DOE/EA-1607

DRAFT ENVIRONMENTAL ASSESSMENT

DISPOSITION OF DOE EXCESS DEPLETED URANIUM, NATURAL URANIUM, AND LOW-ENRICHED URANIUM

December 23, 2008

U.S. Department of Energy
Office of Nuclear Energy

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LIST OF ACRONYMS AND ABBREVIATIONS

ACP	American Centrifuge Plant
ALARA	as low as reasonably achievable
ANSI	American National Standards Institute
CaF_2	calcium fluoride
CEQ	Council on Environmental Quality
CFR	U.S. Code of Federal Regulations
D&D	decontamination and decommissioning
dB[A]	A-weighted decibel
DCP	dry conversion process
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
DU	depleted uranium
DUF_6	depleted uranium hexafluoride
EA	environmental assessment
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
ERI	Energy Resources International, Inc.
ETTP	East Tennessee Technology Park
FONSI	Finding of No Significant Impact
FFF	fuel fabrication facility
g	force of gravity
GDP	gaseous diffusion plant
GNEP	Global Nuclear Energy Partnership
GNF	Global Nuclear Fuel
HEU	highly enriched uranium
HF	hydrogen fluoride
IAEA	International Atomic Energy Agency
ISO	International Organization for Standardization
LCF	latent cancer fatality
LES	Louisiana Energy Services
LEU	low-enriched uranium
$LEUF_6$	low-enriched uranium hexafluoride
LLMW	low-level mixed waste
LLW	low-level waste
µCi/cc	microcuries per cubic centimeter
MEI	maximally exposed individual
mg/kg	milligrams per kilogram
mrem	millirem
mSv	millisievert
MT	metric ton
MTCA	Model Toxics Control Act
MTU	metric tons of uranium
N/A	not applicable
NAAQS	National Ambient Air Quality Standards

NEF	National Enrichment Facility
NEPA	National Environmental Policy Act
NRC	U.S. Nuclear Regulatory Commission
NU	natural uranium
NUF_6	natural uranium hexafluoride
pCi/g	picocuries per gram
PEIS	programmatic environmental impact statement
$PM_{2.5}$	particulate matter with a diameter of 2.5 microns or less
PM_{10}	particulate matter with a diameter of 10 microns or less
PSF	Physical Sciences Facility
RAI	request for additional information
ROD	Record of Decision
SAR	safety analysis report
SNM	special nuclear material
SWU	separative work unit
Tc	technetium
TCE	trichloroethylene
U_3O_8	triuranium octoxide
UDS	Uranium Disposition Services, LLC
UF_6	uranium hexafluoride
UO_2	uranium dioxide
UO_2F_2	uranyl fluoride
USEC	United States Enrichment Corporation
VOC	volatile organic compound
WEC	Westinghouse Electric Corporation

SUMMARY

On March 11, 2008, the Secretary of Energy issued a policy statement (the Secretarial Policy Statement) on the management of the U.S. Department of Energy's (DOE's) excess uranium inventory (Appendix A). The policy statement commits DOE to manage all of its excess uranium inventories in a manner that (1) is consistent with all applicable legal requirements; (2) maintains sufficient uranium inventories at all times to meet the current and reasonably foreseeable needs of Departmental missions; (3) undertakes transactions involving non-U.S. Government entities in a transparent and competitive manner, unless the Secretary of Energy determines in writing that overriding Departmental mission needs dictate otherwise; and (4) is consistent with and supportive of the maintenance of a strong domestic nuclear industry.

In accordance with this policy, DOE proposes to disposition part of its excess uranium inventory using one or a combination of two methods: (1) enrichment to either natural uranium (NU) or low-enriched uranium (LEU) product, and subsequent storage or sale of the resultant NU or LEU product (the Enrichment Alternative), and (2) direct sale[1] to appropriately licensed entities (the Direct Sale Alternative). Under the Enrichment Alternative, DOE could enrich depleted uranium (DU) to the ^{235}U content of NU (i.e., 0.711 percent ^{235}U), and DOE could enrich DU, NU, and/or LEU (with a current ^{235}U content of less than 4.95 percent) up to 4.95 percent ^{235}U content. This draft environmental assessment (EA) assumes that the Proposed Action would result in the annual enrichment and/or sale of amounts of the excess inventory that, combined with other DOE sales or transfers to the market, generally would not exceed 10 percent of the total annual fuel requirements of all licensed U.S. nuclear power plants—that is, approximately 2,000 metric tons of uranium (MTU). In some years, the annual amount enriched and/or sold could be greater than 2,000 MTU (for example, due to startup of new reactors, which requires approximately three times the amount of material needed for normal operations).

The excess inventory that DOE proposes to disposition is stored as uranium hexafluoride (UF_6) at the DOE Portsmouth site in Ohio and the DOE Paducah site in Kentucky. DOE also anticipates the potential identification of additional amounts of LEU with a ^{235}U content of less than 4.95 percent. Under the Enrichment Alternative, the uranium could be transported by truck or rail to one or more of three enrichment facilities in the United States or to an enrichment facility in France. Shipments to France could be via any of several east-coast or gulf-coast U.S. ports; however, this EA assumes, for purposes of analysis, that the uranium would be transported by barge to New Orleans, Louisiana, then by ship to France. The LEU product could be stored at up to three U.S. commercial nuclear fuel fabrication facilities (FFFs) in North Carolina, South Carolina, and Washington State, and/or at DOE's Portsmouth or Paducah sites. When DU is enriched to NU, it would be stored at enrichment facilities in Kentucky, New Mexico, and/or Ohio, and/or at DOE's Portsmouth or Paducah sites. The DU that would result from the enrichment process, called "DU tails", would be stored and managed at the enrichment facility or be transported to and stored and managed at DOE's Portsmouth or Paducah sites.

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[1] In this EA, the term "sale" includes direct sales, transfers, or other transactions the Department may undertake to disposition its excess uranium inventory.

Under either alternative, DOE would disposition the excess inventory consistent with market conditions and applicable law and in a manner tailored to avoid or minimize adverse material impacts to the domestic uranium market.

In this EA, DOE assesses the potential environmental impacts associated with this Proposed Action and a No Action Alternative. The potential impacts of all aspects of enrichment operations and the conversion of DU tails, *per se*, have been previously addressed in existing National Environmental Policy Act (NEPA) documents. This EA focuses on previously unanalyzed impacts: (1) health and safety impacts from transportation of the excess inventory, LEU product, NU, and DU tails; (2) impacts associated with accidents and intentional destructive acts (terrorism, sabotage); and (3) economic impacts of the Proposed Action on the domestic uranium industry.

In general, the impacts identified for the Enrichment and Direct Sale Alternatives are similar if not identical. The potential impacts are summarized as follows:

- For all truck, rail, and barge transport options, for all domestic and foreign enrichment facility locations, and for all storage options, transportation of the entire inventory of DU, NU, and LEU subject to this EA is estimated to result in approximately 3 transportation-related fatalities over approximately 25 years.[2] For overseas transportation, this includes impacts from sea transit, U.S. port operations, and overland transport. These transportation impacts include the radiological and nonradiological impacts from incident-free transportation and transportation accidents.

- For enrichment at the National Enrichment Facility (NEF) near Eunice, New Mexico, the truck or rail transportation impacts would be higher than for enrichment at Paducah, Kentucky, or Portsmouth, Ohio, because the NU, LEU, or DU feed would be shipped greater distances, and the DU tails and NU product, could be stored/dispositioned by NEF, or could be shipped back to Paducah or Portsmouth.

- The probability of a latent cancer fatality (LCF) for the maximally exposed individual (MEI) along the truck transportation routes was estimated to range from 8.3×10^{-8} to 5.3×10^{-7}. For the analysis, the MEI was located 30 meters from the highway and was exposed to all truck shipments. The shipments are assumed to travel at a speed of 24 kilometers (15 miles) per hour, which is representative of speeds in urban areas.

- The probability of an LCF for the MEI along the rail transportation routes was almost identical to truck transport, ranging from 8.2×10^{-8} to 5.2×10^{-7}. For the analysis, the MEI was located 30 meters from the railroad and was exposed to all rail shipments. The shipments are assumed to travel at a speed of 24 kilometers (15 miles) per hour, which is representative of speeds in urban areas.

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[2] For perspective, over the period 2002 to 2006, about 43,000 people were killed each year in motor vehicle accidents and about 900 people were killed each year in railroad accidents and incidents in the United States (DOT 2007).

- The transportation-related impacts of transporting the uranium to New Orleans by barge would be less than the impacts of transporting the uranium there by truck or rail due to the fewer number of required shipments and the fact that the exposed population would be smaller for barge transport.

- Severe rail accidents would have higher consequences than truck accidents because each railcar would carry four cylinders of DU, NU, or LEU (feed), compared with only one for each truck. For LEU product, each railcar would carry 12 cylinders, compared with 3 for each truck.

- For a severe truck accident involving one cylinder of depleted uranium hexafluoride (DUF_6), the population radiation dose could be as high as 32,000 person-rem in an urban area if stable atmospheric conditions existed at the time of the accident. Based on this population radiation dose, it was estimated that there could be 20 LCFs in the exposed population of about 3 million people. For comparison, in a population of 3 million people, approximately 700,000 would be expected to die from cancer of all causes. The radiation dose for the MEI was estimated to be as high as 0.91 rem if stable atmospheric conditions existed at the time of the accident. The probability of an LCF for this individual was estimated to be 0.0005. If the severe transportation accident involved NU feed or product, the radiological consequences would be higher—about 28 LCFs. For the MEI, the probability of an LCF would be 0.0008. If the severe transportation accident involved LEU product, the radiological consequences would be about 75 LCFs in the exposed population, assuming that all three 30B cylinders in a truck shipment were breached during the severe accident. For the MEI, the probability of an LCF would be 0.002.

- For a severe rail accident involving four cylinders of DUF_6, the population radiation dose could be as high as 130,000 person-rem in an urban area if stable atmospheric conditions existed at the time of the accident. Based on this population radiation dose, it was estimated that there could be 80 LCFs in the assumed exposed population of about 3 million people. For comparison, in a population of 3 million people, approximately 700,000 would be expected to die from cancer of all causes. The radiation dose for the MEI was estimated to be as high as 3.7 rem if stable atmospheric conditions existed at the time of the accident. The probability of an LCF for this individual was estimated to be 0.002. If the severe transportation accident involved NU feed or product, the radiological consequences would be higher—about 110 LCFs in the exposed population. For the MEI, the probability of an LCF would be 0.003. If the severe transportation accident involved LEU product, the radiological consequences would be about 310 LCFs in the exposed populations, assuming that all twelve 30B cylinders in a rail shipment were breached during the severe accident. For the MEI, the probability of an LCF would be 0.009.

- Three individuals could suffer irreversible health effects from severe truck accidents and four individuals could suffer irreversible health effects from severe rail accidents due to the chemical toxicity associated with UF_6, hydrogen fluoride (HF), and uranyl fluoride (UO_2F_2). No fatalities are estimated to result from chemical exposure.

- In a 1999 study, DOE concluded that the consequences of an intentional destructive act involving the transport of NU would be less than or similar to the consequences of severe transportation accidents (DOE 1999a). Therefore, the consequences of intentional destructive acts would be similar to the consequences discussed above for severe truck and rail accidents involving DU, NU, and LEU.

- If a severe accident involving stored LEU product were to occur, the accident would result in an estimated population dose. For example, at the Global Nuclear Fuel (GNF) FFF, a severe accident was estimated to result in a population dose of 29,000 person-rem. In the exposed population of 29,000 people around the GNF facility, this radiation dose is estimated to result in 17 LCFs. The radiation dose for an individual located 2 kilometers from the facility was estimated to be 5 rem. The probability of an LCF for this person is estimated to be 0.003. If this accident occurred at other sites, the results would vary depending on the enrichment of the UF_6, the exposed population, or atmospheric conditions.

- Direct sales or enrichment would be managed by DOE to avoid or minimize adverse material impacts on the domestic uranium industry and market.

1.0 PURPOSE AND NEED FOR AGENCY ACTION

1.1 Background

The U.S. Department of Energy (DOE) owns and manages an inventory of depleted uranium (DU), natural uranium (NU), and low-enriched uranium (LEU). This inventory is currently stored in large cylinders as depleted uranium hexafluoride (DUF_6), natural uranium hexafluoride (NUF_6), and low-enriched uranium hexafluoride ($LEUF_6$) at the DOE Paducah site in western Kentucky (DOE Paducah) and the DOE Portsmouth site near Piketon in south-central Ohio (DOE Portsmouth)[3]. This inventory exceeds DOE's current and projected energy and defense program needs.

Uranium Hexafluoride (UF_6)

Uranium hexafluoride (UF_6) is the chemical form of uranium that is used during the uranium enrichment process. Within a reasonable range of temperature and pressure, it can be a solid, liquid, or gas. Solid UF_6 is a white, dense, crystalline material that resembles rock salt. UF_6 does not react with oxygen, nitrogen, carbon dioxide, or dry air, but it does react with water or water vapor (including humidity in the air). When UF_6 comes into contact with water, such as water vapor in the air, the UF_6 and water react, forming corrosive hydrogen fluoride (HF) and a uranium-fluoride compound called uranyl fluoride (UO_2F_2). For this reason, UF_6 is always handled in leak-tight containers and processing equipment.

On March 11, 2008, the Secretary of Energy issued a policy statement (the Secretarial Policy Statement) on the management of DOE's excess uranium inventory (Appendix A). The policy statement commits DOE to managing all of its excess uranium inventories in a manner that (1) is consistent with all applicable legal requirements; (2) maintains sufficient uranium inventories at all times to meet the current and reasonably foreseeable needs of Departmental missions; (3) undertakes transactions involving non-U.S. Government entities in a transparent and competitive manner, unless the Secretary of Energy determines in writing that overriding Departmental mission needs dictate otherwise; and (4) is consistent with and supportive of the maintenance of a strong domestic nuclear industry.

In accordance with the principles set forth in the Secretarial Policy Statement, DOE is proposing to disposition excess NU, DU and LEU inventory by enriching it, and then storing or selling the resultant product, and/or selling excess NU, DU and LEU inventory, to appropriately licensed entities. Hereafter in this environmental assessment (EA), "excess inventory" means that part of DOE's excess NU, DU, and LEU inventory that would be dispositioned under DOE's Proposed Action. The characteristics and quantities of the excess inventory are discussed further in Section 2.0, Description of the Proposed Action and Alternatives.

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[3] DOE also has additional uranium of varying levels of enrichment that, in the future, may be added to the excess DU, NU, and LEU inventory (e.g., uranium that could be recovered during facility decontamination and decommissioning [D&D]). In addition, the DOE uranium inventory includes quantities of highly enriched uranium (HEU), which is being dispositioned through an ongoing National Nuclear Security Administration (NNSA) program and is not addressed in this EA.

1.2 Purpose and Need

The purpose of the Proposed Action is to disposition DOE's excess inventories of NU, DU, and LEU to reduce expenses associated with storing, managing, and securing DOE's excess uranium inventory. Increases in the market price for uranium would make the enrichment of DU, NU and LEU more economically attractive. Implementation of the Proposed Action also could enhance DOE's ability to support a healthy domestic nuclear infrastructure. The Secretarial Policy Statement provides the framework within which DOE would make decisions concerning future disposition of the excess inventory.

Uranium-235: DU, LEU, and HEU

Uranium exists as three naturally occurring isotopes: uranium-238 (^{238}U), uranium-235 (^{235}U), and uranium-234 (^{234}U). The ^{235}U isotope can fission, or split, into lighter fragments when bombarded with neutrons. This process can release energy either in a controlled manner in a nuclear reactor or an uncontrolled manner in a nuclear weapon explosion. Of the three naturally occurring uranium isotopes, only ^{235}U can sustain an energy-releasing chain reaction.

Natural uranium (NU) refers to refined uranium ore with the same isotopic ratio found in nature; it contains approximately 0.711 percent ^{235}U. Through gaseous diffusion or centrifugation enrichment processes, the concentration of ^{235}U can be increased (enriched), and the resultant uranium is called either low-enriched uranium (LEU) or highly enriched uranium (HEU). LEU has a concentration of ^{235}U less than 20 percent. HEU has a concentration of ^{235}U of 20 percent or greater. For use in commercial light water reactors, the most prevalent power reactors in the world, uranium is enriched to LEU having 3 to 5 percent ^{235}U.

After increasing the concentration of ^{235}U in a portion of the uranium mixture during the enrichment process, the remaining uranium mixture has a reduced concentration of ^{235}U. This is called depleted uranium (DU) or sometimes DU tails. The U.S. Nuclear Regulatory Commission (NRC) definition of DU is uranium in which the percentage fraction by weight of ^{235}U is less than 0.711 percent, although enrichment normally results in DU having much lower levels of ^{235}U.

1.3 The National Environmental Policy Act and Related Procedures

Before deciding whether to implement the Proposed Action, DOE must comply with the National Environmental Policy Act (NEPA), 42 U.S. C. §§ 4321 *et seq*. Consequently, DOE is preparing this EA to determine if the Proposed Action would result in significant impacts to the human environment. Based on the findings of this EA, DOE will either prepare an environmental impact statement (EIS) or issue a Finding of No Significant Impact (FONSI). A FONSI would identify commitments to mitigation, if any, that are essential to render the impacts of the Proposed Action not significant. This draft EA has been prepared in accordance with NEPA regulations issued by the Council on Environmental Quality (CEQ) (40 CFR Parts 1500–1508) and DOE (10 CFR Part 1021), as well as guidance by both agencies. It is being distributed to the host/affected states, the U.S. Nuclear Regulatory Commission (NRC), uranium producers and enrichers, fuel fabricators, and other interested parties. Appendix B contains a copy of the transmittal letter and distribution list.

