinating its efforts with those of DOE; however, IBTC has not submitted any plans for coordinating reactor conversion activities, nor has it made a formal proposal to DOE. In addition, the Department understands that IBTC is investigating the possibility of using other facilities for boron neutron capture therapy (BNCT) and that other reactors under consideration for this project may be usable for BNCT. If the Department decides to proceed with a production alternative for this proposed project, it would welcome a proposal from IBTC for dual use of the reactor facility selected.

Although the potential for privatization of the proposed action in this EIS is important, the process for privatization is not part of this proposed action. Each of the production alternatives has potential for privatization. DOE has solicited expressions of interest from the industrial community for the privatization of any isotope production activity conducted by DOE, including the proposed Medical Isotopes Production Project. If promising concepts are received and the Department proceeds with the action proposed in this EIS, the Department would seek privatization proposals on a competitive basis.

1 I have a hard time understanding the legal basis for establishing short-term production capability as the primary condition on which DOE is basing its preferred alternative.

2 I would like to see information charting out the production quantity plotted out on a graph compared with the time of production and see if the values that the preferred alternative, compared with PBF, really are that incomparable.

3 My second question is what is the crisis? The Canadian facility is currently in production. There was one horror story told at the public meeting of a six-day supply. What is the current back-up supply for the Canadian facility and why is a time period of 28 months unreasonable, given that reliable supply that has been operating without this crisis for six years since the other facility was discontinued in 1989?

Responses to Transcript IDB24

1 The ability to produce even a small amount of Mo-99 in a short period of time is important in that, if a Mo-99 shortage were to occur in the near future, the Department would be able to supply at least a fraction of the U.S. demand. The Department has proposed the Medical Isotopes Production Project to respond to a near-term "window of vulnerability" in the Mo-99 supply situation; therefore, the ability to produce even a small amount of Mo-99 in a short period of time is an important factor and will be considered in the Department's decision on the proposed project. The preferred alternative would be able to produce a small amount of Mo-99 in the shortest period of time, and this factor contributed to its selection as the preferred alternative. In the near term, with a single reactor producing 100% of the U.S. demand, the unavailability of that reactor for any reason would result in a Mo-99 supply shortage. The potential for such a shortage is why the ability to produce even a fraction of the U.S. demand in the near term is considered important. This alternative would provide DOE with a Mo-99 extraction process which has met FDA approval requirements in the very near term and would be capable of providing up to 30% of the U.S. demand on an emergency basis. This early experience would also be an asset in the expansion to full-scale production capability.

2 Potential future production quantities are not known and cannot be plotted. Since each alternative would be capable of producing 100% of the U.S. demand for Mo-99, the production quantities would be identical for each alternative.

3 The problem is that the entire U.S. supply comes from a single source. It should also be noted that this single source accounts for about 85% of the world supply of Mo-99. If this source were to become unavailable, production facilities in other countries would most likely focus on meeting their own needs first and, in any case, would not be able to meet even half of U.S. demand for Mo-99. Given this supply situation, the Department has proposed establishing a domestic production source as soon as possible to ensure that a reliable supply of Mo-99 is available to the U.S. medical community.

1 . . .privatization of this process should be the preferred option and should be given heavy weight in this day and age in our government where the Department has reducing budgets, and we should be doing everything to promote the private sector and reduce the size of government.

2 I wholeheartedly encourage that Idaho Falls Power Burst Facility should be the preferred site.

Responses to Transcript IDB25

1 Private U.S. production of Mo-99 could be accomplished by privatization of a DOE operation or by a separate initiative by the private sector. The process of privatization is not part of this proposed action. The Department published a Notice for Expression of Interest in the *Federal Register* in December 1995 to solicit concepts from private industry for privatization of DOE isotope activities. Businesses interested in pursuing Mo-99 production have been invited to respond to this solicitation. If the Department decides to implement the action proposed in this EIS and if concepts on privatization of Mo-99 production received from the private sector are promising, DOE would proceed with a request for proposals to facilitate privatization on a competitive basis.

2 Comment noted.

1 In looking over the Draft Environmental Impact Statement, it was clear that there were some economic benefits to choosing a lab, specifically the INEL Lab, above all other alternatives.

The INEL choice is $2 million less costly in construction and modification expenses and, more importantly, the INEL is about $4 million less per year in routine operating expenses. For every two dollars that is spent at the INEL for operations, three dollars must be spent at the Sandia Lab.

2 Until DOE investigates what kinds of contractual obligations there are to Nordion with the pharmaceutical companies, it is not clear that even if the production were brought up in six months that there would be any market for the medical isotopes. It is not clear that there is any imparity to meet the six-month deadline. It is not clear that that amount of medical isotope produced after six months could even be marketed.

Responses to Transcript IDB26

1 The Department recognizes that the estimated cost of the INEL alternative is lower than that of the preferred alternative; however, the uncertainties associated with the estimated cost of the INEL alternative are higher than for the preferred alternative. If the Department decides to proceed with the proposed action, the information presented in the EIS (including the cost data), the operational readiness of facilities, and other programmatic factors will be considered in the final selection of facilities for Mo-99 production.

2 The Department intends to act as a backup to the Canadian supplier, not to compete with them. The Department would operate at full production levels only in response to a Mo-99 supply shortage. Thus, the ability to produce even a small amount of Mo-99 in a short period of time is important in that, if a Mo-99 shortage were to occur in the near future, the Department would be able to supply at least a fraction of the U.S. demand. To replace their single existing reactor, the Canadians plan to build two new reactors, each with the capability to produce 100% of the worldwide demand for Mo-99. They plan to have these two new reactors operating by the year 2000, so even if one of those reactors were to shut down, there would be adequate backup production capability at that time.

1 Number two, it seems like it would be wise to give stress to a reactor that actually runs. And the document does give some indication of emphasis on that.

2 In the case of the ORRR, in fact, it has been down a decade and would take some time to fill out all the documents. I doubt that it would take a major redesign.

In the case of the Sandia reactor, for instance, the reactor has the wrong fuel, the wrong internal chamber, the wrong control mechanism. It has never been operated in a steady state. It appears a new reactor is needed. That may not be true. That is what appears from reading the draft state-
3 ment. I just read it today. I am not an expert. I have not seen the reactor. But it looks as though costs must have been hidden. It looks as though the reactor has never been used in this type of mode and, therefore, a major rebuilding job is concerned, not just filling out paperwork. So it is not apparent from the text that it is a really feasible project at Sandia. It may well be, of course. They can do lots of things given enough incentive.

The draft indicates that the operation of the system could be interrupted by a decision to return to the best use of the annular core reactor. It would be required to change fuel again, put back the reactor internals, perhaps not rebuilding the whole system again. Perhaps the new one could do both jobs.

The fact that needs to be put in the report seems to give it a higher level of likelihood than the common statement that in an emergency anything can happen. Given a bad enough emergency, the president could stop all diagnostic procedures in all hospitals. If the life of the country depended
4 on it, that could happen. But that is a remote thing. It has not happened in any war up to date and it is not really noted. If this needs to be noted, that the defense needs could take over, then say it is a fairly likely thing. And that is important since the whole choice which the Department is said to have made depends on reliability of source and the reliability of starting sooner. It does not seem reliable at all.

So the report in its final form needs to deal with this problem. I am not saying it is absolutely impossible to deal with it. Perhaps a higher level of assurance could be made. Perhaps the Defense part of the group can decide they really do not need this facility anymore. Whatever. It can be handled perhaps. But it does seem to be a problem. Thank you.

Responses to Transcript ORA01

1 If the Department proceeds with the proposed action, the present status of the reactor (operational, standby, or shut down) will be an important consideration in the Department's decision. The fact that the Annular Core Research Reactor (ACRR) is the only operational reactor among the reasonable alternatives is a principal reason why that reactor was identified as part of the preferred alternative.

2 Section 3.3.3 discusses the required modifications.

3 The ACRR at SNL/NM would require several modifications, which are described in Section 3.3.1.9. The costs of these modifications were included in the SNL/NM cost estimates (shown in Table 5-1 and Table 5-52). Section 5.22 has been revised to provide a better description of the basis for the cost estimates.

All of the reactors evaluated as reasonable alternatives for the proposed project would (after necessary modifications) have the ability to produce at least 100% of the U.S. demand for Mo-99.