1.4 Relationship to Other National Environmental Policy Act Documents

Since 1993, DOE and the NRC have proposed and, in some instances, implemented agency actions related in greater or lesser degrees to the Proposed Action assessed in this EA. The impacts of these actions have been assessed in a series of EISs and EAs. Those NEPA documents were reviewed, used as existing sources of information, and, when appropriate, incorporated by reference into this EA. Appendix C lists those NEPA documents, summarizes their content, and indicates how they were used in the preparation of this EA.

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2.0 DESCRIPTION OF THE PROPOSED ACTION AND ALTERNATIVES

DOE proposes to disposition its excess uranium inventory using one or a combination of two methods: (1) enrichment to either NU or LEU product and subsequent storage or sale of the resultant NU or LEU product (the Enrichment Alternative), and (2) direct sale[4] to appropriately licensed entities (the Direct Sale Alternative). Under the Enrichment Alternative, DOE could enrich DU to the ^{235}U content of NU (i.e., 0.711 percent ^{235}U), and DOE could enrich DU, NU, and/or LEU (with a current ^{235}U content of less than 4.95 percent) up to 4.95 percent ^{235}U content. A target enrichment level for LEU of 4.95 percent ^{235}U content was selected for analysis in this EA because it is near the upper end of the range of enrichment (3 to 5 percent ^{235}U) used in fuel for most commercial light-water power reactors. In practice, DOE might choose to enrich to lower-percentage ^{235}U content. This chapter describes these two action alternatives, including options within them, and the No Action Alternative (i.e., continuing the status quo).

2.1 Enrichment Alternative

2.1.1 Uranium Shipments and Involved Facilities

Under the Enrichment Alternative, DOE would contract to ship and enrich excess NU, DU (having an assay equal to or greater than 0.35 percent ^{235}U), and LEU (having an assay greater than 0.711 percent ^{235}U but less than 4.95 percent ^{235}U) as UF_6.

DOE would contract with appropriate commercial carriers (truck, rail, barge, and/or ship) to transport the excess inventory to one or more of four enrichment facilities (three domestic and one foreign). The U.S. enrichment facilities are (1) the currently operating United States Enrichment Corporation (USEC) gaseous diffusion plant (GDP) in Paducah, Kentucky; (2) the USEC American Centrifuge Plant (ACP) near Piketon, Ohio, which is scheduled to begin enrichment operations in late 2009 or 2010; and (3) the Louisiana Energy Services (LES) National Enrichment Facility (NEF) near Eunice, New Mexico, which is scheduled to begin enrichment operations in late 2009. The foreign enrichment facility is operated by AREVA and is located at the Tricastin nuclear complex in south-central France on a diversion canal of the Rhone River, approximately 130 kilometers (80 miles) north of the port of Marseilles.

U.S. facility enrichment operations (including enrichment technologies; feed material, end product, and waste product handling; logistics; and facility management) have been described in detail in applicable DOE and NRC NEPA documents. Those documents describe the enrichment operations, the enrichment facilities, the waste management activities, and the environmental impacts that would be applicable to the enrichment activities that would occur under the Proposed Action. Those descriptions are summarized and incorporated into this EA by reference (NRC 2005 [LES NEF]; NRC 2006 [USEC ACP]; DOE 1982 [Paducah GDP]). The French enrichment plant uses a gas diffusion process to enrich uranium into reactor-grade LEU for some 100 nuclear reactors in France and throughout the world.

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[4] In this EA, the term “sale” includes direct sales, transfers, or other transactions the Department may undertake to disposition its excess uranium inventory.

If DOE contracts for the enrichment of DU to NU, DOE would contract for the storage of the resultant NU at the enrichment facility performing the enrichment operations, or for the transport of the NU to DOE Paducah and/or DOE Portsmouth. If DOE contracts for the enrichment of DU, NU, or LEU to obtain LEU with up to 4.95 percent ^{235}U content, DOE would contract to transport the LEU product to, and store it at, one or more of five domestic sites. Three of these sites are commercial nuclear fuel fabrication facilities (FFFs) operated by AREVA in Richland, Washington (AREVA FFF); by Westinghouse Electric Corporation (WEC) near Columbia, South Carolina (WEC FFF); and by Global Nuclear Fuel (GNF) near Wilmington, North Carolina (GNF FFF). DOE considers on-site storage at these FFFs to be desirable because they require LEU as process feedstock and already store quantities of LEU on-site. In total, up to 670 metric tons of uranium (MTU) could be stored at the FFFs. DOE also could contract to ship the LEU product to DOE Paducah and/or DOE Portsmouth and store or sell it. Both DOE sites have the required infrastructure and security, as well as extensive experience in the safe management, storage, and logistics of uranium cylinders. If other sites are proposed in the future for storage, additional NEPA analysis would be prepared, as appropriate.

Figure 2-1 shows the locations of the six potentially affected domestic sites; Figures 2-2 through 2-6 illustrate the domestic and international uranium transportation options.

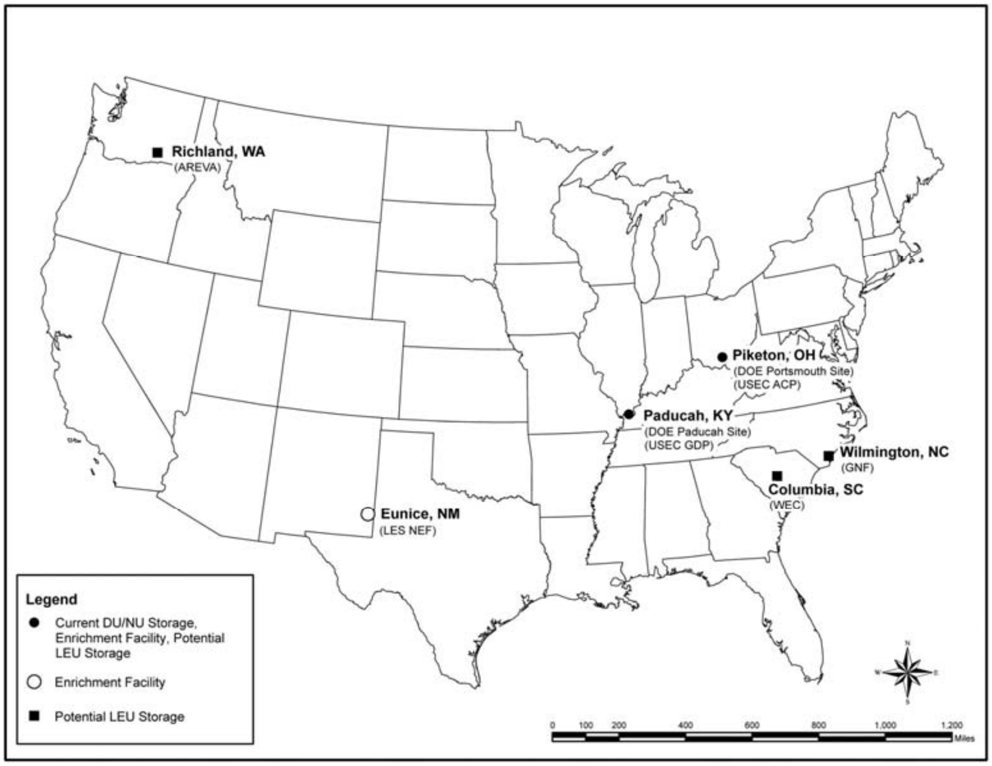

Figure 2-1. Domestic Facility Locations

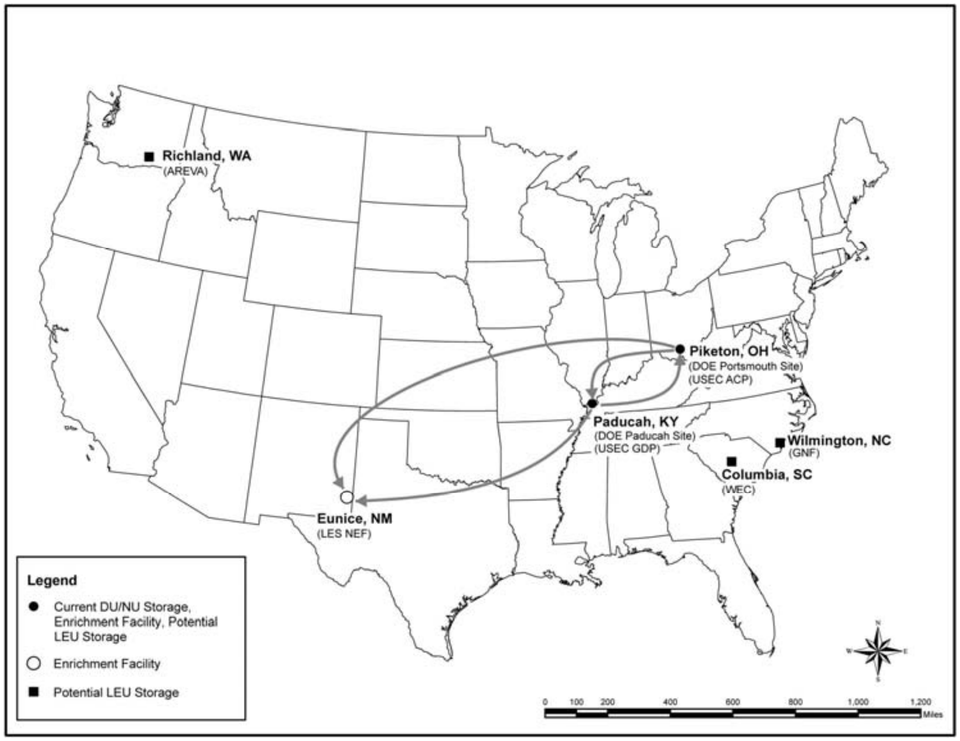

Figure 2-2. Excess Inventory Shipments to Domestic Enrichment Facilities

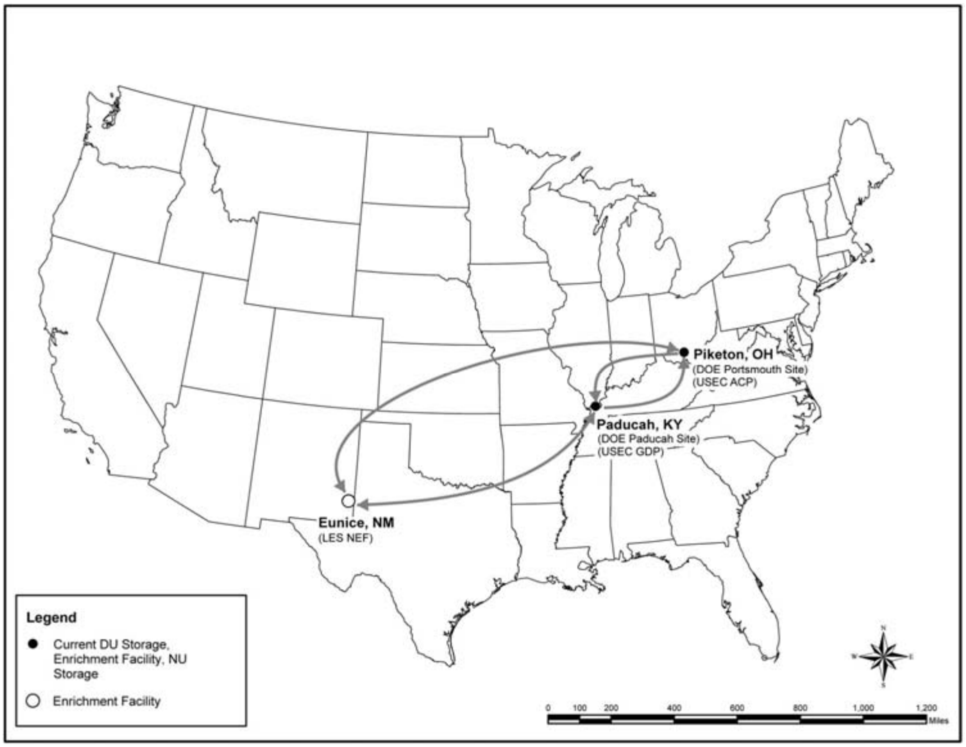

Figure 2-3. NU Product Shipments

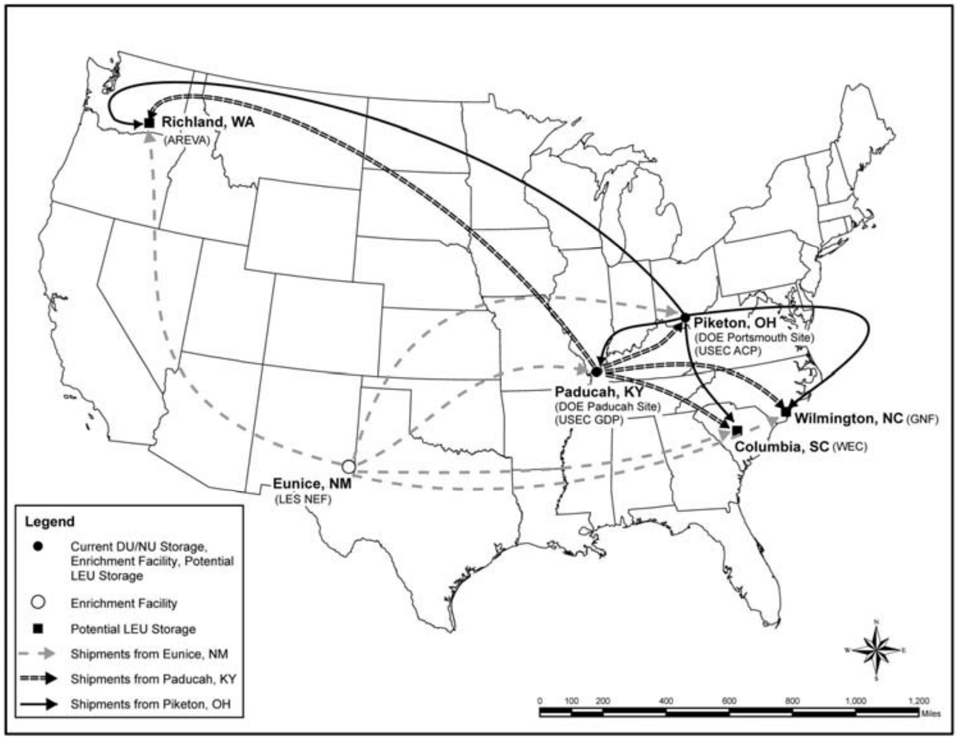

Figure 2-4. LEU Product Shipments to Five Optional Storage Locations

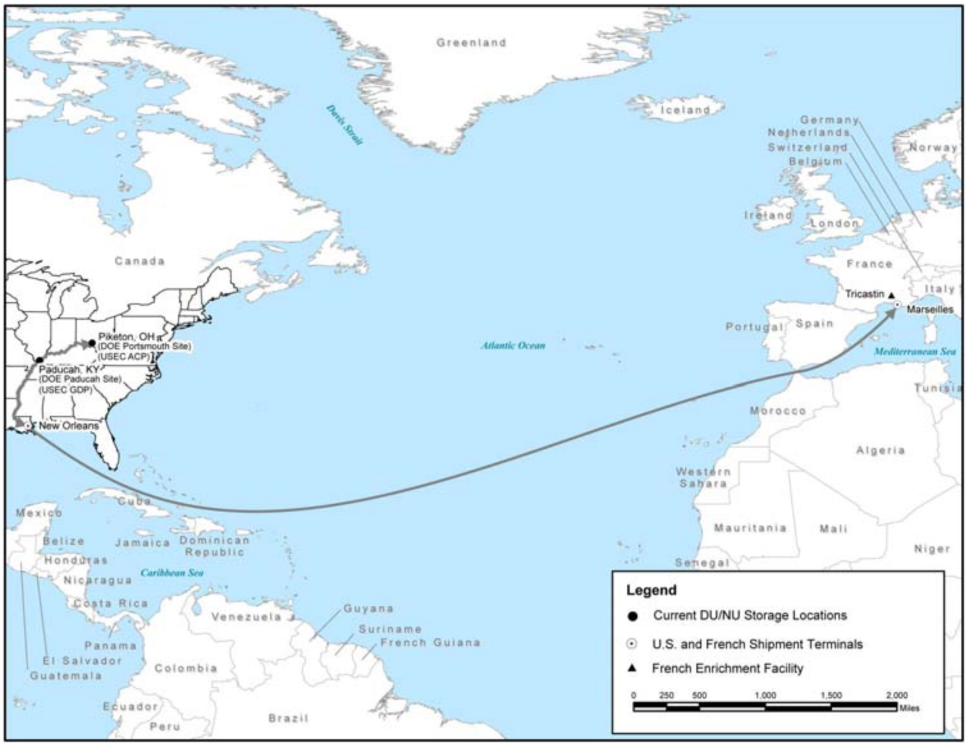

Figure 2-5. Excess Inventory Shipments to, and NU Product and/or LEU Product Shipments from, France

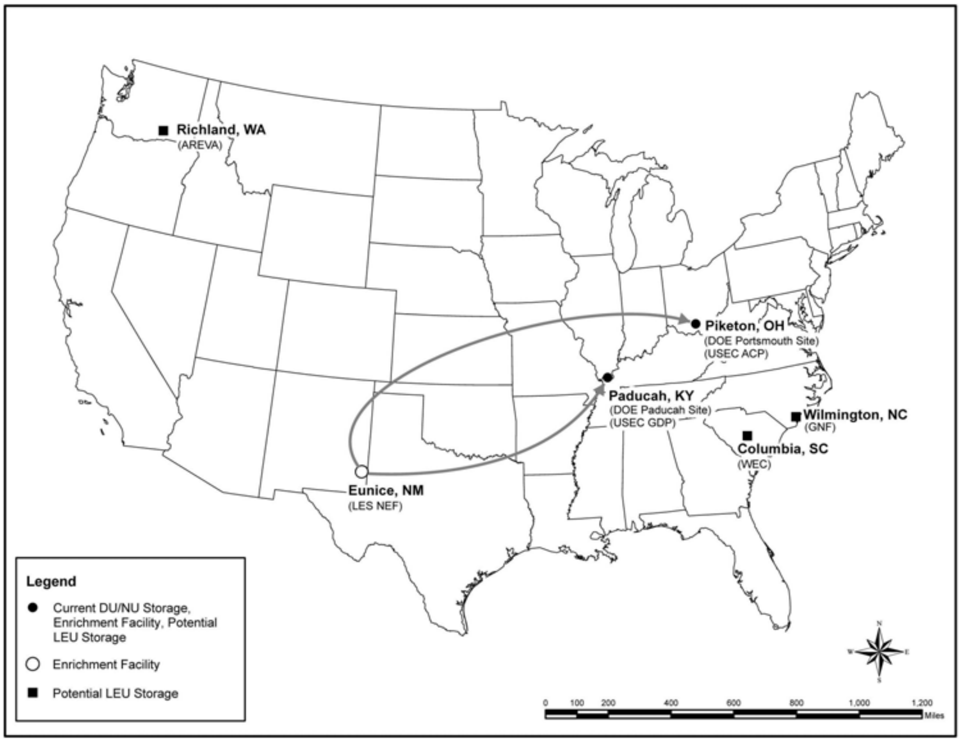

Figure 2-6. DU Tails Shipments for Storage at Paducah or Portsmouth

Enriching the excess inventory to either NU or LEU product would result in the production of "DU tails". In this EA, it is assumed that the DU tails would have a 0.20 percent ^{235}U content. The DU tails are an end product that results from uranium enrichment; they have a lower ^{235}U content than the DU that would serve as feed for enrichment operations. As part of the Proposed Action, DOE would contract with the enrichment facility to store and/or dispose of the DU tails or, in the case of domestic enrichment facilities, to ship the DU tails from the domestic enrichment facilities to DOE Paducah and/or DOE Portsmouth for storage, pending final disposition consistent with the DOE decisions announced in the *Record of Decision for Construction and Operation of a Depleted Uranium Hexafluoride Conversion Facility at the Paducah, KY, Site* (69 FR 44654); and *Record of Decision for Construction and Operation of a Depleted Uranium Hexafluoride Conversion Facility at the Portsmouth, OH, Site* (69 FR 44649). DOE assumes DU tails from enrichment in France would not be returned to the United States but would be disposed of in France in accordance with French policies and regulations. DOE may contract with the enricher to store, convert, and dispose of the tails.

Table 2-1 summarizes the weight and number of cylinders of excess NU, DU, and LEU inventory that would be enriched and/or sold and the number of cylinders of NU product, LEU product and DU tails that would result.

Table 2-1. Excess Inventory, LEU Product, and DU Tails Characteristics

Material Type	MTU	Number of Cylinders
NU feed	17,595	2,270
DU feed	75,296	10,776
LEU feed	2,000[a]	296
LEU product	4,919	3,195
DU tails	89,972[b]	10,931
NU product	22,213	3,445
DU tails	53,083[c]	6,450

a. DOE currently has identified approximately 1,110 MTU of LEU feed. The analysis in this EA uses a larger quantity because DOE anticipates that additional LEU may be identified as excess inventory.
b. DU tails from enriching NU feed, DU feed, and LEU feed to LEU product.
c. DU tails from enriching DU feed to NU product.

The excess inventory would be shipped from DOE Paducah or DOE Portsmouth to U.S. enrichment facilities by either truck or rail. The NU and LEU product and DU tails would also be shipped to storage sites by either truck or rail. This EA analyzes the possibility of rail shipments, assuming that potentially affected sites have serviceable rail sidings and transfer terminals within a reasonable distance. DOE has not identified any need for major new rail infrastructure as part of the Proposed Action. Minor upgrades to existing sidings or rail terminals could be implemented, if necessary, to accommodate or allow for rail shipments. The decision whether to undertake any rail upgrades would be DOE’s responsibility only at DOE Paducah or DOE Portsmouth, and DOE would evaluate the need for related NEPA analysis if such a proposal were under consideration.

The excess inventory to be shipped from DOE Paducah or DOE Portsmouth to France could be transported to New Orleans, Louisiana, by barge, rail, and/or truck, and then transported to Marseilles by ship. LEU or NU product imported from France could be first returned to DOE Portsmouth or DOE Paducah via New Orleans, and then shipped to one or more of the three FFFs by truck or rail. This two-step shipment scenario for importing LEU product from France would provide conservative impact estimates (that is, larger estimated impacts than if the LEU product were shipped directly from France to a FFF). Uranium could be exported to and imported from France via U.S. marine terminal ports other than the port of New Orleans. Other options include the ports of Providence, Rhode Island; New York, New York; Elizabeth, New Jersey; Philadelphia, Pennsylvania; Baltimore, Maryland; Hampton Roads, Virginia; Morehead City, North Carolina; Charleston, South Carolina; Savannah, Georgia; Jacksonville, Florida; Fernandina, Florida; and Houston, Texas. However, of these and other optional marine terminal ports, only New Orleans can be reached directly or nearly directly by barge from DOE Paducah and DOE Portsmouth. Commercial carriers would decide which ports to use. Impacts would be generally similar at any port capable of handling the materials because the operations would be the same or similar. In a 1994 EA, DOE found no significant difference in comparative transportation-related risks among 13 optional ports of entry for importing LEU into the United States (DOE 1994). Based on the availability of direct barge access and the previously determined comparability of transportation-related risk to optional ports, DOE has determined that analyzing only New Orleans as a marine terminal port is sufficient for the purposes of this EA. If other marine terminal ports were proposed, DOE would evaluate the need for additional NEPA analysis.

DOE's estimates of the number of requisite shipments of excess inventory, NU product, LEU product, and DU tails that would occur using the various transportation options are shown in Section 4.2.1 (Transportation Impacts under the Enrichment Alternative).

2.1.2 Maximum Annual Amount and Program Duration

Section 3112(d) of the 1996 USEC Privatization Act requires the Secretary of Energy to determine that the sale or transfer of NU or LEU will not have an adverse material impact on the domestic uranium mining, conversion, or enrichment industry and that DOE will receive a price that is at least equal to the fair market value of the material.

Under the Enrichment Alternative, enrichment of excess inventory would be managed consistent with applicable law and in a manner tailored to avoid or minimize adverse impacts to the uranium market and industry. In accordance with the Secretarial Policy Statement, to the extent practicable, the Department will manage its uranium inventories in a manner that is consistent with and supportive of the maintenance of a strong domestic nuclear industry. Consistent with this principle, the Department believes that, as a general matter, the introduction into the domestic market of uranium from Departmental inventories in amounts that do not exceed 10 percent of the total annual fuel requirements of all licensed nuclear power plants—that is, approximately 2,000 MT NU equivalent based on current requirements—should not have an adverse material impact on the market or uranium industry. The Department anticipates, however, that it may introduce into the domestic market, in any given year, less than that amount, or, in some years for certain special purposes (such as the provision of initial core loads for new reactors), more than that amount. The increase in demand would arise because loading the core of a new reactor requires approximately three times as much LEU fuel as the amount subsequently required during reloading. DOE has conservatively assumed that such events could double the amount of uranium introduced into the market in a given year (i.e., 4,000 MT rather than 2,000 MT). These annual amounts would include uranium introduced into the domestic uranium market from all Departmental inventories, including LEU generated via the down-blending of highly enriched uranium (HEU) in the ongoing National Nuclear Security Administration (NNSA) HEU disposition program (61 FR 40619).

The specific annual amounts would be determined on an ongoing basis; the amounts would depend upon market analyses for particular sales. Because precise annual enrichment or sale quantities would be uncertain and would change from year to year, for purposes of assessing environmental impacts in this EA, DOE assumes that the Proposed Action could result in the annual enrichment and/or sale of excess inventory sufficient to introduce into the domestic market in a given year up to approximately 2,000 MT NU equivalent. This EA also analyzes the impacts of introducing approximately 4,000 MT NU equivalent in the event the Department determines, in a given year, that circumstances warrant the introduction of the greater amount into the market. Such circumstances might arise, for example, as new reactors are scheduled to begin operating, thereby increasing the short-term demand for uranium. This increase in demand would arise because loading the core of a new reactor requires approximately three times as much LEU fuel as would be required later during re-loading. For the purposes of this EA, DOE has conservatively assumed that such events could lead to a doubling of the amount of uranium introduced into the market in a given year (i.e., 4,000 MT NU, rather than 2,000 MT NU). Because these annual amounts could also include, for example, LEU entering the domestic market via the NNSA HEU disposition program, it is likely that the amount of excess inventory enriched and/or sold under the Proposed Action would be somewhat less than the amount sufficient to introduce approximately 2,000 MT NU equivalent or 4,000 MT NU equivalent, respectively, into the domestic market.

Further, this EA assumes that for any given year, the enrichment of either the 2,000 MT NU equivalent or a doubling of that amount could occur at any of the four optional enrichment facilities. However, DOE believes this to be unlikely and believes that enrichment would probably occur at some combination of the four facilities.

Similarly, DOE believes it unlikely that the total amount of NU or LEU product would be stored at only one of the optional storage facilities.

Because the actual annual amounts of excess inventory enriched would likely be less than the maximum annual amount, and because it would probably change from year to year, DOE is not limiting the Proposed Action to a particular number of years. However, for purposes of modeling the impacts of processing the entire inventory, 25 years is used.

2.1.3 Regulations Governing Material Shipments: United States

Within the United States, uranium would be shipped in accordance with U.S. Department of Transportation (DOT) and NRC regulations governing the transport of radioactive materials—in particular, 49 CFR Part 173, subpart I, “Class 7 (Radioactive) Materials.” Among other things, 49 CFR 173.420 requires that each UF_6 cylinder be designed, fabricated, inspected, tested, and marked in accordance with the version of American National Standards Institute (ANSI) N14.1, *Uranium Hexafluoride - Packaging for Transport* that was in effect at the time the cylinder was manufactured. Cylinders not meeting these requirements are referred to as “nonconforming” because they are overfilled, over-pressurized, or structurally substandard. Any UF_6 currently stored in a nonconforming cylinder would not be transported without prior preparation, such as obtaining a DOT exemption, placing the nonconforming cylinder in an over-pack, or transferring the material to a conforming cylinder.

2.1.4 Regulations Governing Material Shipments: Overseas

Uranium would be shipped to and from France in accordance with applicable DOT regulations, applicable French regulations, International Atomic Energy Agency (IAEA) *Safety Standards Regulations for the Safe Transport of Radioactive Material* (IAEA 2005), IAEA *Interim Guidance on the Safe Transport of Uranium Hexafluoride* (IAEA 1991), and the provisions of the International Organization for Standardization (ISO) document ISO 7195 (ISO 1993). As with domestic shipments, any UF_6 currently stored in a cylinder that did not conform to all applicable regulations would not be transported without prior preparation sufficient to make the cylinder conform to all applicable regulatory requirements. With regard to international shipments, it is noteworthy that in 2004, the NRC issued a final rule, effective October 2004, that amended its regulations on packaging and transporting radioactive material. This rule made NRC regulations compatible with the latest version of the IAEA standards and codified other applicable requirements.[5]

2.2 Direct Sale Alternative

Under the Direct Sale Alternative, annual sales of excess inventory would be managed consistent with applicable law and in a manner tailored to avoid or minimize adverse impacts to the uranium market and industry. The annual amounts discussed in Section 2.1.2 would also apply to the amount of excess inventory DOE would introduce into the market annually through any combination of enrichment and sales.

DOE assumes that licensed purchasers would take delivery, transport and enrich the excess inventory, and transport and store the NU or LEU product in essentially the same manner and using essentially the same facilities as would DOE under the Enrichment Alternative. DU tails resulting from the ultimate enrichment of DOE’s sold excess inventory would be disposed of in a manner consistent with existing practices at the enrichment facilities, and DU tail (waste) disposal practices are analyzed in existing enrichment facility and DU tails conversion facility NEPA documents and NRC licenses. For that reason, DOE assumes that the transportation, enrichment, and storage activities (and impacts) of the Direct Sale Alternative would be similar to the potential impacts of the Enrichment Alternative. Consequently, with the exception of the economics analysis in Section 4.3.2, Direct Sale Alternative activities and impacts are not further described or analyzed. The potential impacts of the Enrichment Alternative are similar to the impacts of a combination alternative; consequently, combination alternative impacts are not analyzed.

2.3 No Action Alternative

In 1999, DOE prepared and issued a programmatic environmental impact statement (PEIS) that assessed the potential impacts of alternative DOE management strategies for DUF_6 stored at three DOE sites: Paducah, Portsmouth, and the East Tennessee Technology Park (ETTP) at Oak Ridge, Tennessee (DOE 1999b). The PEIS considered the environmental impacts, benefits, costs, and institutional and programmatic needs associated with the management and use of approximately 700,000 MT tons of DUF_6. The alternatives analyzed in the PEIS included no action, long-term storage as UF_6, long-term storage as uranium oxide, use as uranium oxide, use as uranium metal, and disposal. In its Record of Decision (ROD) (64 FR 43358), DOE stated the following:

> “DOE has decided to promptly convert the depleted UF_6 inventory to depleted uranium oxide, depleted uranium metal, or a combination of both. The depleted uranium oxide will be used as much as possible and the remaining depleted uranium oxide will be stored for potential future uses or disposal, as necessary.”

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[5] Available online at http://www.epa.gov/EPA-IMPACT/2004/January/Day-26/i35.htm

In 2003, DOE amended the ROD (68 FR 53603), stating the following:

> "The DOE has now decided to transfer up to 1,700 of the approximately 4,700 cylinders containing DUF_6 from the East Tennessee Technology Park (ETTP) in Oak Ridge, Tennessee, to its storage facilities at DOE's enrichment facility at Portsmouth, Ohio…"

Subsequently, in 2004 DOE issued two site-specific EISs (DOE 2004a, 2004b) and associated RODs (69 FR 44654; 69 FR 44649) for construction and operation of two DUF_6 conversion facilities, one at the DOE Paducah site (DOE 2004a) and one at the DOE Portsmouth site (DOE 2004b). These two new facilities are nearing completion, and operations are projected to begin in 2010.

Prior to the Secretarial Policy Statement, DOE planned to convert excess DU inventory stored at Portsmouth and Paducah to a more stable chemical form suitable for use or disposal consistent with the two RODs cited above. However, in accordance with the Secretarial Policy Statement and other considerations, DOE is now proposing to enrich or sell part of the excess DU inventory as described above in the Enrichment and Direct Sale Alternatives.

The No Action Alternative for this EA is defined as continuation of the status quo; that is, DOE would continue with existing plans to convert DU to a more stable chemical form at the two new conversion facilities consistent with the two RODs cited above and would not enrich or sell any of its excess DU inventory as proposed in this EA. Under the No Action Alternative, DOE would also continue to store excess NU and LEU in their current configurations at Portsmouth and Paducah. The two DU conversion facility EISs (DOE 2004a and 2004b) evaluated continued storage of NU and LEU cylinders as part of their no action alternatives. This storage option is comparable to the No Action Alternative in this EA and is also comparable to the storage of NU and LEU cylinders after enrichment at Portsmouth and Paducah in the Proposed Action of this EA.

2.4 Enrichment Options Considered but Not Analyzed in Detail

2.4.1 Other Enrichment Facilities

DOE considered enriching the excess inventory at other U.S. and foreign facilities. However, the three U.S. facilities proposed for enrichment are the only U.S. facilities that are expected to be operating in 2009 and 2010, although other new facilities have been announced or are planned for the future. Such facilities could be considered if they became available. In addition to the French facility in Tricastin, other foreign enrichment facilities are operating in various European countries, Russia, Japan, and elsewhere. However, France is the only foreign country where the necessary agreements are already in place. Other foreign enrichment facilities could be considered in the future if the necessary agreements were implemented.

2.4.2 Other LEU Product Storage Sites

DOE considered storing LEU product at the AREVA nuclear FFF in Lynchburg, Virginia. This site was eliminated from further analysis because this facility uses uranium feed in the form of uranium oxide, not UF_6.

2.4.3 Other French Ports of Exit and Entry

The port of Marseilles in France was identified as the most reasonable French port of entry due to its proximity (approximately 130 river kilometers [80 river miles]) to Tricastin. Entry via Le Havre on the English Channel in northern France, an alternate port of entry, would require approximately 800 kilometers (500 miles) of additional overland transportation in France.

2.4.4 Other Modes of Transport: Air Transport

Air transport of radioactive materials is typically used for rapid delivery when the half-life of the material is short or immediate use of the material is required. If speed of delivery is not a consideration (as is the case with this Proposed Action), large, frequent shipments of radioactive materials by air are unwarranted.

2.4.5 Use of Great Lakes Ports

Uranium could conceivably be exported and imported using Great Lakes ports. However, doing so would require using the Great Lakes St. Lawrence Seaway System, a deep-draft waterway extending 3,700 kilometers (2,340 miles) from the Atlantic Ocean to the head of the Great Lakes. The St. Lawrence Seaway portion of the system extends from Montreal to mid-Lake Erie. The St. Lawrence Seaway includes 13 Canadian and 2 U.S. locks. Because of the likely logistical and diplomatic complexities, this option was not analyzed further.

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3.0 AFFECTED ENVIRONMENTS

This chapter describes two classes of environment—geographic and economic—that are potentially affected by DOE's Proposed Action. The affected geographic environment comprises the six sites where the excess uranium is now stored, where enrichment could occur, and where LEU and DU tails could be stored[6]. The economic environment is the existing uranium market.

A third potentially affected environment, the transportation corridors and global commons over which uranium could be transported is described in Section 4.2.1 (Transportation Impacts). For domestic shipments, uranium could be transported by truck and/or rail; for shipments to France, uranium would be transported by truck, rail, barge, and/or ship.