4 The possible diversion of the ACRR for defense use is highlighted in the EIS because, in an emergency, the ACRR is more likely than the other reactors considered in the EIS to be used for defense purposes. However, the Department has determined that the probability of needing the ACRR for defense purposes is sufficiently low to preclude disqualifying the reactor from consideration. A discussion on converting the ACRR back to support defense-related activities is provided in Section 3.3.1.9.

1 As a taxpayer, I am very concerned that the most expensive alternative seems to be the preferred alternative. And not only that, we are comparing an annual operating cost and a preparation cost. We are not comparing a life-cycle cost. I would like to see the Final EIS use life-cycle costs for comparison.

In this political climate where we are trying to balance the budget, I do not think we should choose the most expensive alternative. Now, I looked at the cost on page 5.100 to try to get some idea as to why is the preferred alternative the most expensive. I find several things. It is the only one of the four alternatives that needs to have major modifications made to its hot cell. And the reactor has to be upgraded from two megawatts to four megawatts. And because their fuel elements, they require a different size, I suspect that is why their annual operating costs are the highest. I am not sure about that. But I would like to see life cycles. I do not know whether that be a ten-year period or a twenty-year period. It is not that difficult to take a period of time and do a life-cycle cost so that we are comparing apples and apples.

There are some costs that are not — that are identified as being not in the tables. One of them is the restacking of fuel storage for the preferred alternative. The other one is an upgrade to the reactor for the Idaho facility. That is stated on page 5.101. I would like to see an estimate made of that.

2 Now, what really bugs me is the justification for there being a preferred alternative. I do not know why we should even go in to an official with a preferred alternative. Give them the data. Let them make the decision. Why are we even trying to go forward with a preferred alternative?

3 The statement -- the only statement really given in this document is on page Roman numeral X at the beginning, and it says because the reactor is currently operating. And certainly when we saw the schedule slide, we could see that they could start producing something relatively fast at six months. But that is a very small percentage as we found out during the question period. It is less than 10%. So it really would not get us too far along. And when you really consider being able to produce the entire amount needed, you are looking at twenty eight months versus thirty months in the case of Oak Ridge to battle the problem. So I do not consider that adequate justification for picking the currently operating reactor when it was not designed to do this job.

4 Now, there is some hand waving in the document about uncertainty of costs for the reactors that are not currently operating. What about the uncertainties in costs and schedule when your personnel are not experienced in what they are going to be undertaking? The experience is here in Oak Ridge. It is even stated correctly in the document that we have the experience here to do the whole job. There is also some 16 experience stated in the case of Idaho. And also in that case, there is also a potential for some cost sharing.

5 Now, my understanding is we stopped producing isotopes here because the government made the decision to go commercial. Now, I have had experience with this business of commercializing government functions. I am a retiree of NASA. And we have successfully commercialized the communication satellites, but we were not successful when it went to the case of the LANDSATS.

Now, the government made a good attempt to commercialize. And I am not saying that is wrong
or right. But it failed. It did not continue. And now we are having to go back to the government
5 to provide a source of a critically necessary vital component of our modern-day life. So I do not
feel as though the government has an obligation to try to help somebody commercialize this again.

We should not try to put the Canadian firm out of business. But I think we are going to have a
growth in this industry. This business of using the radioisotopes for body imaging has been
6 growing all along. And I suspect that we could in the future sometime even sell the full hundred
percent production from here and still not put the Canadian firm out of business. I do not really
know that.

I really do not think we should go — the Department of Energy should go forward in an EIS with a
preferred alternative when the numbers do not come out to support it. Your costs do not support it.
Your environmental things are really a wash. I mean, there is a slight preference maybe for Oak
7 Ridge, but it is basically a wash. But the costs are very important in this political climate. So I
urge you to include a life-cycle cost. Do not go forward with the preferred alternative unless it is
clear cut and you can really make a case. And this EIS has not made the case for the preferred
alternative.

Responses to Transcript ORA02

1 The costs for the modification of facilities and facility operations are presented in Table 5-1 and Table 5-52. An analysis of these costs and the projected revenues specific to this proposed project will be evaluated for each alternative as information for the Record of Decision process. Since each alternative proposes the use of existing facilities and the Department is already responsible for facility-related costs, such as facility decommissioning, an incremental cost analysis (rather than a life-cycle cost analysis) was considered appropriate information for the decision-making process for the proposed project.

2 The Department has not made a decision regarding if and where to conduct the proposed project. A preferred alternative is identified in an EIS, in essence, to tell the public which way the Department is leaning on a decision, but it does not mean that the decision has been made. Further, Council on Environmental Quality regulations require Federal agencies to identify the preferred alternative in a Draft EIS if the agency has one, and require that the agency identify a preferred alternative in a Final EIS.

The Annular Core Research Reactor/Hot Cell Facility combination at SNL/NM is the preferred alternative for target irradiation and processing for the reasons stated in Section 3.3.1.1.

3 The ability to produce even a small amount of Mo-99 in a short period of time is important in that, if a Mo-99 shortage were to occur in the near future, the Department would be able to supply at least a fraction of the U.S. demand. The Department has proposed the Medical Isotopes Production Project to respond to a near-term "window of vulnerability in the Mo-99 supply situation; therefore, the ability to produce even a small amount of Mo-99 in a short period of time is an important factor and will be considered in the Department's decision on the proposed project. In the near term, with a single reactor producing 100% of the U.S. demand, the unavailability of that reactor for any reason would result in a Mo-99 supply shortage. The potential for such a shortage is why the ability to produce even a fraction of the U.S. demand in the near term is considered important. This alternative would provide DOE with a Mo-99 extraction process which has met FDA approval requirements in the very near term and would be capable of providing up to 30% of the U.S. demand on an emergency basis. This early experience would also be an asset in the expansion to full-scale production capability.

4 The Department recognizes that, with the exception of SNL/NM, each of the sites has significant experience in the production and distribution of radioisotopes.

5 The Department would prefer that the private sector assume responsibility for ensuring that a reliable supply of Mo-99 is available to the U.S. medical community; however, private industry has thus far been unwilling to do so. Therefore, DOE has proposed to conduct the Medical Isotopes Production Project. If private industry is able to ensure a reliable supply of Mo-99 on its own, the Department could phase out its production activities.

6 Since the Department intends to be a backup to the Canadian supplier, the Department does not plan to compete with the Canadians and does not believe that the proposed project will put the Canadians out of business.

7 Please see response to comment ORA02-1 above.

1 The document, the Draft Environmental Impact Statement, in my opinion, doesn't adequately justify the preferred alternative. I think additional information needs to be discussed about why the preferred alternative was chosen.

2 For example, the table that was presented with the schedule information, it's unclear in the Oak Ridge area whether or not this is thirty months to full production, or if that's thirty months to initial production. So maybe some additional information there in terms of the schedules.

3 I think that the Environmental Impact Statement needs to consider the probability that the Nevada Test Site will not be open for disposal of low-level waste and talk about contingencies at each of the alternatives for on-site storage until disposal is available and the associated risks with that disposal of that on-site storage.

4 I think given that the Department of Energy is currently in discussions with private industry regarding possibilities for private partnerships, given the downsizing of the Department of Energy on many different competing needs, [and] that they could only carry the environmental cleanup that the final Environmental Impact Statement might be able to provide some additional information regarding any outcomes from the February 13th meeting.

Responses to Transcript ORB01

1 The Department has not made a decision regarding if and where to conduct the proposed project. A preferred alternative is identified in an EIS, in essence, to tell the public which way the Department is leaning on a decision, but it does not mean that the decision has been made. Further, Council on Environmental Quality regulations require Federal agencies to identify the preferred alternative in a Draft EIS if the agency has one, and require that the agency identify a preferred alternative in a Final EIS.

The Annular Core Research Reactor/Hot Cell Facility combination at SNL/NM is the preferred alternative for target irradiation and processing for the reasons stated in Section 3.3.1.1.

2 Table 3-2 has been clarified as appropriate.

3 The Department recognizes that "cradle-to-grave" waste management is a benefit of the INEL and LANL alternatives and will consider this factor in making its decision on the proposed project.

Regarding the issue of shipping low-level radioactive waste to the Nevada Test Site (NTS) under the preferred and ORNL alternatives, the NTS is preparing a site-wide environmental impact statement and has included waste generated from the Mo-99 mission in the quantities and description of materials to be stored on the site. The Department believes that any uncertainty surrounding NTS's ability to accept the waste from the Mo-99 mission is sufficiently small that there will not be an impact on a proposed Mo-99 program. The ultimate disposition of waste generated under the proposed project may change based on future decisions resulting from the DOE Waste Management Programmatic Environmental Impact Statement.