3.1 Affected Facilities

The six domestic facilities where the excess uranium is now stored, where enrichment could occur, and where NU, LEU, and DU tails could be stored (see Figure 2-1) are:

- *DOE Paducah/USEC Paducah GDP*: current storage, proposed enrichment site, and proposed NU, LEU, and DU tails storage;
- *DOE Portsmouth/USEC ACP*: current storage, proposed enrichment site, and proposed NU, LEU, and DU tails storage;
- *Louisiana Energy Services (LES) National Enrichment Facility (NEF), Eunice, New Mexico*: proposed enrichment site, and proposed temporary storage for NU;
- *AREVA Fuel Fabrication Facility (AREVA FFF), Richland, Washington*: proposed LEU storage;
- *GNF Fuel Fabrication Facility (GNF FFF), Wilmington, North Carolina:* proposed LEU storage; and
- *WEC Fuel Fabrication Facility (WEC FFF), Columbia, South Carolina*: proposed LEU storage.

Each of these six geographic locations either currently hosts a DOE site or has been licensed by NRC to host an existing or under-construction uranium enrichment facility, DUF_6 conversion facility, or nuclear FFF. Therefore, each of these affected environments has been previously and extensively described and categorized in a DOE or NRC EA, EIS, or other agency document. These existing documents provide detailed site maps and descriptions of the environments that would be affected by agency actions. Sections 3.1.1 through 3.1.6 of this EA provide site locator maps, summary site descriptions, and summaries of those aspects of the environment that may affect, or be affected by, DOE's Proposed Action based on the descriptions in these existing

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[6] The affected environment and impacts associated with uranium import and enrichment operations at the Tricastin facility in France are not addressed in this document. Activities occurring within the territorial limits of France will be evaluated by French authorities in accordance with regulatory requirements of that country.

documents. More detailed descriptions of resource areas that would not be affected by DOE's Proposed Action (including, for example, ecological resources, endangered species, wetlands, noise, construction-related impacts) are also found in these existing documents.

3.1.1 United States Department of Energy and United States Enrichment Corporation, Paducah Gaseous Diffusion Plant, Paducah, Kentucky

Figure 3-1 shows the location of the DOE Paducah site and USEC GDP in rural McCracken County in far western Kentucky. The affected environment as summarized below is described in detail in the following documents, which are incorporated into this EA by reference:

- *Final Environmental Impact Statement for Construction and Operation of a Depleted Uranium Hexafluoride Conversion Facility at the Paducah, Kentucky, Site* (DOE 2004a). DOE/EIS-0359. June 2004. http://web.ead.anl.gov/uranium/documents/paddeis/index.cfm.
- *Paducah Annual Site Environmental Report for Calendar Year 2005* (DOE 2007a). PRS-ENM-0002. August 2007. http://www.prs-llc.net/aser/2005.html.

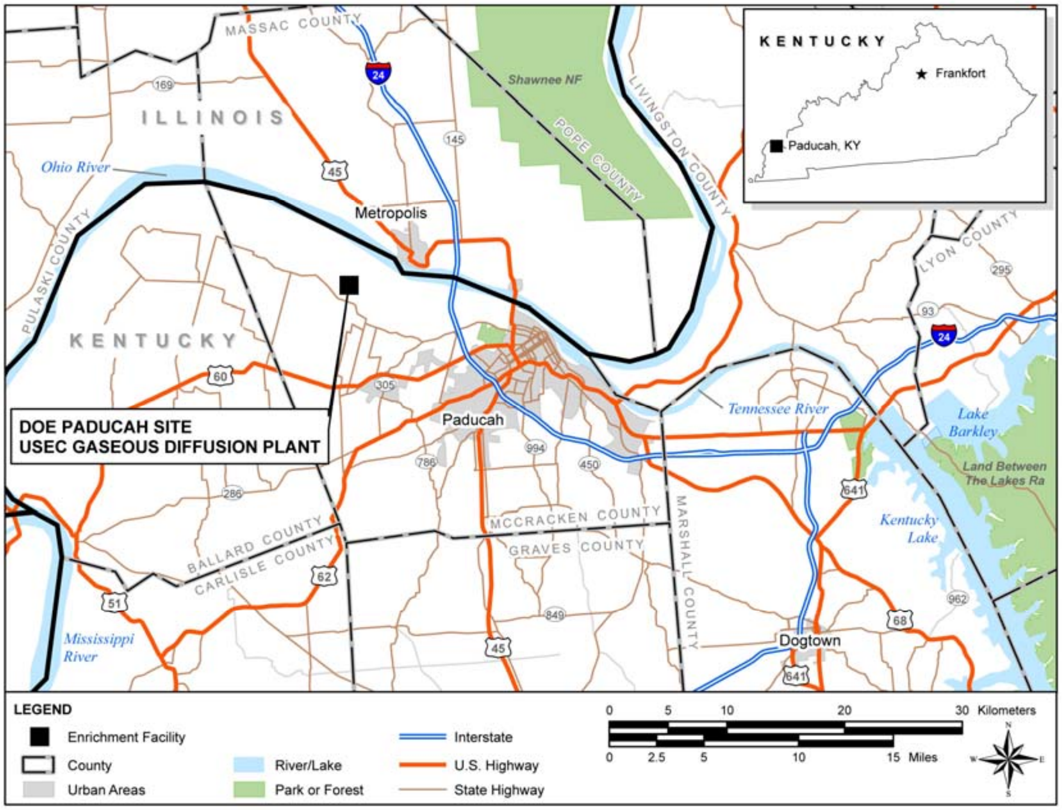

Figure 3-1. Paducah, Kentucky, Locator Map

- *Final Environmental Impact Assessment of the Paducah Gaseous Diffusion Plant Site* (DOE 1982). DOE/EA-0155. August 1982. http://www.osti.gov/bridge/product.biblio.jsp?osti_id=6727682.

- *Final Programmatic Environmental Impact Statement for Alternative Strategies for the Long-term Management and Use of Depleted Uranium Hexafluoride* (DOE 1999b). DOE/EIS-0269. April 1999. http://web.ead.anl.gov/uranium/documents/nepacomp/peis/index.cfm.

Site Description

The DOE Paducah site/USEC GDP is located in rural McCracken County, Kentucky, approximately 16 kilometers (10 miles) west of the City of Paducah and 6 kilometers (3.6 miles) south of the Ohio River. The site consists of 1,439 hectares (3,556 acres) currently held by DOE. The site is surrounded by the 1,125-hectare (2,781-acre) West Kentucky Wildlife Management Area, which was conveyed by DOE to the Commonwealth of Kentucky for wildlife conservation and for recreational purposes. The City of Paducah is the largest urban area in the six counties surrounding the site. The six-county area is primarily rural, with industrial uses accounting for less than 5 percent of land use. The Paducah site is located in an area with an established transportation network. The area is served by two interstate highways, several U.S. and state highways, several rail lines, a barge terminal, and a regional airport.

The Paducah GDP occupies a 303-hectare (750-acre) complex within the DOE Paducah site and is surrounded by a security fence. The plant, previously operated by DOE and now operated by USEC, includes about 115 buildings with a combined floor space of approximately 0.76 million square meters (8.2 million square feet). The Paducah GDP has operated since 1955.

In 2002, DOE awarded a contract to Uranium Disposition Services, LLC (UDS) to design, build, and operate DUF_6 conversion plants at the DOE Paducah and Portsmouth sites. The contract includes cylinder surveillance and maintenance, which began June 2005. The Paducah conversion plant is currently under construction; it has a projected January 2010 completion date and June 2010 start-up date.[7]

At the end of 2003, the Paducah site managed an inventory of approximately 38,000 cylinders containing approximately 454,000 MT of UF_6 (mostly DUF_6) stored in outdoor facilities, commonly referred to as cylinder storage yards. Additional cylinders are added to the DOE inventory periodically as a result of formal agreements with the USEC. The site has 13 storage yards used to store DOE-generated DUF_6 cylinders; an additional 4 yards are used to store USEC-generated cylinders that are now managed by DOE. Over several years, most of the storage yards that previously had gravel bases have been reconstructed with concrete bases to better control water infiltration and runoff.

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[7] Personal communication: telephone conversation, May 27, 2008; William Fallon, Battelle; and Barry Tilden, UDS.

Radiation Environment

The average annual radiation dose to people in the United States from all sources of natural background radiation is 300 millirem (mrem) (DOE 2007b). DOE Order 5400.5 (*Radiation Protection of the Public and the Environment*) requires that exposure of members of the public to radiation sources as a consequence of all routine DOE activities shall not cause, in a year, an effective dose equivalent greater than 100 mrem (DOE 1990). U.S. Environmental Protection Agency (EPA) regulations establish additional public dose limits for exposures to several selected sources or exposure modes: regulations implementing the Clean Air Act (40 CFR 61) establish a dose limit of 10 mrem from airborne emissions, and regulations implementing the Safe Drinking Water Act (40 CFR 141) establish a dose limit of 4 mrem from beta-emitting radionuclides in drinking water.

Operations at the Paducah site result in radiation exposure to on-site workers and off-site members of the public. Exposure pathways potentially contributing to dose include ingestion of surface water, ingestion of sediments, ingestion of deer meat, direct radiation, and atmospheric releases. Exposures of on-site workers generally are associated with the handling of radioactive materials used in the on-site facilities and with the inhalation of radionuclides released from processes conducted on the site. Off-site members of the public are exposed to radionuclides discharged from on-site facilities with airborne and/or waterborne emissions and, in some cases, to radiation emanating from radioactive materials handled in the on-site facilities.

For 2005, the highest estimated dose a maximally exposed individual (MEI) might have received from all combined DOE exposure pathways (worst-case scenario) was 0.55 mrem. This dose is less than 1 percent of the applicable federal standard of 100 mrem per year.[8] The closest location that would be accessible to the public in 2005 resulted in external radiation exposures below background. Based on results from this location and other data obtained from all locations, the dose to the MEI member of the public from DOE operations was zero.

In 2001, the measured external radiation doses for Paducah cylinder yard workers was 254 mrem, well below the maximum dose limit of 5,000 mrem per year set for radiation workers (10 CFR Part 835).

Seismic Environment

In late 1811 and early 1812, a series of earthquakes centered in the New Madrid fault zone destroyed the town of New Madrid, Missouri. These quakes are considered to be the largest recorded earthquakes to have occurred in the contiguous United States. Based on the effects of these earthquakes, it has been estimated that they would have had a magnitude of about 8.0 on the Richter scale.

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[8] Regulatory dose limits are set well below levels where measurable health effects have been observed. The total radiation dose limit for individual members of the public as defined by the Code of Federal Regulations (10 CFR 20.1301) is 1 millisievert (mSv) per year (100 mrem per year), not including the dose contribution from background radiation. Limits on emissions of radionuclides (other than radon) to the air from certain DOE facilities are set such that they will not result in a dose greater than 0.1 mSv per year (10 mrem per year) to any member of the public (40 CFR 61.92).

The seismic hazards at the Paducah site have been studied extensively. A safety analysis report (SAR) for this site, completed in March 1997, provided comprehensive analyses and discussions of seismic hazards at the site (Lockheed Martin Energy Systems 1997a). The analyses considered the possibility of large-magnitude earthquakes similar to the New Madrid earthquakes of 1811–1812. The analyses performed by DOE were independently reviewed by the U.S. Geological Survey. This independent review indicated that the seismic sources, recurrence rates, maximum magnitudes, and attenuation functions used in the SAR analyses were representative of a wide range of professional opinion and were suitable for obtaining probabilistically based seismic hazard estimates. Because of the proximity of the site to the New Madrid seismic zone, special deterministic analyses were also performed to estimate the ground motions at the site in the case of recurrence of an earthquake of the same magnitude as the 1811–1812 New Madrid earthquakes. The results of the deterministic analyses were similar to the probabilistic seismic hazard results for the probabilities associated with the recurrence of the New Madrid earthquake of 1811–1812. The results indicated that continued storage of DUF_6 cylinders at the Paducah site is safe.

Groundwater

Contamination has been detected in off-site and on-site groundwater. Beta activity, trichloroethylene (TCE) and technetium-99 (^{99}Tc) are found in the off-site and on-site contamination plumes. Groundwater monitoring results from all sampling efforts conducted by the Paducah site are compiled in the Oak Ridge Environmental Information System database (Bechtel Jacobs 2006). DOE protects members of the public from contaminated groundwater by providing landowners affected by the plume with municipal water. DOE is actively addressing the groundwater contamination through source removal actions and groundwater pump-and-treat systems.

Air Quality

The Paducah site is located in the Paducah-Cairo Interstate Air Quality Control Region, which covers the westernmost parts of Kentucky. McCracken County currently is designated as being in attainment for all criteria pollutants (40 CFR 81.318).

Waste Management

The Paducah site generates wastewater, nonhazardous waste, nonradioactive hazardous waste, low-level waste (LLW), and low-level mixed waste (LLMW). Wastewater is discharged through permitted outfalls; nonhazardous solid waste is disposed of at an on-site landfill; and nonradioactive hazardous waste is stored on-site and sent to permitted treatment/disposal facilities. LLMW and LLW are sent to approved treatment/disposal facilities.

3.1.2 United States Department of Energy and United States Enrichment Corporation, Portsmouth American Centrifuge Plant, Portsmouth, Ohio

Figure 3-2 shows the location of the DOE Portsmouth site and USEC ACP in rural Pike County in south-central Ohio. The affected environment as summarized below is described in detail in the following documents, which are incorporated into this EA by reference.

- *Final Environmental Impact Statement for the Proposed American Centrifuge Plant in Piketon, Ohio* (NRC 2006). NUREG-1834, Vol.1. April 2006.

- *Environmental Assessment of the USEC Inc. American Centrifuge Lead Cascade Facility at Piketon, Ohio* (NRC 2004). January 2004.

- *Final Environmental Impact Statement for Construction and Operation of a Depleted Uranium Hexafluoride Conversion Facility at the Portsmouth, Ohio, Site* (DOE 2004b). DOE/EIS-0360. June 2004. http://web.ead.anl.gov/uranium/documents/portdeis/index.cfm.

- *Portsmouth Annual Site Environmental Report for 2005* (DOE 2007b). August 2007. http://www.lpports.com/05%20Annual%20Environmental%20Report.htm.

- *Final Programmatic Environmental Impact Statement for Alternative Strategies for the Long-term Management and Use of Depleted Uranium Hexafluoride* (DOE 1999b). DOE/EIS-0269. April 1999. http://web.ead.anl.gov/uranium/documents/nepacomp/peis/index.cfm.

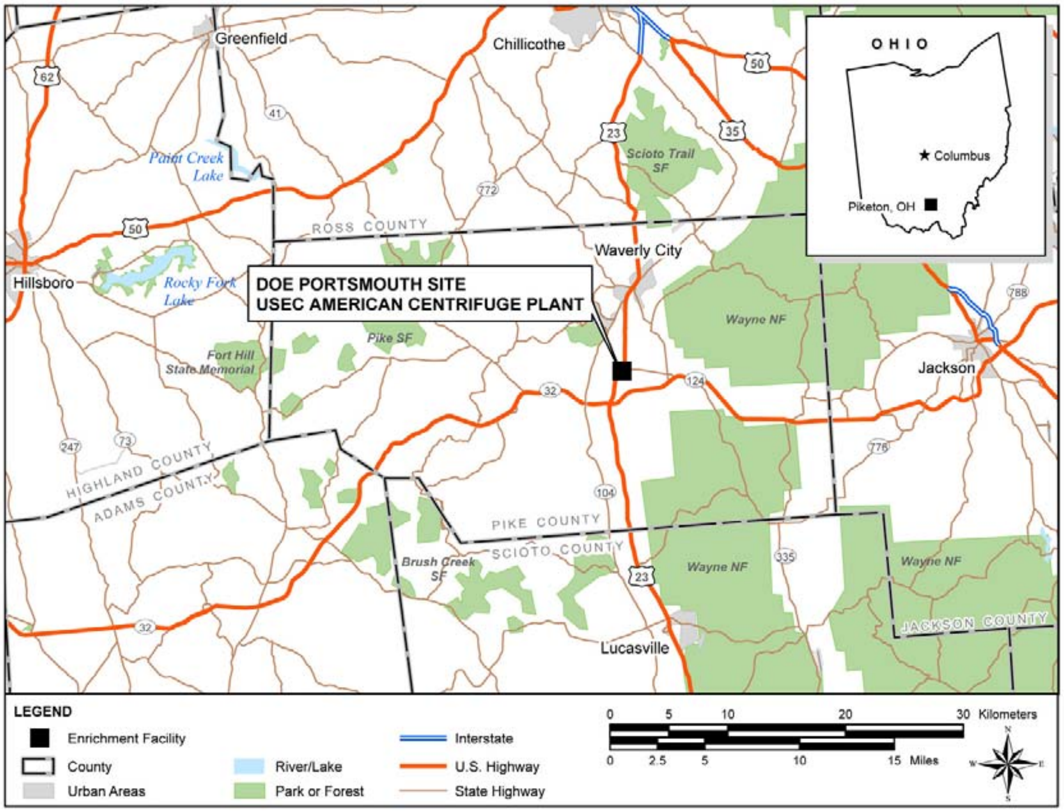

Figure 3-2. Piketon, Ohio, Locator Map

Site Description

The NRC issued a construction and operating license to USEC for the ACP in April 2007. The license, which is valid for 30 years, includes authorization to enrich uranium up to an assay level of 10 percent ^{235}U.

The DOE Portsmouth site is located in Pike County, Ohio, approximately 35 kilometers (22 miles) north of the Ohio River and 5 kilometers (3 miles) southeast of the town of Piketon. The two largest cities in the vicinity are Chillicothe, located 42 kilometers (26 miles) north of the site, and Portsmouth, 35 kilometers (22 miles) south. The Portsmouth site includes the Portsmouth GDP, which was previously operated by DOE and later by USEC. Uranium enrichment operations were discontinued in May 2001.

The Portsmouth site occupies 1,500 hectares (3,714 acres) of land, with a 320-hectare (800-acre) fenced core area that contains the former production facilities. The 1,180 hectares (2,914 acres) outside the core area include restricted buffers, waste management areas, plant management and administrative facilities, GDP support facilities, and vacant land. Wayne National Forest borders the plant site on the east and southeast, and Brush Creek State Forest is located to the southwest, slightly more than 1.6 kilometers (1 mile) from the site boundaries. The Portsmouth site has direct access to major highway and rail systems, a nearby regional airport, and barge terminals on the Ohio River. Use of the Ohio River barge terminals requires transportation by public road from the Portsmouth site.

The ACP is being constructed by USEC within the confines of the Portsmouth site. It will be situated on approximately 81 hectares (200 acres) of the southwest quadrant of the controlled access area. In addition to this space, two UF_6 cylinder storage yards (the existing X-745G-2 and proposed X-745H), occupying a total of 11 hectares (27 acres), will be located in the northeast part of the DOE reservation just north of the Perimeter Road. The ACP will consist of refurbished existing buildings and land formerly used for the Portsmouth GDP as well as newly constructed facilities in that same area.

In 2002, DOE awarded a contract to UDS to design, build, and operate DUF_6 conversion plants at the DOE Paducah and Portsmouth sites. The contract includes cylinder surveillance and maintenance, which began June 27, 2005. Construction of the Portsmouth conversion plant is complete, the facility is preparing for its operational readiness review, and start-up is projected for March 2010.[9]

The Portsmouth site houses over 20,000 DUF_6 cylinders. The cylinders are located in two storage yards that have concrete bases. The cylinders are stacked two high. All 10- and 14-ton (9- and 13-tonne) cylinders stored in these yards have been or are being inspected and repositioned. They have been placed on new concrete saddles with sufficient room between cylinders and cylinder rows to permit adequate visual inspection of cylinders.

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[9] Personal communication: telephone conversation, May 27, 2008; William Fallon, Battelle; and Barry Tilden, UDS.

Radiation Environment

Past operations at the Portsmouth site resulted in radiation exposures to on-site workers and off-site members of the public. Exposures of on-site workers generally were associated with the handling of radioactive materials used in the on-site facilities and with the inhalation of radionuclides released from processes conducted on the site. Off-site members of the public were exposed to radionuclides discharged from on-site facilities with airborne and/or waterborne emissions and, in some cases, to radiation emanating from radioactive materials handled in the on-site facilities.

Environmental monitoring data collected at DOE Portsmouth are used to assess potential impacts to human health and the environment from radionuclides released by current and historical site operations. Radiation exposure can be caused by radionuclides released to air and/or water, or radiation emanating directly from buildings or other objects at the site.

The Portsmouth site environmental report for 2005 (DOE 2007b) reported that the maximum dose a member of the public could receive from radiation released by DOE Portsmouth in 2005 was 1.67 mrem, based on a maximum dose of 0.012 mrem from airborne radionuclides, 0.025 mrem from radionuclides released to the Scioto River, 1.1 mrem from direct radiation from DU cylinder storage yards, and 0.53 mrem based on exposure to radionuclides detected at off-site monitoring locations in 2005. This dose (1.67 mrem) was well below the 100-mrem-per-year limit set by DOE for the dose to a member of the public from radionuclides from all potential pathways. The dose to a member of the public from airborne radionuclides released by DOE Portsmouth (0.012 mrem) was approximately 1,000 times less than the 10-mrem-per-year standard set by EPA. Operation of the Portsmouth conversion facility would add a very small increment to the current public dose. The MEI dose from operation of the conversion facility was modeled to be less than 3.0×10^{-5} mrem per year (DOE 2004b).

In 2001, the average dose for Portsmouth cylinder yard workers was 64 mrem per year, well below the maximum dose limit of 5,000 mrem per year set for radiation workers (10 CFR Part 835) (DOE 2004b).

Seismic Environment

The Portsmouth site is within 96 kilometers (60 miles) of the Bryant Station-Hickman Creek Fault. No correlation has been made between this fault and historical seismicity. The seismic hazards at the Portsmouth site were analyzed and documented in a March 1997 SAR (Lockheed Martin Energy Systems, Inc. 1997b). The results presented in the SAR indicate that continued storage of DUF_6 cylinders at the Portsmouth site is safe.

Groundwater

On-site groundwater at and around the Portsmouth site is monitored for radioactive and nonradioactive constituents at more than 400 wells. On site, five areas of groundwater contamination have been identified that contain contaminants. The main contaminants are volatile organic compounds (VOCs) (mostly TCE) and radionuclides (e.g., uranium, and ^{99}Tc). Data from annual groundwater monitoring (DOE 2007b) showed that no contaminants exceeded their primary drinking water standards at off-site locations near the Portsmouth site. TCE was detected in three on-site monitoring wells in concentrations exceeding the drinking water standard. However, TCE has not been detected in an off-site well adjacent to Portsmouth above the drinking water standard. DOE is addressing the groundwater contamination through a variety of groundwater remediation and containment systems, including phytoremediation, pump-and-treat systems, and barrier walls.

Air Quality

The Portsmouth site is located in the Wilmington-Chillicothe-Logan Intrastate Air Quality Control Region, which covers the south-central part of Ohio. Currently, Pike County is designated as being in attainment for all criteria pollutants.

Waste Management

Section 3.1.4 of the Portsmouth conversion facility EIS (DOE 2004b) describes the solid, hazardous, radioactive, and mixed (i.e., hazardous plus radioactive) wastes currently generated and managed by USEC at DOE Portsmouth and describes the existing waste management practices used by USEC at the DOE site. Most of these practices would also be used to manage wastes from the proposed ACP. USEC’s waste management program directs the storage, treatment, and disposal of waste generated by its operations at the DOE reservation at Piketon. The company must satisfy NRC, EPA, Ohio EPA, and Ohio Department of Health regulations as part of these activities. Waste generated by USEC at the DOE reservation and then transferred to DOE for storage, treatment, or disposal is subject to DOE Orders. Additional policies have been implemented by USEC for management of radioactive, hazardous, and mixed wastes generated at the site. The USEC is currently operating in accordance with an NRC Certificate of Compliance issued under 10 CFR Part 76. Waste collection and segregation activities are completed in accordance with applicable state and federal rules and regulations and site procedures. Wastes are collected and packaged, where feasible, at the location where the waste is generated. Wastes are also segregated into the various waste streams and handled accordingly to minimize the generation of hazardous waste, LLMW, and low-level radioactive waste.

The DOE Portsmouth site generates wastewater, nonhazardous waste, nonradioactive hazardous waste, LLW, and LLMW. Wastewater is treated and discharged through permitted outfalls; nonhazardous solid waste is disposed of at an off-site landfill. Nonradioactive hazardous waste is stored on-site until treatment or disposal. Solid nonradioactive hazardous waste is sent to permitted disposal facilities, and liquid nonradioactive hazardous waste streams are sent to approved treatment/disposal facilities such as the incinerator at the ETTP. The LLW is sent to off-site treatment/disposal facilities. Some LLW has been sent to the DOE Hanford site (Washington) for disposal.

3.1.3 Louisiana Energy Services National Enrichment Facility, Eunice, New Mexico

Figure 3-3 shows the location of the NEF near Eunice in Lea County, New Mexico. The affected environment as summarized below is described in detail in the following document, which is incorporated into this EA by reference:

- *Final Environmental Impact Statement for the Proposed National Enrichment Facility in Lea County, New Mexico* (NRC 2005). NUREG-1790, Vol.1.

Site Description

The NEF site covers about 220 hectares (543 acres) located 8 kilometers (5 miles) east of the city of Eunice, New Mexico. Lea County currently owns the property; however, on December 8, 2004, LES began a lease for 30 years, after which LES would purchase the land from Lea County. Before NEF construction began, the entire site was undeveloped with the exception of an underground carbon dioxide pipeline and a gravel road. The site was previously used for cattle grazing. There is no permanent surface water on the site, and appreciable groundwater reserves are deeper than 340 meters (1,115 feet). The nearest permanent resident is 4.3 kilometers (2.6 miles) west of the proposed site near the junction of New Mexico Highway 234 and New Mexico Highway 18.

New Mexico Highway 234 is a two-lane highway located on the southern border of the proposed NEF site. It has 3.6-meter (12-foot) wide driving lanes, 2.4-meter (8-foot) wide shoulders, and a 61-meter (200-foot) right-of-way easement on either side. The highway provides direct access to the site. The northern side of the site is bordered by a railroad spur.

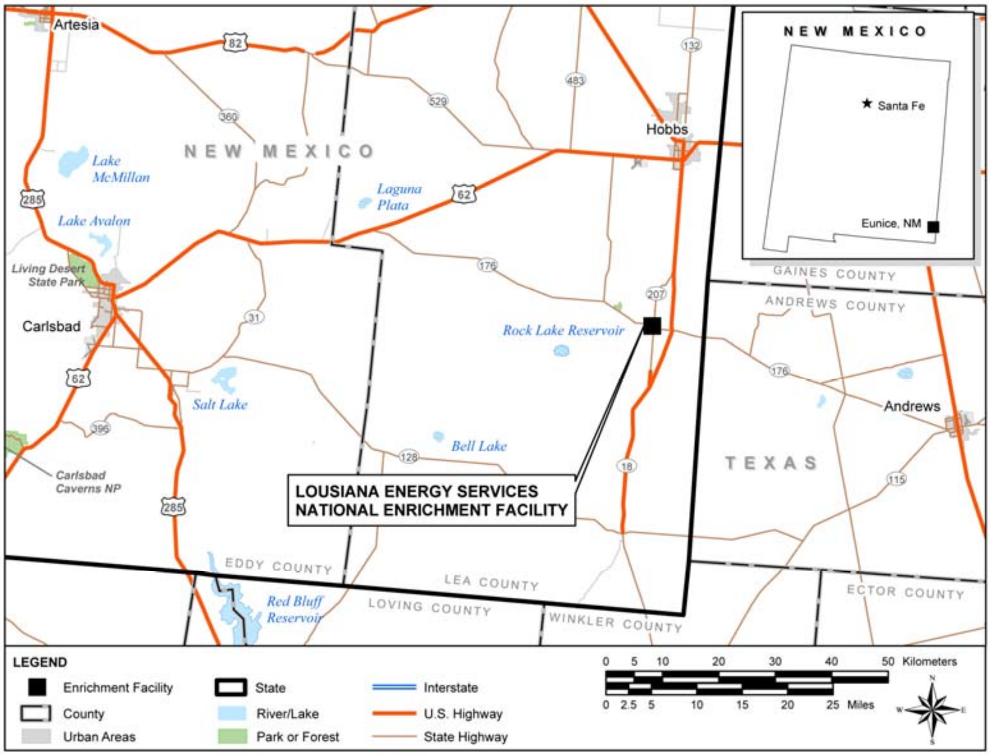

Figure 3-3. Eunice, New Mexico, Locator Map

Radiation Environment

Because the site is not yet operational, there is only natural background radiation.

Seismic Environment

Earthquakes in the vicinity of the proposed NEF site include isolated, small clusters of low- to moderate-size events (i.e., Richter magnitude earthquakes of 3 to 5.9). A review of earthquake data collected for the site and the vicinity indicates that most earthquakes that occurred near the proposed NEF site likely were induced by gas/oil recovery operations and were not tectonic in origin. A magnitude 5.0 earthquake occurred in the area of Eunice in 1992. This earthquake is attributed to a tectonic origin.

Air Quality

Lea County is designated as being in attainment for all criteria air pollutants.

Waste Management

In Eunice and Hobbs, solid-waste-disposal pickup is contracted to Waste Management, Inc. Pickups are offered once or twice a week. Solid wastes are disposed of in the Lea County landfill located about 8 kilometers (5 miles) east of Eunice just across from the proposed NEF site. The landfill accepts all types of residential, commercial, special wastes, and sludges.

3.1.4 AREVA Fuel Fabrication Facility, Richland, Washington

Figure 3-4 shows the location of the AREVA FFF in Richland, Washington. The affected environment as summarized below is described in detail in the following documents, which are incorporated into this EA by reference. A new EA to support an NRC license renewal application is currently in preparation.

- *Environmental Assessment for Renewal of Special Nuclear Material License SNM-1227, Docket 70-1257* (NRC 1995). Siemens Power Corporation Richland, Washington. (June)

- *Supplement to Applicant's Environmental Report* (AREVA 2006). E06-04-004. October 2006.

Site Description

The AREVA FFF is located at 2101 Horn Rapids Road, just within the northern limits of the City of Richland in Benton County, Washington. The fenced exclusion area of approximately 20 hectares (50 acres) lies within 130 hectares (320 acres) of land owned by AREVA within the Horn Rapids Industrial Park. Stevens Drive, the primary route south into Richland, is approximately 1,200 meters (4,000 feet) to the east.

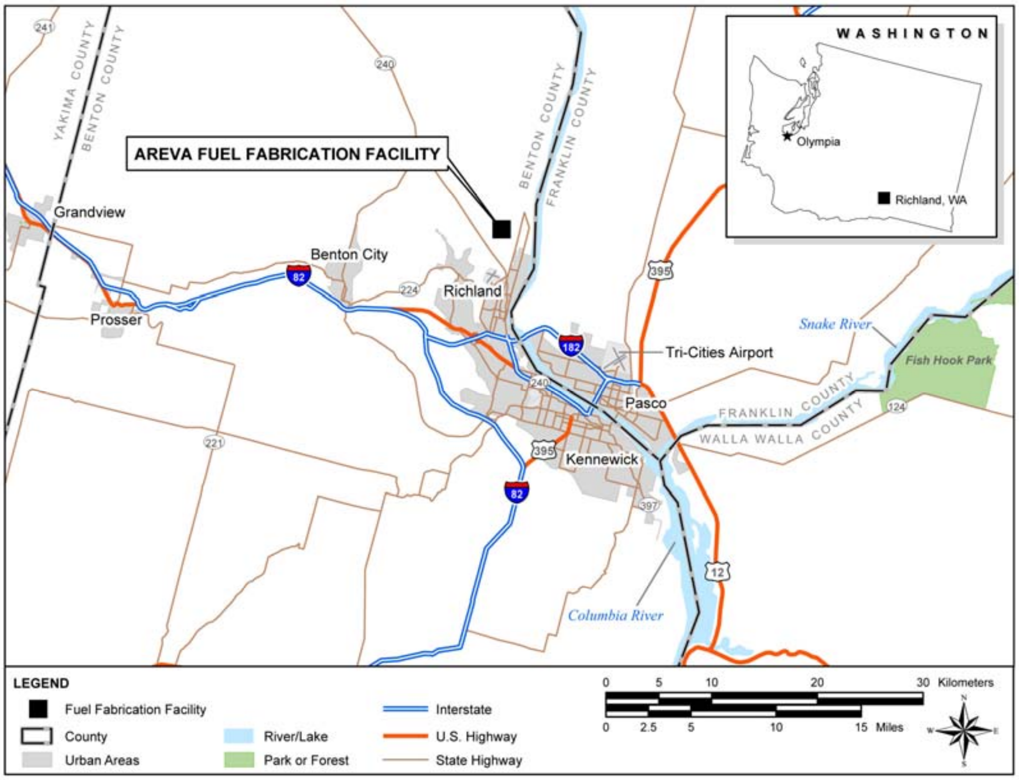

Figure 3-4. Richland, Washington, Locator Map

The facility contains numerous buildings plus various outside facilities/structures (tank farms, storage pads, etc.). The buildings and structures are confined within a secured fenced area and include the major special nuclear material (SNM)-processing production facilities, a number of SNM-handling production support facilities (product storage warehouses, waste treatment facilities, etc.), and a large number of non-SNM-handling production and administrative support facilities (materials warehouses, craft shops, office buildings, etc.). There is a UF_6 cylinder storage facility for the receipt, handling, and storage of full, empty, and heel quantity UF_6 cylinders, including weighing and assaying of cylinder contents. There is also a UF_6 cylinder recertification facility.

There are no public facilities (schools, hospitals, parks) in the immediate vicinity of the plant site. The nearest schools, Washington State University at Tri-Cities and the Hanford High School, are approximately 3 kilometers (2 miles) southeast of the plant, and the northernmost portion of Leslie Groves Park along the Columbia River is about 5 kilometers (3 miles) southeast of the site. The West Richland Public Golf Course is approximately 5.6 kilometers (3.5 miles) southwest of the plant. The nearest hospital, Kadlec Hospital, is located approximately 8 kilometers (5 miles) south of the plant in Richland.

There are no bodies of surface water adjacent to or in the immediate vicinity of the plant. The Columbia River is located approximately 2.4 kilometers (1.5 miles) to the east, and the Yakima River, a tributary to the Columbia, passes approximately 3 kilometers (2 miles) to the west. The

Columbia River is regulated by multiple dams upstream of Richland. At its closest point, the site lies approximately 8 meters (25 feet) above the normal level of the Columbia. The immediate area surrounding the site is a relatively flat and essentially featureless plain. There are no significant geographic features that may impact accident analyses within 1.6 kilometers (1 mile) of the site.

Radiation Environment

As a nuclear/chemical processing and manufacturing facility, the Richland plant can potentially impact the surrounding environment via plant effluents associated with routine or abnormal conditions. For the Richland plant, these effluents may be airborne, liquid, or solid wastes. In practice, these impacts are managed in accordance with applicable regulations, licenses, and permits via an integrated system of process and effluent controls, backed by effluent and environmental monitoring programs. These impacts on environmental media are discussed in Sections 3.1.1 through 3.1.4 of the supplement to the applicant's environmental report (AREVA 2006).