4 The purpose of the meeting held on February 13, 1996, at DOE Headquarters in Germantown, Maryland, was to discuss the Department's desire to privatize isotope production and distribution functions and to answer questions on that subject from industry representatives. No questions were raised regarding the Department's proposed Medical Isotopes Production Project.

It seems to me that the analysis for taking this action is somewhat incomplete. In other words, I
would like to see a better argument based on the history of the continuous operation in Canada,
continuous supply from Canada, alternative sources that could be used in short-term emergency
1 situations. In other words, a more complete analysis in order to justify the decision for doing this.

I'd also like to understand what would happen if the Canadian production were simply to cease. Would the U.S. be in a position to supply that demand also?

I also, in a second point, I feel that the justification for the preferred method is a little bit on the
2 light side. I would like to see something in terms of a life cycle cost, something of that nature, to
justify using the most expensive alternative.

I also think there should be some consideration of how reliable will the U.S. methodology be, do
3 we do ourselves a service by discouraging the Canadian enterprise by replacing a part of -- a
willing part of our demand by internal sources and thus limiting their opportunities.

Responses to Transcript ORB02

1 Since 1993, radiopharmaceutical companies and nuclear medicine physicians in the U.S. have relied on Mo-99 from a single source, the 40-year-old nuclear reactor in Chalk River, Ontario, Canada, which produces Mo-99 for Nordion International. While Nordion has maintained a steady supply of Mo-99, a series of recent mechanical and maintenance problems with the reactor and labor disputes have nearly disrupted production a number of different times. Other smaller production facilities for Mo-99 operate in Russia, China, Australia, Belgium, and South Africa, but none of these could meet the current clinical demand for Mo-99 in the U.S. The Mallinckrodt Medical High Flux Reactor in Petten, the Netherlands, is not expected to produce Mo-99 for sale in the U.S. until late 1996 or 1997, leaving the U.S. vulnerable to a supply disruption in Canada.

Any of the DOE production alternatives could be capable of providing 100% of the current U.S. demand for Mo-99. When fully operational, a DOE facility plus the Petten reactor could meet the current U.S. demand plus the current European demand in the event that production in Canada were interrupted for an extended period of time. The alternative reactors under consideration could not individually meet the total world requirements for Mo-99.

2 The Department has not made a decision regarding if and where to conduct the proposed project. A preferred alternative is identified in an EIS, in essence, to tell the public which way the Department is leaning on a decision, but it does not mean that the decision has been made. Further, Council on Environmental Quality regulations require Federal agencies to identify the preferred alternative in a Draft EIS if the agency has one, and require that the agency identify a preferred alternative in a Final EIS.

The Annular Core Research Reactor/Hot Cell Facility combination at SNL/NM is the preferred alternative for target irradiation and processing for the reasons stated in Section 3.3.1.1.

The costs for the modification of facilities and facility operations are presented in Table 5-1 and Table 5-52. An analysis of these costs and the projected revenues specific to this proposed project will be evaluated for each alternative as information for the Record of Decision process. Since each alternative proposes the use of existing facilities and the Department is already responsible for facility-related costs such as facility decommissioning, an incremental cost analysis (rather than a life-cycle cost analysis) was considered appropriate information for the decision-making process for the proposed project.

3 Since it intends to be a backup to the Canadian supplier, the Department does not believe that the proposed project will limit their opportunities.

. . .the Mo-99 program is part of a national isotope strategy, and this strategy, the program for which is not cited anywhere in the EIS, calls for the privatization of medical isotope production as a programmatic emphasis of the DOE encouraging joint ventures, as well as private operations, and that is not an alternative that is given any consideration in the EIS.

1 The long-term objective of privatization is found in the executive summary. The options that are carried and need to be reviewed are all on government reservations, all operated by government labs. Not even the private operators of those labs are identified, much less their interest in privatization.

There is a document now referred to in the EIS as the Jupiter Report, for those who follow this project. This report also recommends privatization and finds DOE as inappropriate for long-term production of these resources. The EIS is very carefully drafted by well-skilled writers and scientists to address only near-term options and not the long-term need for these isotopes.

The Jupiter Report identifies a 3 to 4 billion dollar medical isotope market with a revenue stream that comes down to about 50 million dollars for the Mo-99 itself, enough to pay the cost of this operation, if cost recovery were a goal. I think that this is particularly important to address because federal dollars are so difficult to find for innovative projects.

2 For projects where there is a fully mature market, we should be relying on that market to drive the supply. The market has had a good deal of time. The DOE is pursuing some options, but that is not the framework within which Mo-99 is considered in the EIS, and I believe it should be. There are people independent of the pharmaceutical industry who might want to participate in those considerations.

The Federal Government is providing more than just tax dollars to drive this program. It is providing a site which is well buffered, and certainly in the Albuquerque area, well armored. For a process which, as the presentation indicated, has a relatively low risk compared to conventional reactors, certainly what would be called a de minimis risk, compared to a reactor 500 times the size, a 1,000 megawatt reactor.

3 Nevertheless, the industry is unwilling and unable to propose a normal public setting for the siting and operation of this facility. I think that the less generous approach would be to say that the industry is hiding behind the fences of the Federal Government because it is unwilling to address the challenge of siting a new nuclear installation, and this is the kind of installation that is likely to be successfully sited because of the relatively low operational risks and relatively low catastrophic risks that are the types of concerns raised.

4 Among some of the changes of note that I am concerned about in the EIS, there is now a reference to a Nevada Test Site as a repository for the low-level radioactive waste. There is no documentation to support the confirmation that there is space there. As I understand it, space is becoming

increasingly limited at repositories, and Sandia Lab is considering putting some environmental
4 restoration waste in waste management disposing units on base. That would be quite important to confirm that, indeed, the off-site capacity has been confirmed.

The EIS has chosen to eliminate any consideration of actual communities near sites and gone to a 100-mile diameter map that just shows classes of people by economy and ethnic status on a census track level. So you really can not see where the communities are, much less is there any actual dialogue with these communities.

5 Communities are interested in being involved in discussions not just because there is a hazard but because there is something happening, and people with inquiring minds may want to know what is going on in their neighborhood. I think that these communities are treated with a very blatant disrespect by failing to identify those communities, much less indicate any communication with them.

I am sensitive to the idea raised by many that the isotopes produced by this project are quite valuable, having had some medical nuclear technology applied to my shoulder after a car accident in northern New Mexico, but I do not think the Canadian and Western European suppliers represent an insecure or vulnerable source, and the Mo-99 and its associated materials must be flown
6 around anyway by rapid scheduling of cargo flights in a very complex manner.

We are not really as vulnerable as the Department of Energy would have us believe, and indeed, the market should demonstrate a capability to take care of itself and not rely on the Federal Government.

Responses to Transcript ALA01

1 There has been no Mo-99 produced commercially in the U.S. since 1989. Since 1989, no private company has stepped forward to fill the void left by the shutdown of Cintichem's Mo-99 production operations. Since Mo-99 is an important medical isotope and since the private sector has thus far been unwilling to produce Mo-99, the Department has proposed to establish a production capability.

The EIS addresses only near-term options because the Department only intends to be a Mo-99 producer in the near term. The Department believes that, as stated in the Jupiter report, Mo-99 production in the long-term should be conducted by the private sector. As stated in the EIS, the Department encourages private sector production of Mo-99 and if the private sector begins reliably producing Mo-99 in the U.S., the Department will phase out its production. The Department has simply proposed to establish a production capability to act as a backup to the existing Canadian supplier, and the Department would be willing to entertain proposals to privatize part or all of its Mo-99 production capability, if it proceeds with the proposed action.

Although the potential for privatization of the proposed action in this EIS is important, the process for privatization is not part of this proposed action. Each of the production alternatives has potential for privatization. DOE has solicited expressions of interest from the industrial community for the privatization of any isotope production activity conducted by DOE, including the proposed Medical Isotopes Production Project. If promising concepts are received, the Department would seek privatization proposals on a competitive basis. Section 2.0 of the EIS has been revised to include a discussion of the relationship between the proposed project and the National Isotope Strategy.

2 As discussed in Section 3.4.3 of the EIS, there are private companies outside of the pharmaceutical industry that may be interested in entering the Mo-99 production market. These companies are either investigating new technologies for Mo-99 production or are interested in privatizing the production capability that DOE may establish.

As also discussed in Section 3.4.3, the new technologies that are being investigated do not appear to hold the potential to produce 100% of the U.S. supply of Mo-99 in the near term. Therefore, these options are not considered in detail in the EIS. However, the Department will continue to monitor the progress of these new technologies and would stand prepared to phase out its production if these new technologies begin reliably producing Mo-99.

3 The historical difficulty in siting a new nuclear facility is quite possibly one of the factors that has kept private industry from re-establishing a Mo-99 production capability in this country.

The Department would prefer that private industry produce Mo-99 in this country, but thus far private industry has been unwilling to do so. There are private companies that are investigating new technologies for Mo-99 production, but these technologies do not appear to be sufficiently developed to be able to meet the goals of the proposed project. As stated in the EIS, the Department will phase out its production if the private sector begins reliably producing Mo-99.

4 The ORNL alternative and the preferred alternative both would require periodic shipments of low-level waste to the Nevada Test Site (NTS). The Nevada Test Site is preparing a site-wide environmental impact statement and has confirmed that the waste generated from the Medical Isotopes Production Project will be included in the quantities and description of materials to be stored on the site.

5 Throughout the EIS process for the proposed Medical Isotopes Production Project, the Department has maintained an open channel of communication with members of potentially affected groups and other interested parties. The Public Participation and Outreach section (Section 1.4) highlights the range of outreach efforts in which the Department's project representatives have engaged to assure that a full exchange of information has been achieved.

6 The Canadian reactor produces all of the Mo-99 used in the U.S. Unplanned reactor shutdowns can and do occur. If the Canadian reactor were to shut down today and were to be out of operation any significant period of time, the U.S. would be without a FDA-approved source of Mo-99. Other sources of Mo-99 supply are being developed, and the Department understands that there are plans to have these suppliers certified by the FDA. To the best of the Department's knowledge, even if all of these suppliers were FDA-approved and were producing Mo-99 at full capacity, they could not supply even half of the present U.S. demand. This situation may change; the Canadians may one day have two new Mo-99-producing reactors in operation, or private industry in this country may begin reliably producing Mo-99. If the Department decides to go forward with the proposed project then at some later time is convinced that a reliable supply of Mo-99 is available to the U.S. medical community, the Department will phase out its Mo-99 production.

1 The original Draft EA should have been finalized, and a FONSI should already have been issued. The DOE unfortunately has been hoodwinked by this tiny minority into preparing an EIS.

2 You sit here today gathering input on an issue with no health consequences whatsoever

3 I urge the DOE to reexamine their well-intentioned but ineffectual policy of activist appeasement and recognize their constitutional obligation to defend the public health and welfare by resolutely pursuing your stated course without further ado.

Responses to Transcript ALA02

1 As stated in the EIS, DOE prepared an environmental assessment (EA) for the proposed production of Mo-99 related isotopes using facilities at LANL and SNL/NM. Based on the EA and on comments received, the Department decided to prepare an EIS.

2 It is the responsibility of the Department to evaluate a proposed action to determine if there are environmental impacts or not. The results of the analysis will appear in the Final EIS and be considered for the Record of Decision.

3 As stated above, DOE decided that it would be appropriate to prepare an EIS for this project. The EIS process includes opportunities for public involvement in the development of the EIS.

1 Currently, a Canadian facility supplies all of the isotopes used in North America, and there are backup supplies. In addition, the Canadians have indicated their intention to build two new production facilities to replace and supplement their existing facility.

2 Why is the United States Department of Energy using our tax dollars to finance an industry that is currently and happily in private hands? We believe this is corporate welfare. That is 34 million dollars to start with, plus 12 million dollars each year.

3 Also, the Draft EIS for the medical isotope facility does not mention the contamination in Tuxedo, New York, where the Cintichem Corporation produced Mo-99 for 19 years. When the reactor was shut down in 1989, Cintichem left a radioactive mess behind that has still not been cleaned up.

Do we want our community to take on this burden? It could happen here, especially since the DOE plans to use Cintichem's technology. The Draft EIS needs to address this potential impact.

Responses to Transcript ALA03

1 The Canadian company plans to build two new reactors for Mo-99 production. However, these reactors would not be available to produce Mo-99 until at least 3 years after an agreement is reached by the involved parties to construct the two new reactors. This would mean that the new reactors would not be available until at least the year 1999. Given that the Canadians have announced plans to shut down their existing Mo-99 production reactor in 2000, the Department has proposed to establish a backup source in case the Canadian supply becomes unavailable.

2 One of the charters of the Department of Energy is to produce and make available radioactive isotopes for medical and scientific purposes. At present, the U.S. is totally dependent on foreign sources of Mo-99, the radioactive parent of the important medical isotope Tc-99m. A prolonged interruption in Mo-99 supply would make it impossible to conduct the more than 30 different types of diagnostic examinations that rely on Tc-99m-based radiopharmaceuticals. These examinations are conducted about 36,000 times each day in the U.S. and include bone and liver scans for cancer detection, kidney function tests, brain scans, and a variety of other clinical tests. The inability to conduct these diagnostic procedures could seriously impact the health and well-being of U.S. citizens in need of these diagnostic procedures. In addition, the practice of nuclear medicine represents a sizeable part of the U.S. health care industry. Thousands of jobs could be jeopardized by an interruption in the supply of Mo-99.

The Department has proposed the Medical Isotopes Production Project to ensure that a reliable supply of Mo-99 is available to the U.S. medical community. If the Department decides to pursue this project, the Mo-99 produced would be sold at prevailing world market rates. In so doing, the U.S. government would not artificially lower the cost paid by pharmaceutical companies for Mo-99 and would thus not artificially increase the profits realized by these companies on sales of Mo-99. Therefore, it would be incorrect to label isotope production by the Department as a subsidy to private industry or "corporate welfare."

If the decision is made to pursue this project, the Department would act as a backup to the existing Canadian supplier. The Department would operate its facilities to produce only as much Mo-99 as is necessary to maintain the capabilities of the facility and staff to produce 100% of U.S. demand in response to an interruption of the existing supply. In essence, the project would act as an "insurance policy" for the U.S. against a Mo-99 supply shortage. The goal of the proposed project is to ensure that a supply of Mo-99 is readily available to the U.S. medical community.

As stated in the EIS, DOE supports the production of Mo-99 by private industry. If a private company begins reliably producing Mo-99 in the U.S., DOE will phase out its production of Mo-99.

3 The contamination referred to by the commentor was a result of a underground leak, not a result of the Mo-99 production process itself. At the time, the company determined that it was not financially feasible to repair the reactor and thus shut it down. The Cintichem process is significantly cleaner than the other currently FDA-approved Mo-99 production process. The other process, currently used by Nordion, generates a significant amount of liquid waste.

1 . . .we look at this project as being basically corporate welfare by providing subsidies to the nuclear medicine industry.

2 As you can see, it is 34 million dollars, along with 12 million dollars annually, that we will be paying out of our taxes again to subsidize industry.

3 . . .people being exposed, again, mostly people of color, Native Americans and Chicanos,

Responses to Transcript ALA04

1 One of the charters of the Department of Energy is to produce and make available radioactive isotopes for medical and scientific purposes. At present, the U.S. is totally dependent on foreign sources of Mo-99, the radioactive parent of the important medical isotope Tc-99m. A prolonged interruption in Mo-99 supply would make it impossible to conduct the more than 30 different types of diagnostic examinations that rely on Tc-99m-based radiopharmaceuticals. These examinations are conducted about 36,000 times each day in the U.S. and include bone and liver scans for cancer detection, kidney function tests, brain scans, and a variety of other clinical tests. The inability to conduct these diagnostic procedures could seriously impact the health and well-being of U.S. citizens in need of these diagnostic procedures. In addition, the practice of nuclear medicine represents a sizeable part of the U.S. health care industry. Thousands of jobs could be jeopardized by an interruption in the supply of Mo-99.

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As stated in the EIS, DOE supports the production of Mo-99 by private industry. If a private company begins reliably producing Mo-99 in the U.S., DOE will phase out its production of Mo-99.

2 The estimated cost of the proposed project at each alternative facility and the assumptions on which these cost estimates are based are presented in Section 5.22. The annual operating costs shown for each alternative would be offset by revenues from medical isotope sales. The revenue generated would depend on the amount of isotopes sold and the market price of these isotopes.

3 The Department found that there would be small, if any, environmental impacts from the implementation of medical isotopes production at any of the alternative sites. Thus, there are not any anticipated disproportionately high or adverse impacts to ethnic minorities and disadvantaged people that would result from the implementation of the proposed project. Specifically, Section 5.21 provides a comprehensive analysis of environmental justice issues.