Seismic Environment

The DOE Hanford site, which is adjacent to the AREVA FFF, has been extensively investigated for earthquake potential. The records of eastern Washington show infrequent, low-intensity, deep earthquakes. During the past 100 years, there have been three earthquakes of intensity large enough to cause moderate damage to structures within 50 to 100 kilometers (30 to 60 miles) of the site, though no damage has been reported at the AREVA FFF.

Groundwater

Groundwater contamination in the shallow unconfined aquifer below the Richland facility is attributed to historic 1970s-era releases from the site's former surface impoundment system. By the early 1980s, the impoundments were double-lined with inter-liner leachate detection/collection capability and not implicated in further environmental releases. More recently (1996-2006), the impoundment system has been removed from service under a Washington Department of Ecology (Ecology)-regulated cleanup/closure action. Under that action, the impoundments were emptied of their inventory and physically dismantled, and soil was remediated (removed and disposed of) to uranium, fluoride, and nitrate soil cleanup limits derived in accordance with Ecology's Model Toxics Control Act (MTCA) (WAC 173-340).

With respect to uranium, the Ecology soil cleanup limit was 12.1 milligrams per kilogram (mg/kg) (parts per million), or approximately 29 picocuries per gram (pCi/g) for uranium at a ^{235}U enrichment of 3.5 percent. This limit was conservatively calculated in accordance with Ecology criteria to be protective of groundwater down to the EPA drinking water limit for uranium of 30 parts per billion (also the MTCA groundwater cleanup limit for uranium). DOE monitors groundwater immediately downgradient of the AREVA FFF for uranium and TCE. Based on the latest available data (2005), levels of both constituents in the groundwater are lower than their respective EPA drinking water limits.

Air Quality

Benton County, and all of Washington State, is designated as being in attainment for all criteria air pollutants.

Waste Management

Gaseous, liquid, and solid wastes are produced at the site. These wastes are categorized as low-level radioactive, nonradioactive, hazardous, or mixed wastes. These waste categories, their control strategies, and an estimate of release quantities are described in Section 2.1.2 of the EA for Siemens Power Corporation's license renewal (NRC 1995).

3.1.5 Global Nuclear Fuel Company Fuel Fabrication Facility, Wilmington, North Carolina

Figure 3-5 illustrates the location of the GNF FFF near Wilmington, NC. The affected environment as summarized below is described in detail in the following documents, which are incorporated into this EA by reference:

- *Environmental Assessment for the Renewal of Special Nuclear Material License SNM-1097,* General Electric Company, Nuclear Energy Production Facility, Wilmington, NC (NRC 1997). (May).

- *GNF–Americas Wilmington Environmental Report Supplement* (GNF 2007). For the period 1995-2005. March 30, 2007.

Site Description

The GNF FFF is situated on a 673-hectare (1,664-acre) tract of land located next to NC Highway 133 (formerly designated Highway 117) and is approximately 10 kilometers (6 miles) north of the City of Wilmington in New Hanover County. New Hanover County is situated in the coastal plains section of southeastern North Carolina with the Atlantic Ocean to the east, Cape Fear River to the west, and Pender County to the north. Due to the curving coastline in this area, the ocean lies approximately 16 kilometers (10 miles) east and 42 kilometers (26 miles) south of the GNF FFF Wilmington site.

The surrounding terrain is typical for coastal Carolina. It has an average elevation of less than 12 meters (40 feet) above mean sea level and is characterized by gently rolling land, with rivers and creeks and adjoining swamps and/or marshlands. Approximately 74 hectares (182 acres) of the southwest portion of the GNF FFF Wilmington property are classified as swamp forest.

The region around the site is lightly settled with large areas of heavily timbered tracts, occasionally penetrated by short roads. Farms, single-family dwellings, and light commercial activities are located along NC Highway 133. Castle Hayne, the nearest community, is approximately 5 kilometers (3 miles) north of the GNF FFF. Jacksonville, North Carolina, and Camp Lejeune (U.S. Marine Corps base) are located approximately 100 kilometers (60 miles) to the northeast of the GNF FFF.

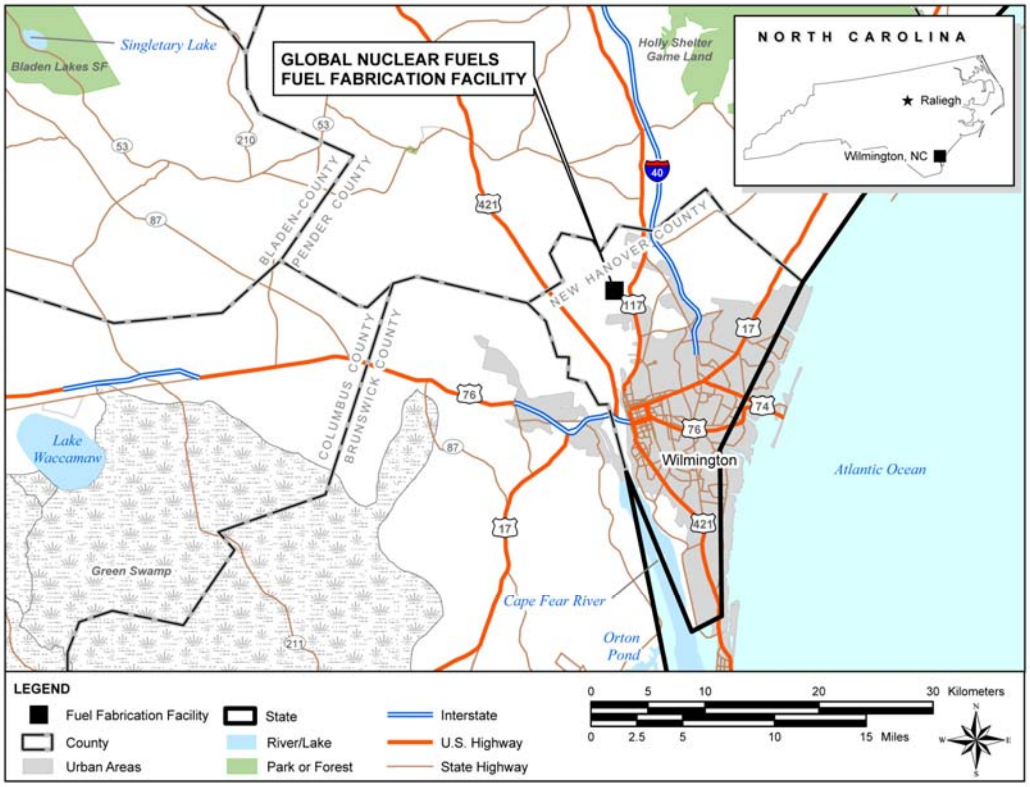

Figure 3-5. Wilmington, North Carolina, Locator Map

The major portion of the site is bordered on the east by NC Highway 133, on the southwest perimeter by the Northeast Cape Fear River; and on the north, and for most of the south property line, by undeveloped forestlands. Approximately 10 hectares (24 acres) are east of NC Highway 133 and contain an employee recreation area, a future railroad right-of-way, three potable water supply wells, and temporary truck parking. The south property line for approximately 900 meters (3,000 feet) is bordered by a new highway (Wilmington Bypass I-140). Due to road construction and the new Bypass I-140, US Highway 117 is now designated NC Highway 133.

Radiation Environment

The gamma radiation exposure levels measured at the site boundary are at background levels. Gross alpha ambient airborne concentrations are measured routinely at the southern fence line and are typically on the order of 4×10^{-15} microcuries per cubic centimeter (µCi/cc).

Direct inhalation of airborne releases is the most likely intake pathway. The off-site population dose estimates have been calculated using EPA's COMPLY code. An individual dose of 8.5×10^{-4} mrem was calculated using the nearest population center 3 kilometers (2 miles) south of the facility and 2005 air stack releases. All releases were assumed to be ^{234}U (Class Y insoluble). When direct data were not available, conservative assumptions were made. Thus, there is a high degree of confidence that dose equivalent values are not underestimated. A conservative assumption was made to apply the individual dose at this population center to the entire 200,000 persons (2000 census) in the surrounding area. The estimated 0.17 person-rem for the surrounding population can be compared to the annual average 60,000 person-rem received by this population due to natural background. Therefore, the average annual dose received by an individual in the surrounding population from releases at this facility is several orders of magnitude less than 1 mrem. There are no potential health effects which might be predicted from such doses.

The annual natural background radiation dose for the average individual in the surrounding area is typical of that received from natural background radiation in this location or elsewhere in the United States. Relative to the 10 CFR 20.1301 NRC off-site individual exposure limit of 100 mrem per year, the annual dose during 1995-2005 to the nearest (potentially most highly exposed) resident using EPA's COMPLY code ranged from 0.03 mrem to 0.4 mrem. In 2005, the dose was 0.03 percent of the NRC limit. The dose has been decreasing over the years.

The uranium concentration and gross alpha activity concentration of the discharge to the Northeast Cape Fear River are determined from analysis of the samples collected at the final process basin outfalls. The final process basin outfall was sampled for gross alpha concentrations during the 1995-2005 period. The highest average concentration during that period was 1.23×10^{-7} μCi/cc in 2005. Compared with the 10 CFR 20 Appendix B limit, the 2005 site discharge was 41 percent of the limit.

Seismic Environment

North Carolina lies within an intraplate region of the North American tectonic plate and has relatively low seismic activity. The Wilmington area has had nine reported earthquakes since 1800. The 1884 and 1958 Wilmington area earthquakes rated 5 on the Modified Mercalli scale. The site is located in Zone 1 of the 1973 Uniform Building Code. The code requirements indicate that structures in Zone 1 must withstand intensities of 5 and 6 on the Modified Mercalli scale without receiving earthquake damage. Earthquakes produced by small faults along the Atlantic seaboard have the potential to cause damage, even if the faults do not reach the surface. The earthquake causing the most damage in North Carolina had an epicenter near Charleston, South Carolina, approximately 250 kilometers (155 miles) southwest of Wilmington. This earthquake, a 7.2 on the Richter scale, occurred in 1886 and caused chimneys and plaster to crack.

Groundwater

The GNF FFF has a shallow aquifer, also called the surficial aquifer, and a deeper aquifer known as the principal aquifer. Typically, the shallow aquifer is 1.5 to 6 meters (5 to 20 feet) below the land surface. The shallow aquifer is recharged by rainfall and is not used for drinking water supplies. There has been no radiological impact to the principal aquifer. All monitoring data from the principal aquifer show uranium concentrations to be less than or at the minimum detectable level. Similarly, gross alpha activity concentration data from three process water supply wells continue to be at natural background levels (at or near the detection limit).

Air Quality

New Hanover County is designated as being in attainment for all criteria air pollutants.

Waste Management

Various solid wastes are generated from the manufacturing processes. These wastes range in form and type from packaging and construction materials, worn-out tools and equipment, spent process chemicals, and oils to uranium sludges. The GNF FFF waste management program provides the capability to select the most suitable management technique for a specific waste. The management concepts employed include eliminating waste; reducing volume through source separation; compacting and incinerating wastes; recycling and reusing wastes; and selling used sodium hydroxide and aqueous hydrogen fluoride (HF) (<50 percent). Waste materials are collected according to the following two primary classifications: uranium-contaminated or contamination-free. Exhibit C-7 in the GNF-Americas Wilmington environmental report supplement (GNF 2007) represents the GNF FFF waste management program by primary classification and end use or disposal method.

3.1.6 Westinghouse Electric Corporation Fuel Fabrication Facility, Columbia, South Carolina

Figure 3-6 illustrates the location of the WEC FFF near Columbia, South Carolina. The affected environment as summarized below is described in detail in the following document, which is incorporated into this EA by reference:

- *Final Environmental Assessment for the Renewal of U.S. Nuclear Regulatory Commission License No. SNM-1107 for Westinghouse Columbia Fuel Fabrication Facility* (NRC 2007a). April.

Site Description

The WEC FFF site occupies a 469-hectare (1,158-acre) area of semi-rural land in Richland County, South Carolina, approximately 13 kilometers [8 miles] southeast of the city of Columbia. The various facilities occupy approximately 24 hectares [60 acres] or about 5 percent of the property area. The remaining 445 hectares [1,100 acres] are undeveloped.

The WEC FFF is bounded by state highway SC 48 to the north and private property owners in all other directions. The WEC FFF site lies within the flood basin of the Congaree River, which flows approximately 6.4 kilometers [4 miles] southwest of the main plant. The site consists of timbered tracts and wetland areas penetrated by unimproved roads. Much of the land within the site boundary is designated agricultural. A variety of activities are conducted in the undeveloped portion of the site. These activities include managing the forested areas for timber production and harvesting hay fields. Recreational facilities in the undeveloped portion of the site include a fitness trail, softball field, and a picnic pavilion for employee use. Employees are permitted to fish and hunt in designated areas on the WEC FFF property.

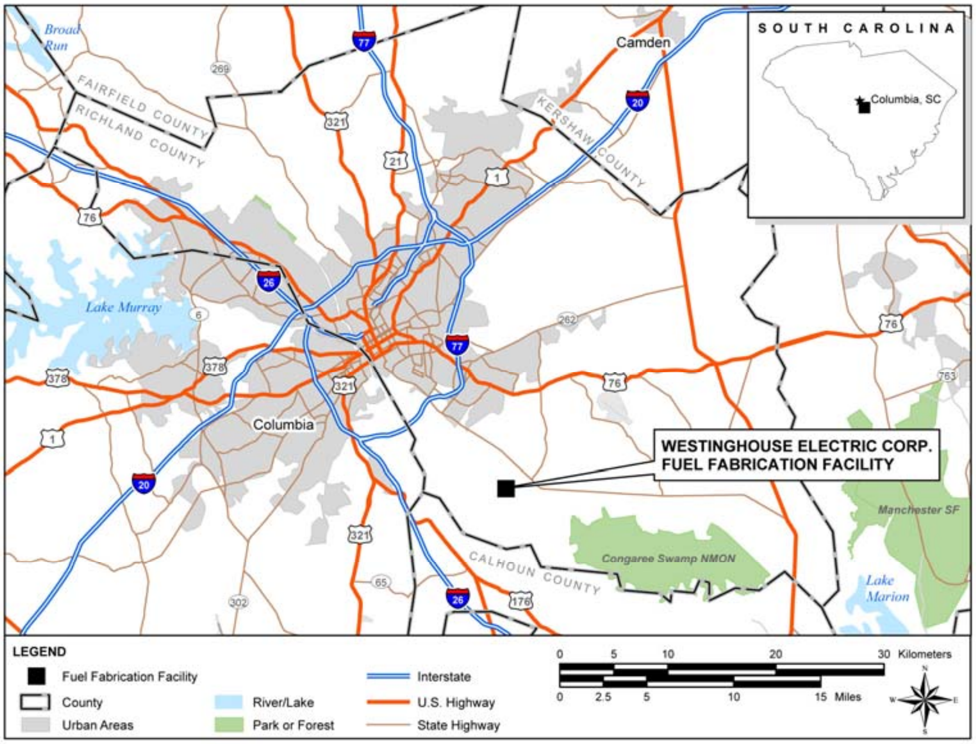

Figure 3-6. Columbia, South Carolina, Locator Map

The land around the WEC FFF site is used for a variety of purposes. Two schools are located within an 8-kilometer [5-mile] radius of WEC FFF. South Carolina Electric and Gas is constructing a new commercial electrical substation on approximately 2.8 hectares [7 acres] along the northwest border of WEC FFF property on land purchased from WEC. The new facility should improve reliability of electrical service to the WEC FFF and other customers in the vicinity and will not routinely be staffed with personnel. The land sale and right-of-way issuance was completed in 2005. Two public parks are near the WEC FFF site: Bluff Road Park is located approximately 5.6 kilometers (3.5 miles) to the north, and Hopkins Park is approximately 4 kilometers (2.5 miles) to the east. Located approximately 8 kilometers (5 miles) southeast of WEC FFF is the Congaree National Park. Other facilities in the vicinity include the Richland County Detention Center located 8 kilometers (5 miles) to the north. Two major military installations are located near WEC FFF: Fort Jackson Military Reservation approximately 11 kilometers (7 miles) north, and McEntire Joint National Guard Station approximately 9.7 kilometers (6 miles) northeast. Columbia and the surrounding area contain a well-developed and maintained system of interstate, regional, and local highways that provide easy year-round access. Three interstate highways serve Columbia. The WEC FFF site can be accessed by state highway SC 48. Although CSX Transportation Inc. operates two rail lines close to the WEC FFF site, there are no rail lines or spurs on the property.

Radiation Environment

Radiological doses to the public from the WEC FFF operations are primarily from air emissions. Over 99 percent of the off-site dose originates from the airborne pathway. Typical cumulative WEC FFF stack emissions would result in a total effective dose of less than 0.4 mrem to a hypothetical exposed individual living at the site boundary. For the 6-year period from 2000 to 2005, this annual dose ranged between 0.30 mrem and 0.38 mrem. This is approximately 4 percent of the 10-mrem annual dose limit from air emissions cited in 10 CFR 20.1101. In contrast, the annual radiological total effective dose from liquid effluents is only 3×10^{-4} mrem. The annual total effective dose from the combined effluent releases for the nearest actual resident to the licensed operations is approximately 3×10^{-2} mrem. This is approximately 0.03 percent of the 100-mrem annual dose limit from all pathways imposed by 10 CFR 20.1301.

Seismic Environment

The WEC FFF site is not located near an active tectonic margin. The nearest major seismic source is the Charleston seismic zone, located approximately 145 kilometers (90 miles) southeast of the WEC FFF site. Seismicity in the area is characterized by small-magnitude background earthquakes and very infrequent moderate-to-large intra-continental earthquakes. The U.S. Geological Survey reports that 69 earthquakes have occurred within a 200-kilometer (120-mile) radius of the WEC FFF site since 1973, ranging in magnitude from 1.1 to 4.9 on the Richter scale. The largest of these recent earthquakes occurred in 1974 and was located 144 kilometers (89.5 miles) from the WEC FFF site. However, an earthquake of magnitude 7.2 on the Richter scale occurred near Charleston, South Carolina, in 1886, killing 60 people and causing major damage in the area. The site has a 10-percent probability of exceeding a peak-ground acceleration of approximately 0.1 g (the force of gravity) and a 2-percent chance of exceeding a peak-ground acceleration of approximately 0.3 g in a 50-year period.