Transcript: ALB01 **Author: Ron Motz**

1 Los Alamos and Sandia have the facilities, the personnel, the procedures and the experience to perform this operation.

2 Our only concern is the fact of, and it was brought up earlier, the transport. We feel that every effort should be made to keep the transportation of the isotopes from the Sandia facility to the airport within the confines of Kirtland Air Force Base and the airport ramp.

Responses to Transcript ALB01

1 Comment noted.

2 The proposed SNL/NM alternative would use Kirtland Air Force Base roads to access the airport. It is not anticipated that public roads outside the confines of the Base would be used.

1 Our position is in strong support of the proposed medical isotope production facility at Sandia.

2 In July of 1995, I testified that a finding of no significant environmental impact was perfectly adequate for the proposed project at Sandia, and we are still of this opinion.

3 It is strange that the actual Canadian operation and shipping experience and the American experience before the shutdown of the production facilities was not used in assessing environmental impact. The environmental impacts of production and shipment are well-known because both the U.S. and Canada have produced Mo-99, and one need not rely totally on the assumptions and prognostications of the EIS.

4 The socioeconomic analysis refers only tangentially to the economic role that Sandia plays in the community of Albuquerque and fails to consider the economic impact of shutting down the ACRR. Job multiplier factors are not even mentioned in the discussion.

The same thing can be said for Oak Ridge National Laboratory, which is the economic mainstay of that community, and the economic impacts that might occur at Idaho Falls and Espanola, New Mexico.

5 As far as the ecological impacts are concerned, although the Sandia/Kirtland Air Force Base site does include no endangered species, which the EIS says, it does abound with wildlife. It houses a number of sizable prairie dog colonies. There is a large variety of birds that winter on site or nest there year round, and both large and small mammals make their homes on the site. We do not believe that any of these would be adversely affected at all by the Mo-99 project, but their existence should be acknowledged in the EIS.

All four sites, in fact, because they contain a lot of undeveloped land, abound with wildlife and natural vegetation, and Los Alamos possibly includes archeological sites of possible significance. Again, isotope production would have no impact on any of this, but they should be included in a proper environmental impact assessment.

6 It appears that the RADTRAN 4 LINK mode, which is the mode used when you do route-specific analysis, was not used in this analysis, although the Department of Energy has committed to route-specific transportation risk analysis. RADTRAN route-specific analyses using the LINK mode for one shipment are generally better than the aggregate mode, not only for their level of detail, but because it is easier to use.

7 It is very difficult to understand, moreover, why the defaults in RADTRAN were used when it is very easy to put in your own numbers. Some of the numbers that came out of the RADTRAN analyses make very little sense.

7 For instance, RADTRAN 4 LINK mode runs for a Mo-99 shipment give approximately the same radiological impacts for crew and handlers whether the shipment is by truck or by air, on the order of .01 person-rem per shipment. This is consistent with the total crew impacts given this Table 5-10 where they range from 30 to 32 person-rem per year.

However, the footnotes in the tables state that the air crew impacts are from 15 to 30 times greater than the truck crew impacts, even though you have the same number of air crew, roughly the same three as the truck crew, and the air crew are, in fact, further from the source than the truck crew are. It is not possible that the impacts would be greater.

8 The EIS implication that there will be many more shipments by air than by truck is difficult to understand, given the lifetime of these isotopes that requires them to be shipped almost immediately to the distributors. The implication is also inconsistent with the shipments per year column which shows 3225 shipments per year from the separation facility to the airport followed by 1100 for the by-air and 1040 for the by-truck shipments each year to Boston, Chicago and St. Louis. We do not know where the 3225 came from. Your numbers are inconsistent.

9 Another inconsistent set of numbers lists the one-way air distances from Albuquerque to St. Louis at 2200 kilometers while the road atlas for 1995 gives the corresponding highway miles as 1038. Is it possible that air cargo takes a more roundabout route to St. Louis than the highway route? Similarly, the numbers to Chicago do not make much sense.

10 There appears to be no justification for assuming that air shipments will be on passenger flights rather than cargo flights. We understand that DOE had always planned for purely cargo flights at least to ease the problems of regulatory compliance if not to actually expedite the shipments.

Perhaps the use of passenger flights followed from a decision to use the RADTRAN aggregate mode and defaults instead of the LINK mode. It is not justifiable on the basis of being conservative because it is just plain incorrect.

Page 5.19 implies that the greatest public impact of the entire transportation system would be to airline passengers. It is hard to imagine a public official would not decide to reduce public impacts by a factor of nearly 100 at practically no cost simply by using cargo-only shipments, no matter how small the impacts may be in any case. In this connection, a description of current operational experience with the Canadian reactor supply system would have been useful.

11 The final RADTRAN 4 default that I want to mention is the default stop time per kilometer for truck transport of .011 hours per kilometer, or .7 of a minute per kilometer regardless of the length of the trip. If you put that in the shipping from the Sandia facility to the airport, you get a ten-minute stop for what ought to be a 20-minute truck trip. That does not make any sense at all that you are going to stop for ten minutes and lengthen the trip to a half-an-hour. I would suggest that the RADTRAN analysis either be redone for the other sites, or use the one that was done for the FONSI.

12 The conclusions essentially coincide with the FONSI, and I would suggest in order to avoid delays, litigation and above all, unnecessary expense, that DOE should submit a FONSI based on the published Environmental Assessment published by Sandia and get on with preparing the production facility at Sandia.

Responses to Transcript ALB02

1 Comment noted.

2 As stated in the EIS. DOE prepared an environmental assessment (EA) for the proposed production of Mo-99 and related isotopes using facilities at LANL and SNL/NM. Based on the EA and on comments received, the Department decided to prepare an EIS.

3 Experience at the Cintichem facility was, in fact, used to estimate releases from the DOE target processing facility by adjusting historic emissions from the Cintichem facility to the production levels assumed for the EIS (see Section 5.7.1). Cintichem experience with shipping Mo-99 and other isotopes was also used to identify appropriate modes of shipment for the transportation analysis. Experience from the Nordion facility would be less applicable to the proposed action because the process used by Nordion is very different from that proposed by DOE. Nordion has also been consulted with regard to transportation issues.

4 The Department realizes the importance of all of its laboratories to their respective communities as well as the importance of maintaining the valuable technical capabilities that exist at each laboratory.

5 The affected environment descriptions in the EIS were intentionally limited to information that is important in evaluating relative impacts of the alternatives, and they were therefore restricted to those resources that could be most affected by the proposed action. These descriptions were also reviewed to ensure that they present a comparable level of detail for each alternative. DOE believes the information included in the EIS is presented at a level of detail appropriate to the level of risk associated with the proposed action, which is very low for all alternatives.

6 There is no DOE requirement to use the RADTRAN 4 link mode to calculate transportation impacts in support of NEPA documents. The aggregate data mode used in the EIS was applied using route-specific data (shipping distances, population densities, and travel fractions in rural, suburban, and urban regions) and in this sense is a route-specific analysis. Furthermore, supplementary calculations were performed to explore the effects of implementing the link mode for the Mo-99 shipments analyzed in the EIS. The results indicated that use of the link mode would not result in large differences (greater than a factor of 2) in the calculated transportation impacts, and the differences are all well within the uncertainty of the analysis. Furthermore, use of the aggregate mode does not bias the results toward any of the alternatives examined in the EIS. Thus, the Department has concluded that the value of the additional information that would be generated by a link analysis would be minimal.

7 The source of much of the input data for the EIS was the SNL/NM feasibility study (Massey et al. 1995). Where appropriate, input parameters were taken directly from this study. Where they were not available, default input parameters were used unless a sufficient technical basis existed elsewhere. RADTRAN 4 default parameters are believed to appropriately bound actual transport conditions such that the resulting exposures are conservative.

The results shown in Table 5-10 for Crews (as shown in the footnote) include truck crew, air crews and handlers at three hubs (i.e., origin, destination, and intermediate stop). A large portion of the air crew impacts include handlers at the three hubs.

8 The truck transportation analysis evaluated a total of 1140 shipments of isotopes per year. That is broken down for air shipment as follows: 345 shipments each of Mo-99, iodine-31, and xenon-133 to each of 3 distributors (3 U.S. radiopharmaceutical companies) and 35 shipments of iodine-125 to each distributor. For each isotope, 3 packages (one for each distributor) will be transported from the processing facility to the airport. Section 5.11.1.1 has been revised accordingly.

(3 distributors)(345 shipments)(3 isotopes) = 3105

(3 distributors)(35 Shipments)(1 isotope) = 105

Total = 3210 air shipments

The number of shipments of Mo-99 to Nordion (if Nordion were to distribute all the Mo-99) would total 1140.

9 The one-way air distances include an intermediate stop. For example, the flight from Albuquerque to St. Louis or Chicago includes an intermediate stop in Salt Lake City. The airline pocket guide lists the distance for the Albuquerque to St. Louis flight at 2200 km. Assuming longer flight distances adds more conservatism to the analysis.

10 A final decision has not been made to use cargo-only flights to support the mission described in the EIS. Ultimately, cargo air transport may be selected. However, at this time, there is no reason to believe that, technically, the shipments could not be made using passenger air flights. Assuming the isotopes are shipped by passenger air clearly establishes a bounding analysis. Also, the commercial air assumption does not bias the results toward any of the alternatives examined in the EIS.

11 The Department agrees that this assumption is unrealistic for very short shipping distances. The default value gives conservative stop times for long distance shipments, as well, given that most shipments of radioactive materials use two drivers and stop infrequently for only short durations along the route. It was decided to include the stop times in both short and long distance shipments to ensure that the calculated public and worker exposures are bounded and would encompass potential obstacles in transit that would require the shipment to stop or slow down, such as highway construction/repair, traffic accidents not involving the shipments, heavy traffic, and vehicle breakdowns.

12 As stated in comment ALB02-2 above, DOE determined that an EIS was appropriate for this proposed project.

1 . . .the intent is not to make a place that is already perhaps somewhat contaminated more contaminated, but instead to consider the cumulative effects of all the work that goes on and to try and keep a place from getting any worse than it already is. I do not think Kirtland is a good place to locate your reactor.

I think 11 million gallons of water a year is too much. We constantly read in the newspaper that if we continue to draw water from our underground aquifers, our city is going to sink, plus our water is going to be bad. There just is not enough. People are fighting over water now. They are fighting over water rights. There is not enough for Intel. There is not enough for anybody. We have already promised more water than we probably have.

2 A lot of people have water rights. They want to continue to own the water that they own and not have somebody come and take down the level of the aquifer where we depend on what little water there is in order to keep or forest and farms going. We have a certain life-style here that we like, and you can not take all the water out of it and expect it to go on being a place that all of us have grown to love and have chosen to live in.

There are areas that have more water than we do, and I think that one of those areas might be more appropriate for a location of this facility.

Responses to Transcript ALB03

1 The cumulative effects of medical isotope production, in conjunction with other ongoing or planned activities at SNL/NM, are considered in Section 5.16 of the EIS. The risks of these activities are evaluated in the EIS and were found to be very low. They would not be expected to result in any measurable residual environmental contamination that would affect the region over the long-term. The Annular Core Research Reactor (ACRR) is an existing facility; DOE is not planning to locate a new reactor at this site.

2 Additional water usage should have very little, if any, impact on the unconfined aquifer at SNL/NM. Although the pumping of Kirtland Air Force Base production wells and southeast Albuquerque municipal wells has created a cone of depression in the northern portion of the SNL/NM area, the amount of water being withdrawn for reactor cooling would be minimal compared to current groundwater usage at SNL/NM or in the Albuquerque region. The additional water usage at the ACRR would amount to less than 3% of current SNL/NM usage and less than 0.03% of water used in the region (see Section 5.16.1.1). Well water is drawn from highly transmissive valley fill, with pumping rates having, at maximum, a very localized effect on groundwater flow.

1 I support the selection of Sandia National Laboratories as the preferred site with target fabrication facilities at Los Alamos National Laboratories.

2 The alternative of no action is unacceptable due to the potential consequences that this choice may have on the U.S. nuclear medicine community. Considering that thousands of patients are imaged with technetium-based pharmaceuticals every day, it is essential to have a stable, reliable source of Mo-99.

Responses to Transcript ALB04

1 Comment noted.

2 Comment noted.

1 Because catastrophic failure of containers is assumed to result in crew fatalities, radiological impacts to the crew were not calculated. I find this an amusing way to do math.

2 In Appendix B-24, bystanders are assumed to be no closer than 325 feet from any accident, but when 3,225 shipments per year go 8.5 miles off site to a metropolitan airport, that assumption overlooks reality, in my opinion.

3 On page 5.33, we see that the gamma radiation facility pool has a 5-year storage capacity that could be upgraded to 17 years. After a one-year cooling off period, waste could be moved to dry, on-site storage until some kind of other storage could be arranged, quote, that would be in accord with a future DOE decision. I am concerned about a buildup of radioactive wastes so close to our homes.

Responses to Transcript ALB05

1 The transportation containers used for shipping radioactive materials are required by law to be robust enough to withstand severe mechanical and thermal stresses without breaching the container or releasing the contents. As a result, any transportation accident that assumes release of radioactive materials would necessarily involve very severe mechanical or thermal stress, or both, to the vehicle. Under such conditions, it is not unreasonable to assume the driver of the vehicle would be killed in the accident and calculating radiation dose to a deceased worker would be of little value in assessing the relative risks associated with actions proposed in the EIS. Acute traffic fatalities resulting from transportation of medical isotopes and waste are included in the risks evaluated for the EIS, and although they are relatively low, any radiological accident risks are many times smaller.

2 The assumption regarding distance to the nearest receptor is a standard convention for transportation safety analyses, determined to some extent by limitations of the models used to estimate radiation dose to this individual. Estimating dose to an individual at a closer distance becomes highly speculative and depends on the nature of the accident, local atmospheric conditions, and the specific location of the bystander. An individual who might spend any length of time in proximity to an accident scene is likely to be an emergency worker, who could be equipped with protective gear that minimizes exposure to hazardous materials involved in the accident.

3 DOE's programmatic EIS for management of spent nuclear fuel (SNF PEIS [DOE 1995b]), completed in 1995, provides for interim management of all spent fuel in the DOE complex, including any generated by medical isotope production, until a decision is made concerning its ultimate disposition. That document was intended to provide for safe and secure storage of DOE's spent fuel inventory over a 40-year period at sites that have the facilities and experience to handle this material. The Record of Decision for the SNF PEIS provides for regional storage of DOE spent fuel, other than Hanford defense production reactor fuel, at either the INEL or the Savannah River site. It was DOE's intent that sites other than those designated in the programmatic EIS would not undertake long-term storage of spent fuel. Under that Record of Decision for the SNF PEIS, spent fuel from any of the medical isotope production facilities would be transferred to one of the designated regional management sites after a suitable cooling period. The transportation risks associated with such transfers were evaluated in the SNF PEIS. The logistics and timing of the shipments would be subject to arrangements between the shipping and receiving sites.

It should be noted that the spent nuclear fuel storage capacities cited in this EIS are based on the assumption that DOE might be required to replace 100% of the U.S. demand for Mo-99 over an extended period. Under anticipated conditions, the production rates would be much lower, and the quantities of spent fuel generated by the medical isotope project would be small. The intent of the EIS analysis was not to imply that spent fuel would be left at the generating sites over the indicated time periods, but to assure that the isotope production sites would be able to safely manage spent fuel before it could be transferred to the appropriate regional management site. Heat generation in the fuel elements would require that they be stored under water for a period after removal from the reactor. Subsequent transfer of spent fuel to dry storage at the generating sites before offsite shipment would have the advantages of lower maintenance requirements and additional cooling time to reduce the risks during transport.

1 I object strenuously to tax dollars being forced into this to bring up capabilities then to look at transferring those capabilities to private corporations like Lockheed where they can continue to make a profit, and I continue to pay the tax bill.

Responses to Transcript ALB06

1 Comment noted.

The Department would prefer that the private sector assume responsibility for ensuring that a reliable supply of Mo-99 is available to the U.S. medical community; however, private industry has thus far been unwilling to do so. Therefore, DOE has proposed to conduct the Medical Isotopes Production Project. If private industry is able to ensure a reliable supply of Mo-99 on its own, the Department could phase out its production activities.