Groundwater

Groundwater samples from the site are collected quarterly and analyzed for radiological components. Analysis results indicate small radiological impacts to groundwater from WEC FFF operations. In 1998, radiological sample results from three wells exceeded the gross beta investigation limit. In response, WEC implemented corrective actions to the WEC FFF operations and facilities, which eliminated the source causing the elevated gross beta levels.

Air Quality

Air pollutant concentration levels in Richland County are lower than the established National Ambient Air Quality Standards (NAAQS) for all pollutants except ozone. Portions of Lexington and Richland Counties, including the area around WEC FFF, have exceeded the NAAQS ozone standard. The EPA has deferred designating this area as nonattainment because the counties have successfully participated in the Early Action Compact. Pending final EPA action, the state considers Richland County, especially southern Richland County where the WEC FFF is located, to be an attainment area for ozone.[10]

3.2 Uranium Market

This section describes the uranium market that could be affected by DOE's Proposed Action. Unless otherwise noted, the following description of the uranium market is based largely on a discussion of the uranium market available on the copyrighted website of Cameco Corporation, a publicly traded uranium company (Cameco 2007); that description is used here by permission.[11]

Sources and Production

The only significant commercial use for uranium is to fuel nuclear reactors for the generation of electricity. In the United States, there are 104 operating commercial power reactors (NRC 2008). Before uranium is ready for use as nuclear fuel, it must undergo four intermediary processing steps, which collectively comprise the "front end" of the uranium fuel cycle:

- mining and milling to produce triuranium octoxide (U_3O_8), also called yellow cake or urania,
- refining and conversion to produce UF_6 and uranium dioxide (UO_2),
- enrichment to produce LEU, and
- fuel fabrication to produce the fuel assemblies or bundles used in reactors.

Figure 3-7 illustrates the uranium fuel cycle.

LEU can be generated from several sources or processes, including (1) from NU (the mine concentrates or U_3O_8); (2) from conversion services that convert U_3O_8 to UF_6; (3) from enrichment (the process of enriching UF_6 to LEU), and (4) from downblending HEU. Together, U_3O_8 plus UF_6 conversion is referred to as the "NU feed" component of the fuel.

Nuclear utilities, the end users of nuclear fuel, purchase uranium in all of these intermediate forms. Typically, a fuel buyer from power utilities contracts separately with suppliers at each step of the process. Sometimes, the fuel buyer may purchase enriched uranium product, the end product of mining/milling, conversion, and enrichment and contract separately for fabrication. Sellers consist of suppliers in each of the stages as well as brokers and traders.

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[10] Personal communication: telephone conversation, May 19, 2008; William Fallon, Battelle; and Jack Porter, South Carolina Department of Health and Environmental Control.

[11] Personal communication: e-mail, May 28, 2008; from Jennifer Skinner, Manager, Communication Projects, Cameco, to William Fallon, Battelle.

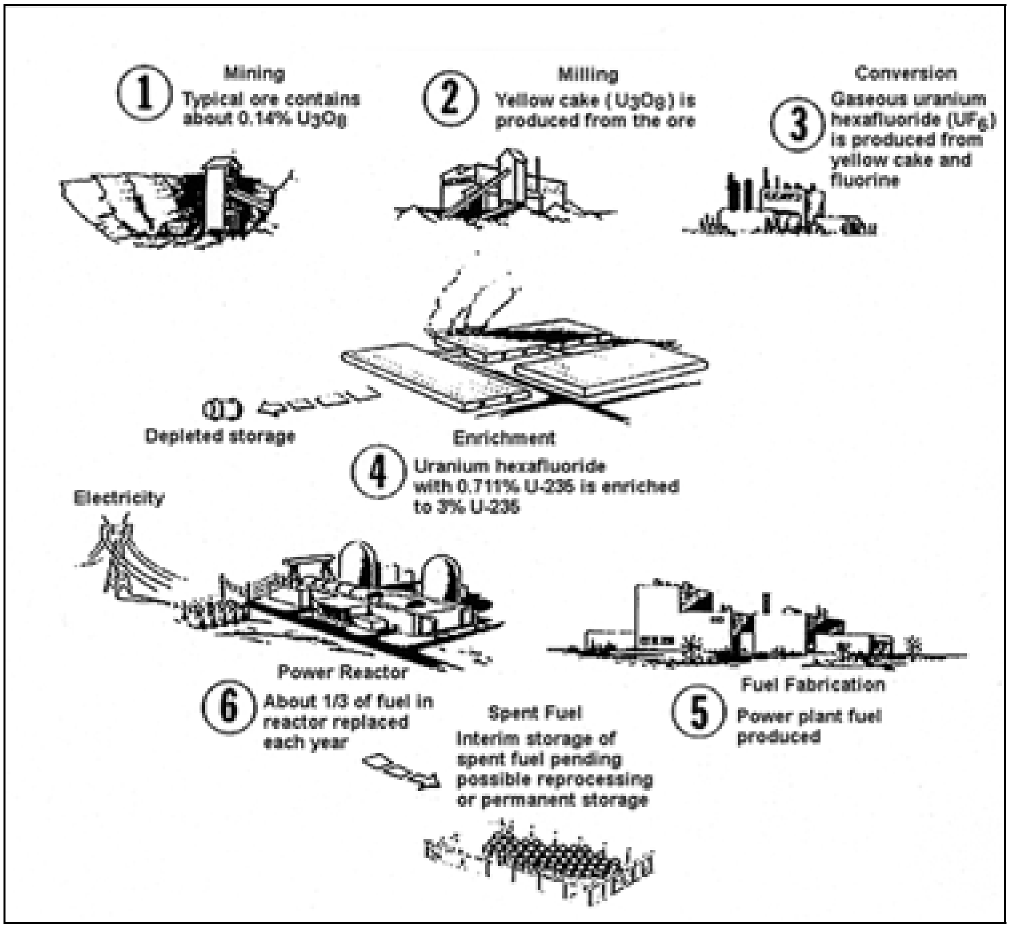

Figure 3-7 Uranium Fuel Cycle

In addition to being sold in different forms, uranium markets are differentiated by geography. The global trading of uranium has evolved into two distinct markets shaped by historical and political forces. The first, the western world market, comprises the Americas, Western Europe, and the Far East. A second market comprises countries within the former Soviet Union, Eastern Europe, and China. Most of the fuel required for nuclear power plants in these countries is supplied from their own stockpiles. Often, producers within these countries also supply uranium and fuel products to the western world market, thereby increasing competition. Fewer than 100 companies buy and sell uranium in the western world market.

New production from uranium mines supplies about 60 percent of the requirements of power utilities. The balance comes from secondary sources. Secondary supplies include existing inventories held by utilities and other fuel cycle companies, inventories held by governments, used reactor fuel that has been reprocessed, excess materials from military nuclear programs, and uranium in DU stockpiles. The uranium production industry is international in scope, with a small number of companies operating in relatively few countries. In 2005, eight producers provided approximately 80 percent of the estimated world production of 49 million kilograms (108 million pounds) U_3O_8.

Since 1985, western world uranium production has fallen short of western world utility uranium consumption. This shortfall has been covered by a number of secondary sources. Excess inventories held by utilities, producers, other fuel cycle participants, and governments have been and continue to be a significant source of supply, but availability is declining. Recycled products, including reprocessed uranium, mixed oxide fuel, and re-enriched tails materials, have been a source. Some utilities use reprocessed uranium and plutonium derived from used reactor fuel as a source of supply. In recent years, another source of supply has been the use of excess Russian enrichment capacity to re-enrich DU tails held by European enrichers. Finally, HEU derived from the dismantling of Russian nuclear weapons has become a significant source of LEU supply.

Demand Factors

Demand for uranium is directly linked to the level of electricity generated by nuclear power plants. Reactor capacity is growing slowly, and at the same time the reactors are being run more productively, with higher capacity factors and reactor power levels.

An external factor expected to have a particularly important impact on the prospects for nuclear power is the trend toward the liberalization of electricity markets in many countries. Historically, electric power utilities in the western world have operated in regulated electricity markets. Typically, a government regulator allowed each utility to serve a captive market area and earn a prescribed rate of return on its assets. The focus was on delivering a reliable supply of electricity. Since the mid-1990s, however, there has been a transition toward market liberalization. This trend began in the United States and has been adopted to varying degrees in Europe and the Far East.

In theory, deregulation in the electrical generation industry should result in utilities competing for market share on the basis of price, although the degree to which this is actually happening is unclear. The new bottom-line focus has necessitated changes in utilities' planning and operations, including improving operating methods, lowering unit production costs, and optimizing the use of assets. Faced with the challenge of deregulation, electric utilities world-wide have been restructuring through mergers and acquisitions.

U.S. nuclear utilities have dramatically improved the operating performance of their reactors. One measure of performance is the capacity factor. Across the entire U.S. fleet of reactors, the average capacity factor increased from 66 percent in 1990 to almost 90 percent in 2005. Improved reactor performance translates into greater uranium consumption and to more demand for nuclear services in general.

Uranium Sales Contracts

Unlike other metals such as copper or nickel, uranium has historically not been traded on an organized commodity exchange. Instead, it is traded in most cases through contracts negotiated directly between a buyer and a seller. However, in April 2007, the New York Mercantile Exchange announced a 10-year agreement to provide for the trade of on- and off-exchange uranium futures contracts.

The structure of uranium supply contracts varies widely. Pricing can be as simple as a single fixed price, or they can be based on various reference prices with economic indices built in. Contracts traditionally specify a base price, such as the uranium spot price, and rules for escalation. In base-escalated contracts, the buyer and seller agree on a base price that escalates over time on the basis of an agreed-upon formula, which may take economic indices, such as gross national product and inflation factors, into consideration. Delivery quantities, schedules, and prices vary from contract to contract and often from delivery to delivery within the term of a contract.

The Spot Market

A spot market contract usually consists of just one delivery and is typically priced at or near the published spot market price at the time of contract award. When a contract is priced at spot, it is usually the value quoted by one of the several market information services, such as Ux Consulting, TradeTech, or Nukem, at the end of the month prior to the delivery date. Spot market delivery quantities vary from 23,000 kilograms (50,000 pounds) to a few hundred thousand pounds U_3O_8. Over the last few years, about 15 percent of the western world's uranium requirements have been procured in the spot market—that is, for delivery within 12 months of contract award.

The Long-term Market

Historically, some 85 percent of all uranium has been sold under long-term, multi-year contracts with deliveries starting 1 to 3 years after contract award. Long-term contract terms range from 2 to 10 years or more, with the first delivery occurring within 24 months of contract award. Commercial terms are specified in the contract for each individual (usually annual) delivery, although those terms may vary from delivery to delivery over the duration of the contract. Long-term contracts may include a clause that allows the buyer to vary the size of each delivery within prescribed limits. For example, delivery quantities may vary from the prescribed annual volume by plus or minus 15 percent.

To diversify market risks, producers and utility customers often maintain a mix of contract terms and pricing mechanisms in their contract portfolios. Buyers are often willing to pay a premium in long-term contracts compared to spot prices, because they can achieve secure supply at prices that are more predictable.

The U.S.-Russian HEU Agreement

The Energy Policy Act of 1992, Public Law 102-486, amended the Atomic Energy Act of 1954 by establishing USEC as a wholly-owned government corporation to take over the operation of DOE’s uranium enrichment enterprise. Subchapter A of Title III of Public Law 104-134, the USEC Privatization Act, in Section 3103, authorized USEC’s Board of Directors, with approval of the Secretary of the Treasury, to transfer the interest of the United States in USEC to the private sector in a manner that provides for the long-term viability of USEC, provides for the continuation by USEC of the operation of DOE’s GDPs, provides for the protection of the public interest in maintaining a reliable and economical domestic source of uranium mining, enrichment and conversion services, and, to the extent not inconsistent with such purposes, secures the maximum proceeds to the United States.

In 1993, the United States and Russia entered into an agreement whereby Russia would dismantle a significant portion of its nuclear weapons by 2013. This agreement is known as the U.S.-Russian HEU agreement, or the "megatons-to-megawatts" agreement. It stipulates the annual quantities of HEU that may be delivered to the United States by Russia. The dismantled weapons contain a valuable resource for Russia. HEU can be blended down into LEU and sold in the western world market as reactor fuel for hard currency.

In 1994, the USEC, as agent for the U.S. government, and Russia signed an agreement whereby USEC would purchase the enrichment component of the LEU upon delivery to the United States. In 1999, Cameco and two other western companies, AREVA and RWE Nukem (now part of EnergySolutions), concluded an agreement with Russia whereby they have the option to purchase the majority of the natural feed component of LEU. This agreement is officially called the UF_6 Feed Component Implementing Contract. In November 2001, the western companies agreed to exercise a portion of their options to bring predictability to the program—predictable supply to the western market and predictable revenue to the Russians.

4.0 ENVIRONMENTAL IMPACTS

This chapter assesses the environmental impacts of DOE's two Proposed Action alternatives and the No Action Alternative. Consistent with DOE and CEQ guidance, this assessment focuses on those areas where there is a potential for impacts to occur.

4.1 Existing Analyses and Scope of Impact Assessment

This section reviews existing, relevant NEPA documents; identifies resource areas that DOE believes would not be impacted by the Proposed Action and DOE's basis for this position; and identifies the resource areas which DOE has identified as having a potential for impacts.

If implemented, the Proposed Action (Enrichment or Direct Sale Alternative) would result in a new source of feedstock for two operating and two soon-to-be-operating uranium enrichment facilities. Regardless of DOE's Proposed Action, enrichment operations at these four facilities would continue or commence as currently scheduled. The enrichment operations that would be implemented under DOE's Proposed Action would use existing work forces and existing plant and community infrastructures, and would not involve construction or expansion of any new uranium enrichment or uranium fuel fabrication plants. The environmental impacts of these ongoing and soon-to-be-ongoing enrichment and fuel fabrication plant operations have been previously analyzed in existing NEPA documents. Operations and impacts previously analyzed at these faculties would be unaffected, either adversely or beneficially, by the Proposed Action.

Separative Work Unit

The separative work unit (SWU) is a uranium enrichment unit related to the amount of uranium processed, the composition of the starting material, and the degree to which it is enriched. The SWU is proportional to the total machine operation time required to achieve a desired level of enrichment, but it is defined independent of the enrichment technology.

Plant operations, including storage, at the three FFFs (AREVA FFF, WEC FFF, and GNF FFF) have also been addressed in existing NRC licensing and NEPA documents. Current or projected operations previously analyzed at these three facilities would be unchanged, either adversely or beneficially, by the Proposed Action. Any potential incremental impacts at the three nuclear fuel facilities from DOE's Proposed Action would be associated with on-site delivery and storage of LEU product, which is currently occurring at the facilities and has been previously assessed in NRC licensing and NEPA documents.

Because the Proposed Action involves no new construction and no on-site or off-site disturbance of previously undisturbed land, there would be no potential for the Proposed Action to impact current land use; biotic communities; cultural, historical, or archaeological resources; visual resources; ambient noise levels; threatened or endangered species or their critical habitats; wetlands; or floodplains. The existing and projected enrichment facility and FFF operational work forces previously analyzed would not change as a result of DOE's Proposed Action. The impacts to current or projected utility and public safety infrastructures in the communities where these plants are located would not differ from those impacts previously analyzed. The Proposed Action would not result in criteria air pollutant emissions beyond those already assessed in existing NEPA documents. The ambient air quality in the regions where enrichment and storage activities would occur complies with applicable ambient air quality standards[12]. Health impacts related to air emissions resulting from transportation activities are addressed in the transportation impacts section (Section 4.2.1). There would be no environmental justice impacts beyond those discussed in the existing NEPA documents, which identified no environmental justice impacts due either to the absence of minority or low-income populations, or to the absence of adverse impacts to any population.

The NEPA documents prepared by DOE and NRC for the enrichment facilities and FFFs that could be used to implement the Proposed Action are summarized below and are incorporated by reference in accordance with 40 CFR 1502.21. The following subsections summarize the impacts from previous DOE and NRC analyses of uranium enrichment and conversion operations and uranium sales.

U.S. Department of Energy 1996 Assessment of Sale of Surplus Natural Uranium and Low-Enriched Uranium

In 1996, DOE prepared an EA evaluating the impacts of the sale of approximately 35.7 million pounds of natural uranium equivalent [U_3O_8 (e)] (approximately 13,730 MTU) of surplus NU and LEU in the form of UF_6, stored at the department's GDPs near Piketon, Ohio, and at Paducah, Kentucky (DOE 1996).[13] That EA analyzed six categories of potential impacts: radiation exposure under normal operations, transportation impacts, socioeconomic impacts, accidents, cumulative impacts, and environmental justice. DOE determined that the proposed sale or disposition of the excess uranium did not constitute a major federal action significantly affecting the quality of the human environment within the meaning of NEPA.[14]

The 1996 EA demonstrated that the proposed sale would not have a significant impact on collective radiological doses to workers or the public due to transportation or normal operations. In some cases, there would be a decrease in radiological dose due to reduced handling and transportation activities. Sale of all of the material in 1 year could result in a substantial reduction in the collective radiological dose to workers in the mining and conversion industries. Only if the uranium were all sold for foreign end use and shipped abroad for enrichment would there be an increase in risk due to transportation. The analysis showed a slight increase in dose to port workers and cylinder handlers at the GDPs. Impacts resulting from a transportation accident and effects on the global commons were analyzed and shown to be minimal. The analysis of severe accidents indicated that potentially fatal exposures to HF could result if a cylinder were to fall and be punctured while its UF_6 contents were temporarily in liquid form (heated) for purposes of sampling; however, the probability of such accidents was very low.