One of the charters of the Department of Energy is to produce and make available radioactive isotopes for medical and scientific purposes utilizing the Department's extensive scientific and technical capabilities and facilities. At present, the U.S. is totally dependent on foreign sources of Mo-99, the radioactive parent of the important medical isotope Tc-99m. A prolonged interruption in Mo-99 supply would make it impossible to conduct the more than 30 different types of diagnostic examinations that rely on Tc-99m-based radiopharmaceuticals. These examinations are conducted about 36,000 times each day in the U.S. and include bone and liver scans for cancer detection, kidney function tests, brain scans, and a variety of other clinical tests. The inability to conduct these diagnostic procedures could seriously impact the health and well-being of U.S. citizens in need of these diagnostic procedures. In addition, the practice of nuclear medicine represents a sizeable part of the U.S. health care industry. Thousands of jobs could be jeopardized by an interruption in the supply of Mo-99.

The Department has proposed the Medical Isotopes Production Project to ensure that a reliable supply of Mo-99 is available to the U.S. medical community. If the Department decides to pursue this project, the Mo-99 produced would be sold at prevailing world market rates. In so doing, the U.S. government would not artificially lower the cost paid by pharmaceutical companies for Mo-99 and would thus not artificially increase the profits realized by these companies on sales of Mo-99. Therefore, it would be incorrect to label isotope production by the Department as a subsidy to private industry or "corporate welfare."

If the decision is made to pursue this project, the Department would act as a backup to the existing Canadian supplier. The Department would operate its facilities to produce only as much Mo-99 as is necessary to maintain the capabilities of the facility and staff to produce 100% of U.S. demand in response to an interruption of the existing supply. In essence, the project would act as an "insurance policy" for the U.S. against a Mo-99 supply shortage. The goal of the proposed project is to ensure that a supply of Mo-99 is readily available to the U.S. medical community.

The Mo-99 and related medical isotopes would be marketed through the Department's Isotope Production and Distribution Program and would be sold to intermediaries (e.g., radiopharmaceutical companies) or end users as appropriate.

As presented in Section 2 of the EIS, the Department would consider the privatization of isotope production activities if, by such action, isotope production and delivery would be enhanced. One of the Department's objectives could be to decrease the government's (and taxpayer's) cost.

Number one, we request that the Department of Energy provide supporting documentation that the
Canadian supply for Mo-99 is not reliable. Specifically, we request a letter from the Canadian
sources that stipulate that The Atomic Energy of Canada, Limited, definitely plans to shut down the
Canadian reactor near the end of the century. We do not see any documentation to that effect.
Nordion International and Atomic Energy of Canada, Limited, will not be able to meet U.S.
1 demand.

Our reason for this request is that we do not believe the Department of Energy has met a sufficient burden of proof requirement that the Canadians are not able to meet U.S. needs. If the Canadians plan to meet our needs, then this project represents an unnecessary burden on American taxpayers, justifiable only as a job creation project. If a test of need is not the key reason for this project, the attendant environmental, health and safety risks that the project imposes upon the citizens of Albuquerque are unreasonable and unjustifiable.

Number 2, the Draft EIS does not cite or examine the findings of vulnerability and adverse conditions noted in DOE's Plutonium Working Group Report dated September, 1994, Volume I and II, Appendix B, Part 10, the Sandia National Laboratories site assessment team report.

On spent nuclear fuel on page 4.20, the Manzano Storage Structures are cited as a facility at Sandia
National Laboratories for storage. Yet, it fails to discuss the unique landlord problem at Sandia
2 Laboratories. DOE's Plutonium Working Group stated in Volume I, quote, "Storage of DOE
materials in non-DOE facilities, i.e., the Nuclear Materials Storage Facility and the Manzano
Facility, is a vulnerability unique to Sandia. DOE does not have control over, or ready access to,
these facilities. Also, if DOE materials have to be removed on short notice, the Sandia National
Laboratories may have no facilities suitable for storage."

In Volume II, it notes an additional vulnerability, the lack of safety authorization for vault storage and, quote, "no safety documentation for storage." The Albuquerque Group wonders why this DOE finding is not in DOE's Draft EIS.

On the hot cell facility, critical to the target processing of Mo-99 separation, the following adverse
conditions are noted in Volume II, Appendix B, Part 10, pages A10 and 11, under the headings of
aging, equipment failure and administrative controls. In the narrative description, seals are noted
to be aging. Equipment failure of safety systems lists cranes and hoists, shielded casks. Inad-
3 equate preventative maintenance, equipment fatigue or malfunction are also cited in the working
group report. Some are listed as possible vulnerabilities, others are existing.

The Draft EIS misleads readers when it does not tell the whole story but simply notes that the current configuration, quote unquote, of the hot cell would only be able to conduct limited processing activities and that a new cell would be constructed to enable steady state production of greater than 10% and up to 100% of the U.S. demand for Mo-99.

On the Annular Core Research Reactor critical to Mo-99 target irradiation, the in-facility adverse conditions checked off are aging and potential water sources. Aging for a facility that is 31 years with a design life of 50 years is described as materials deterioration, the lined storage vaults and the dense pack holes. The latter are stated to be even more susceptible to the effects of environ-
4 ment and aging.

Since the dense pack holes are located outside, there is a remote chance of water leakage into the holes either through the top of the holes or through the ground into the holes. While these may be low probability, low consequence risk, they are real, and they are supposed to be noted in the Draft EIS if they are real risks. It just shows how inadequate the Draft EIS is, if not misleading.

On the storage vault problems noted are inadequate seals. Also perhaps more disturbing are uncertainties or concerns regarding compensatory measures. Note the following weaknesses under the section of preventative measures. You have procedures, maintenance, surveillance, material
5 limits, training and controlled access.

Under the section of mitigative problems, vulnerabilities and uncertainties related to emergency preparedness, emergency management, emergency planning, emergency procedures, emergency response and alarm systems. We would like these problems addressed in the EIS.

Waste stream management is a critical step in the Cintichem process approved by FDA for the production and separation of Mo-99 sold in the U.S. The Draft EIS notes that any waste generated by the Mo-99 production would be managed consistently with DOE's complex-wide Programmatic Environmental Impact Statement or known as the PEIS for waste management. The PEIS, as noted in the draft Mo-99 EIS, is still in draft form. If so, it indicates the nation's waste management problem is still not resolved.

The Albuquerque Group wonders about the wisdom of rushing into production on Mo-99 when the PEIS, which takes care of the waste management problem, is not even resolved yet. In this regard,
6 the Albuquerque Group should like to call attention to one disturbing problem. DOE has made a letter public that it requested a Blue Ribbon EPA Panel to investigate charges by individuals who contributed to the drafting of the PEIS that the Programmatic Environmental Impact Statement was not a reliable document because of contractor malfeasance.

The EPA panel is on record warning the DOE that the charges raised should be taken seriously. Acting Undersecretary Tom Grumbly has released the report.

The resolution of this issue alone warrants a decision to postpone Mo-99 production in the U.S. It also suggests DOE is a long way from solving the waste management problem.

The Albuquerque Group holds a few additional concerns related to the production of Mo-99 in the
7 U.S. in general, and at Sandia National Laboratories specifically. These have to do with tritium releases and air quality problems. This problem is glossed over in the draft.

8 Environmental justice issues; impacts on ethnic minorities and disadvantaged people are not fully analyzed.

9 Water consumption; the increased use of water, a critical and scarce natural resources in a city that has just initiated a water conservation program, needs fuller analysis.

10 Accident scenarios need to be addressed as well as those mentioned in the draft. Even plane crashes need to be put in there.

Responses to Transcript ALB07

1 Please see response to C032-1.

2 Please see response to C032-2.

3 Please see response to C032-3.

4 Please see response to C032-4.

5 Please see response to C032-5.

6 Please see response to C032-6.

7 Please see response to C032-7.

8 Please see response to C032-8.

9 Please see response to C032-9.

10 Please see response to C032-10.

1 I think that the no action is not a good way to go. I think the U.S. needs to have in their borders the ability to produce this medical isotope.

2 I think the Canadian situation is not all that stable. I do not mean their government or anything, I mean just the fact that the government is subsidizing this to some extent, and I think it is not reasonable for us to depend upon that source.

3 I think we would support the production with the Omega West Reactor. We have had it here for 37 years and we have lived with it and the people in town see no danger from it.

4 I would also encourage you to go to 50% because I would like to see the government at least break even on this deal, and the Omega West Reactor could immediately do that. In fact I noticed that we could save $2 million a year over the first selection by the operating costs of Omega West over the Sandia reactor, which would be a $20 million savings over ten years.

5 This project also provides an opportunity for Los Alamos to develop a process to successfully privatize this industry, thus aiding Los Alamos in obtaining the self-sufficiency that we and DOE seek. It would be an industry we could probably handle in Los Alamos quite nicely and provide a service to the nation and provide jobs in Los Alamos and Northern New Mexico, which is a region that needs jobs.

Responses to Transcript LAA01

1 The Department is proposing to establish a domestic production source of Mo-99 to ensure that a reliable supply is available to the U.S. medical community. The Department's concern is not that the current source of supply is a foreign source. If the Department decides to pursue this project and at some later date a reliable domestic supply could be ensured by foreign suppliers, then the Department could phase out its production of Mo-99.

2 Nordion estimates the total cost of their proposal to build two new reactors and a new separations facility at $140 million. While the Department does not doubt Nordion's and the Atomic Energy of Canada Ltd.'s ability to construct the new facilities, the Department believes that it is prudent to make a comparatively small investment (around $20 million, plus those annual operating costs not offset by revenues) to ensure a reliable supply of Mo-99 for the U.S. medical community.

3 Comment noted.

4 The Omega West Reactor, like the Power Burst Facility and the Oak Ridge Research Reactor, would have to be restarted for this project and thus does not have the capability to produce any Mo-99 immediately. The Annular Core Research Reactor is currently operational and could be used to supply a small amount of Mo-99 sooner than the other alternative reactors. All the alternatives would eventually allow the Department to produce greater than the 10%-30% U.S. demand. The purpose of the proposed action in the near term is to create a backup capability, not to create a primary source for Mo-99. Producing 10%-30% on a continual basis would provide some certainty that the alternative could meet production demands up to 100% of the U.S. demand if needed.

The Department recognizes that the estimated costs of preparation and operation of the preferred alternative are higher than for some of the other alternatives, as shown in Section 5.22. Cost estimates (including uncertainties) will be one of the factors in determining which alternative to pursue for the proposed project.

5 Although the potential for privatization of the proposed action in this EIS is important, the process for privatization is not part of this proposed action. Each of the production alternatives has potential for privatization. DOE has solicited expressions of interest from the industrial community for the privatization of any isotope production activity conducted by DOE, including the proposed Medical Isotopes Production Project. If promising concepts are received, the Department would seek privatization proposals on a competitive basis.

The anticipated socioeconomic impacts of the proposed project are discussed in Section 5.3 of the EIS.

1 I strongly support the production of Mo-99 in the U.S. at whatever facility the DOE chooses.

However, Sandia National Lab has been indicated in the EIS as the preferred alternative. It is not
2 clear that the results documented in the EIS were used in making this decision. There is no
reasoning for this choice presented in the document. As I read the EIS, Sandia is not supported
as the preferred alternative.

In particular, the stated intent of the Mo-99 production program is to be able to supply 100% of the
U.S. demand for Mo-99 in the case Nordion ceases production. Although Sandia claims the
3 shortest schedule to initial production, it is clear that this initial production does not meet the stated
requirements of the project. In fact the EIS clearly shows that Sandia has the longest schedule to
full production capability.

In addition, Sandia is the most expensive option after just one year of operation. It also requires
the most extensive facility modifications, has the least spent nuclear fuel storage capacity, creates
the most waste, cannot store this low-level waste on-site, has no radioisotope production
experience, does not have the chemical processing experience of the other alternatives, does not
4 have the target fabrication capabilities of the other alternatives, requires modification of the
reactor to a configuration not previously demonstrated, and finally, runs the very real risk of
being usurped for defense program needs.

This last point alone seems to disqualify Sandia with regards to being able to meet the stated intent of the project.

Responses to Transcript LAB01

1 Comment noted.

2 The Chemistry and Metallurgy Research Facility at LANL is the preferred alternative for Mo-99 target fabrication, and the Annular Core Research Reactor/Hot Cell Facility (ACRR/HCF) combination at SNL/NM is the preferred alternative for target irradiation and processing for the reasons stated in Section 3.3.1.1.

3 The ability to produce even a small amount of Mo-99 in a short period of time is important in that, if a Mo-99 shortage were to occur in the near future, the Department would be able to supply at least a fraction of the U.S. demand. The Department has proposed the Medical Isotopes Production Project to respond to a near-term window of vulnerability in the Mo-99 supply situation; therefore, the ability to produce even a small amount of Mo-99 in a short period of time is an important factor and will be considered in the Department's decision on the proposed project. In the near term, with a single reactor producing 100% of the U.S. demand, the unavailability of that reactor for any reason would result in a Mo-99 supply shortage. The potential for such a shortage is why the ability to produce even a fraction of the U.S. demand in the near term is considered important. This would provide DOE with a Mo-99 extraction process which has met FDA approval requirements in the very near term and would be capable of providing up to 30% of the U.S. demand on an emergency basis. This early experience would also be an asset in the expansion to full-scale production capability.

As shown in Table 3-2, the preferred alternative is estimated to be the second fastest to full production, in a tie with the INEL alternative.

4 Each of the sites evaluated as reasonable alternatives has certain advantages and disadvantages, as documented in the EIS. These advantages and disadvantages will be considered in reaching a decision on the proposed project.

Regarding the possible diversion of the ACRR for defense use, it is possible that the ACRR, the preferred reactor for the proposed project, could be diverted to support defense missions in case of a national emergency. However, the Department has determined that the probability of needing the ACRR for defense purposes is sufficiently low to preclude disqualifying the reactor from consideration.

1 I want the Medical Isotope Production Project to proceed.

2 I do have one dissention. I find that the no action alternative is completely unacceptable. I want the project to proceed here in Los Alamos.

3 If the controversy in Albuquerque will prevent or slow this project, then I must insist that the controversy be considered when selecting the site for the MIPP. The people against the project operating at Sandia or against the project in any form would sing a different tune if the medicine was needed to help save the life of one of their children.

Responses to Transcript LAB02

1 Comment noted.

2 Comment noted.

3 The process for preparing an environmental impact statement allows an opportunity for the public to provide the Department their comments on a proposed project. These comments are considered in reaching a decision on whether and where to conduct the proposed project.

1 First, we like the jobs up here. Second, we like the money being spent up here. Third, there is no apparent environmental risk. And fourth, I do not want to see somebody else get their reactor turned on while ours is not.

Response to Transcript LAB03

1 Comment noted.

1 I am, first of all, highly supportive of making the Mo-99 somewhere in this country, and I hope it goes forward somewhere.

. . .one of the alternatives that was not considered in the beginning for reasons that were valid at the time, the reasons have now changed, and that has to do with the Fast Flux Test Facility, FFTF.

As you probably know, at the time it was too large for the moly project by itself. The operation of FFTF could not be justified by just Mo-99, so there was a very active threat to shut it down.

Fortunately, the facility has not been removed and there is now a consortium of companies and individuals in Richland that is actively pursuing the production of a variety, not just Mo-99, but a variety of medical isotopes in the FFTF.

Now, even that by itself is not enough to justify operations, the cost of operation of FFTF. But now Sohinki, Director of the Reconfiguration Department, BP-25, has a study going connected with production of tritium in the FFTF, and whereas FFTF might not be able to supply 100% of the U.S. requirements, since the amount of tritium required is secret they do not know,
2 but it would be a fair proportion, and the sale of the tritium in conjunction with or in addition to sale of the medical isotopes would indeed justify the continuation of FFTF.

The time required to get the FFTF back into operation, full operation, production, would be about three years, which looks as though it might be a little bit longer than some of the other four. But with FFTF we have a 20-year lifetime from start-up again whereas all these others are, let us face it, ancient, and would probably have a maximum of ten years. And it would also be interesting to look at the cost involved.

So I would suggest that if possible we either add the FFTF capability to this EIS or proceed however it would be best to do so, possibly in connection with the privatization effort, but to make sure this does not get lost, and that FFTF does not go down. It is unique in the world and it is something we really should preserve in this country.

Also, if we do use FFTF, we could still have Los Alamos production of the targets, at least for a while. I would like to have jobs here at Los Alamos, but I would also like to preserve our national FFTF.

Responses to Transcript LAB04

1 Comment noted.

2 The Department is conducting a study of the viability of the Fast Flux Test Facility (FFTF) for tritium production, but a decision has not yet been made. As discussed in Section 3.4, the FFTF cannot meet the selection criteria for a Mo-99 production facility. If the FFTF is restarted in response to the proposal from Advanced Nuclear and Medical Systems, the private consortium may wish to produce Mo-99 in the FFTF, and DOE would review its Mo-99 production plans and modify them if appropriate, recognizing that the FFTF cannot provide a continuous supply of Mo-99.