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[12] EPA classifies the northern half of Richland County, South Carolina, as a non-attainment area for 8-hour ozone. However, the state is an Early Action Compact state and the southern portion of Richland County, where the WEC FFF is located, is considered an attainment area by the state. (Personal communication: telephone conversation, May 19, 2008, W.E. Fallon, Battelle, and Jack Porter, South Carolina Department of Health and Environmental Control).

[13] The amount of uranium proposed to be sold or enriched under DOE's current Proposed Action (see Table 2-1)—4,919 MTU of LEU product equivalent or 22,213 MTU of NU product equivalent—would exceed the 13,730 MTU proposed for sale in 1996.

[14] EPA summary of EA and FONSI available online at http://www.epa.gov/fedrgstr/EPA-IMPACT/1996/October/Day-22/pr-17077.html.

U.S. Nuclear Regulatory Commission Analyses of Proposed National Enrichment Facility and American Centrifuge Plant

Under DOE's Proposed Action, excess uranium could be enriched at two soon-to-be-operational enrichment facilities, the NEF and the ACP. To identify the impacts of operations at these facilities, DOE reviewed the recent NRC EISs for the NEF (NRC 2005) and ACP (NRC 2006). These analyses, which are incorporated into this EA by reference, are summarized in Tables 4-1 and 4-2. As characterized in these two EISs, the impacts are predominantly small, occasionally small to moderate, and in all instances could be mitigated. Most of the impacts are construction-related and therefore would not apply to DOE's Proposed Action.

U.S. Department of Energy and U.S. Nuclear Regulatory Commission Analysis of Paducah Gaseous Diffusion Plant Operations

DOE reviewed existing analyses of impacts associated with uranium enrichment operations at the Paducah GDP (DOE 1982) and subsequent NRC assessments of USEC operations at the Paducah GDP. These analyses, which are summarized below, are incorporated into this EA by reference. In March 1982, DOE issued a FONSI indicating that "the operation of the Paducah GDP in the current [1982] mode, without any substantial modification, is not a Federal action significantly affecting the quality of the human environment."

However, the modes of operation at the Paducah GDP have evolved since the DOE's 1982 NEPA review and FONSI. In March 2001, NRC amended USEC's operating certificate for the Paducah GDP. The amendment permits USEC to enrich uranium to levels up to 5.5 percent ^{235}U. NRC reviewed environmental impacts associated with higher assay operations at the facility. As reported in an October 2000 Compliance Evaluation Report (NRC 2000):

> "NRC reviewed available environmental review documentation for the PGDP that was prepared in accordance with the National Environmental Policy Act. Available NEPA documents include site-wide environmental assessments by both the Department of Energy and the United States Enrichment Corporation, and an NRC environmental assessment for approving USEC's compliance plan that was associated with their initial certificate application. The NRC staff conducted this review to ensure that environmental effects associated with facility changes in support of higher assay operations remained appropriately bounded by previous NEPA analyses. Upon completion of this review, the NRC staff affirmed that *there are no new and significant environmental impacts associated with higher assay operations at the PGDP*. Therefore, consistent with the bases for the 10 CFR 51.22(c)(19) categorical exclusion, the NRC staff finds that issuance of the Certificate Evaluation Report for higher assay operation at the PGDP will not result in any significant new environmental impact." (Italicized emphasis added.)

Table 4-1. Summary of Impacts from National Enrichment Facility Construction, Operation, and Decommissioning

Resource Area	Impact Summary
Land Use	**Small Impact**. Construction activities would occur on about 81 hectares (200 acres) of a 220-hectare (543-acre) site that would be fenced. The land is currently undisturbed except for a gravel access road, cattle grazing, and the presence of a carbon dioxide pipeline.
Historical and Cultural	**Small Impact**. There are seven archaeological sites on the proposed site. These sites are considered eligible for listing on the National Register of Historic Places. Two sites would be impacted by construction activities and a third is along the access road.
Visual and Scenic	**Small Impact**. Impacts from construction activities would be limited to fugitive dust emissions that can be controlled using dust suppression techniques. The cooling towers could contribute to the creation of fog 0.5 percent of the total hours per year (44 hours per year). The proposed NEF site received the lowest scenic-quality rating using the U.S. Bureau of Land Management visual resource inventory process.
Air Quality	**Small Impact**. Air concentrations of the criteria pollutants predicted for vehicle emissions and emissions of particulate matter of less than 10 microns in diameter (PM_{10}) from fugitive dust during construction would all be below the NAAQS. Fugitive dust emissions would be temporary and localized. A National Emissions Standards for Hazardous Air Pollutants Title V permit would not be required for operations due to the low levels of estimated emissions. All stack emissions would be monitored.
Geology and Soils	**Small Impact**. Construction-related impacts on the geology and soil would occur within the 81-hectare (200-acre) part of the site on which the proposed NEF structures would be built. Clay and gravel from a nearby site might be used during construction. No soil contamination would be expected during construction and operations. A plan would be in place to address any spills that might occur. There would be no construction or operational impacts on unique mineral deposits or geological resources.
Water Resources	**Small Impact**. There are no existing surface water resources. Impacts on water use would be small because of the availability of excess capacity in the Hobbs and Eunice water supply systems. The proposed NEF's indirect use of the Ogallala Aquifer's water through the Eunice and Hobbs water supply systems would constitute a small portion of the aquifer reserves in New Mexico.
Ecological Resources	**Small Impact**. Construction, operation, and decommissioning of the proposed NEF would have small impacts on ecological resources. There are no wetlands or unique habitats for threatened or endangered plant or animal species on the proposed NEF site. A large part of the site would remain undisturbed and in its natural state. The impacts of the use of water detention/retention basins would be small because animal-friendly fencing and netting or other suitable material over the basins would be used to minimize animal intrusion. Revegetation using native plant species would be conducted in any areas impacted by proposed NEF activities. The design and construction of the electrical transmission lines would address the protection of birds from electric shock.
Socioeconomics	**Small Impact.** During the 8-year construction period, the estimated employment would average nearly 400 jobs per year. The increase in the number of school-aged children during construction would average about 40. The impact on the school system would be small—less than one new student per grade. Tax revenue impacts during construction would be moderate. During operation, the proposed NEF would employ a maximum of 210 people annually and would indirectly create an additional 173 jobs. The impact on local employment would be moderate—approximately 1 percent of the jobs in the area. The increase in demand for public services would be small. Decontamination and decommissioning (D&D) would generally have small impacts.

Table 4-1. Summary of Impacts from National Enrichment Facility Construction, Operation, and Decommissioning (continued)

Resource Area	Impact Summary
Environmental Justice	**Small Impact**. Although the impacts to the general population were small to moderate, an examination of the various environmental pathways by which populations could be affected found no disproportionately high and adverse impacts from construction, operation, or decommissioning on minority and low-income populations living near the proposed NEF or along the transportation routes into and out of the proposed NEF.
Noise	**Small Impact**. Noise would come predominantly from traffic. Noise levels during operations would be within the U.S. Department of Housing and Urban Development guidelines.
Transportation	**Small Impact during Normal Operations**; **Small to Moderate during Accidents**. Truck trips removing nonradioactive waste and delivering supplies would have a small impact on the traffic on New Mexico Highway 234. Workforce traffic would also have a small impact on New Mexico Highway 234, with less than one injury and less than one fatality expected annually due to traffic accidents. Truck shipments of feed, product, and waste materials (including DUF_6) would result in two latent cancer fatalities (LCFs) to the general population over the life of the proposed NEF due to vehicle emissions and fewer than 3×10^{-2} LCFs due to direct radiation. All rail shipments of feed, product, waste materials, and empty cylinders would result in fewer than 8×10^{-2} LCFs to the general population over the life of the proposed NEF due to vehicle emissions and 1×10^{-1} LCFs from direct radiation. If a rail accident involving the shipment of DUF_6 occurred in an urban area, up to 28,000 people could suffer adverse but temporary health effects with no fatalities due to chemical impacts. A truck accident involving the shipment of DUF_6 in an urban area could have temporary adverse chemical impacts on as many as 1,700 people. **Small Impact during Decommissioning**. Small impacts would occur if DUF_6 were temporarily stored at the proposed NEF for the duration of operations. Assuming that all of the material were shipped during the first 8 years (the final radiation survey and decontamination would occur during the ninth year), the proposed NEF would ship approximately 1,966 truckloads per year. If the trucks were limited to weekday, non-holiday shipments, approximately 10 trucks per day or 2½ railcars per day would leave the site for the DUF_6 conversion facility.
Public and Occupational Health and Safety	**Small Impact during Construction and Normal Operations.** During normal operations, there would be approximately eight injuries per year and no fatalities, based on statistical probabilities. A typical operations or maintenance technician could be exposed to 100 mrem of radiation annually. A typical cylinder yard worker could be exposed to 300 mrem of radiation annually. All public radiological exposures would be significantly below the 10 CFR Part 20 regulatory limit of 100 mrem and the 40 CFR Part 190 regulatory limit of 25 mrem annually for uranium fuel cycle facilities. The nearest resident would receive less than 1.3×10^{-3} mrem due to normal NEF operations. **Small to Moderate Impact for Accidents**. The most severe accident is estimated to be the release of UF_6 caused by the rupture of an overfilled and/or overheated cylinder, which could result in a collective population dose of 12,000 person-rem and seven LCFs. The design of the proposed NEF would include certain features to significantly reduce the likelihood of this event.

Table 4-1. Summary of Impacts from National Enrichment Facility Construction, Operation, and Decommissioning (continued)

Resource Area	Impact Summary
Waste Management	**Small Impact**. Solid wastes would be generated during construction and operations. Existing disposal facilities would have the capacity to dispose of the nonhazardous solid wastes. In particular, impacts on the Lea County landfill would be small. There would be enough existing national capacity to accept the low-level radioactive waste that would be generated at the proposed NEF. **Small to Moderate Impact for DUF_6 Waste Management**. Public and occupational exposures would be monitored and controlled to meet NRC regulations for radiation protection. LES identified two potential means for disposing of DUF_6: by private conversion and disposal facilities or by DOE through Section 3113 of the USEC Privatization Act. LES's preferred strategy is to use private facilities outside of the State of New Mexico to convert and dispose of the DUF_6 byproduct. No final location has yet been determined for a private conversion facility, but the EIS contemplated potential DUF_6 conversion at a non-DOE facility. Alternatively, DOE would process the DUF_6 by extending the operation of its conversion facilities. This would prolong the impacts of DOE's conversion facilities, as described in DOE's NEPA documentation. A private conversion facility would have much the same impacts as the planned DOE conversion facilities at Paducah, Kentucky, and Portsmouth, Ohio.

Source: NRC 2005.

Table 4-2. Summary of Impacts from American Centrifuge Plant Construction, Operation, and Decommissioning

Resource Area	Impact Summary
Land Use	**Small Impact**. Site preparation and construction activities would occur on approximately 22 hectares (55 acres) of land, which comprises about 1 percent of the total 1,497-hectare (3,700-acre) DOE reservation. These changes would convert previously disturbed land (e.g., managed lawns, fields, and forests) on the DOE reservation to developed areas. The land is not considered prime farmland, and changes would be consistent with current land use. It is anticipated that after decommissioning activities are completed, existing buildings and structures would remain on-site and the site would remain categorized for industrial use.
Historical/ Archaeological	**Small Impact**. NRC identified the Portsmouth GDP historic district, thirteen historic farmsteads, and one prehistoric lithic scatter as being potentially eligible for inclusion on the National Register of Historic Places. In addition, NRC included three properties located around the perimeter in its consideration of potential effects. There would be no adverse indirect or direct effect on these sites.
Visual	**Small Impact**. Construction of the proposed ACP would not alter the site's Bureau of Land Management Visual Resources Management rating system classification of Class III or IV (moderate to little scenic value). There are no scenic rivers, nature preserves, or unique visual resources in the proposed project area.
Air Quality	**Small to Moderate Impact**. Airborne emissions from site preparation and construction should not result in exceedances of air quality standards, with the possible exception of short-term increases in particulate matter that could exceed the applicable standard up to a distance of 1,000 meters (3,280 feet) beyond the fenceline. Radiological releases from soil disturbances and from activities to refurbish existing buildings that would be used for the ACP would be small and controlled. Emissions from diesel generators would not cause air quality problems, and maximum predicted concentrations of HF resulting from ACP operations are below safe levels.
Geology and Soils	**Small Impact**. There is little likelihood of impact from soil compaction or subsidence, and there are no unique mineral deposits or geologic resources that stand to be affected. The flat terrain where the ACP buildings would be located, and the dense soil, low moisture content, and vegetative cover in the area of a new 10-hectare (24-acre) cylinder storage yard to be located in another spot on the reservation make landslides unlikely. Construction activities would not alter current drainage and would not disturb any soils that qualify for protection as prime farmland. There would be a potential for increased erosion and siltation of streams near the construction site of the new large cylinder storage yard, but both of these potential impacts should be minimized by the use of standard best management practices. The potential for soil contamination resulting from ACP operations would be small. A plan would be in place to address any spills that might occur.
Water Resources	**Small Impact.** Groundwater withdrawals would increase by 10 percent over current usage rates, but would still be only 31 percent of the total design capacity of the site's well fields, would not affect groundwater availability, and would not pose an increased risk of subsidence. Wastewater would continue to discharge from permitted National Pollutant Discharge Elimination System outfalls. Discharge rates, though increased above current levels, would represent only 75 percent of the existing system's design capacity. USEC does not anticipate any liquid discharges of radioactive materials from the proposed ACP (i.e., from cooling water, storm water runoff, or sanitary water). The potential for leaks or spills that could contaminate water resources would be limited by an approved Spill Prevention Control and Countermeasures Plan.

Table 4-2. Summary of Impacts from American Centrifuge Plant Construction, Operation, and Decommissioning (continued)

Resource Area	Impact Summary
Ecological Resources	**Small Impact**. Construction of the new large cylinder storage yard referenced in the section on geology and soils would result in increased erosion, stormwater runoff, and loss of 10 hectares (24 acres) of vegetation but, with planned best management practices, would result in small impacts to the flora and fauna in and around the tributaries of Little Beaver Creek. That same cylinder storage yard would also be located within 500 meters (1,640 feet) of suitable summer habitat for the endangered Indiana bat, although studies have not documented the presence of this bat species on the DOE reservation. None of the site construction activities would occur in wetlands. However, some construction would occur adjacent to small wetlands, and standard erosion control measures would be used to limit sedimentation in these areas.
Socioeconomics	**Small to Moderate Impact**. During construction, full-time employment is estimated to be 3,362 jobs. The impact to regional employment during construction would be approximately 3.5 percent, which is considered moderate. The impact to tax revenue during construction is expected to be small, generating 0.03 percent of Ohio individual income tax receipts and 0.06 percent of sales tax. The impact to tax revenue is considered small. The impact to population characteristics is considered small, approximately 0.13 percent of the regional population. The impact to area housing, community services, and public utilities would also be small. During the ACP operations phase between the years 2010 and 2040, 1,500 jobs would be created in the region of influence. These impacts to regional employment are considered moderate, based on existing employment levels in the region. During operations, there would be a small increase in regional tax revenues as well as small impacts to population characteristics, housing resources, community and social services, and public utilities.
Environmental Justice	**Small Impact**. An examination of the various environmental pathways by which low-income and minority populations could be affected found no disproportionately high or adverse impacts from construction, operation, or decommissioning on any of these populations.
Noise	**Small Impact**. No adverse noise impacts from routine ACP operations are expected at the closest residence due to low operational noise, the attenuation provided by the building facade, and distance attenuation of over 900 meters (3,000 feet). Catastrophic failure of a centrifuge could cause a sudden, brief loud noise due to the high rotational speed of the centrifuge. However, the likelihood of a single centrifuge catastrophically failing is very low. Noise levels during D&D are also anticipated to be small and similar to those generated during construction of the ACP.
Transportation	**Small to Moderate Non-radiological Impacts from Routine Transportation**. Increased truck and vehicle traffic associated with proposed ACP operations should result in small changes in current levels of congestion and delays on U.S. Route 23 and Ohio State Road 32. Traffic associated with proposed operations should also result in small increases in the number of traffic accidents resulting in injuries or fatalities. Substantially greater transportation requirements during the construction phase could result in moderate impacts during the 5-year period in which most of the proposed construction activity is projected to occur. The NRC estimates that increased traffic during construction would temporarily decrease the level of service on U.S. Route 23 and, to a lesser extent, on Ohio State Road 32. The changes on U.S. Route 23 would temporarily increase traffic density, affect the ability to maneuver within the traffic stream, and reduce

Table 4-2. Summary of Impacts from American Centrifuge Plant Construction, Operation, and Decommissioning (continued)

Resource Area	Impact Summary
	travel speeds somewhat. It is also expected that construction traffic accidents would result in about 18 injuries a year involving employees traveling to and from their jobs, and 1 fatality over the entire construction period. These same injury and fatality rates would be expected if the same employees were driving to different employers. **Small Radiological Impacts from Routine Transportation and Transportation Accidents.** The transportation of materials containing radionuclides would result in some increased risk of cancer both to the occupational workers transporting and handling the material and to members of the public driving along the roads or living along the transportation routes. The transport of all materials is estimated to result in approximately 0.014 LCFs per year of operation from exposure to direct radiation during “incident-free” transport (i.e., shipping that does not involve the breach of a shipping container and subsequent release of radioactive material), and an additional 0.008 LCFs per year from accidents that result in the release of radioactive material into the environment. The total LCFs is estimated to be 0.02 per year of operation, or less than one cancer fatality over the 30 years of operation. **Moderate Non-Radiological Impacts from Transportation Accidents**. Transportation accidents involving the release of UF_6, which is the form of uranium that would be transported the most to and from the proposed ACP, could also result in chemical impacts to drivers and the surrounding public. When released from a shipping cylinder, UF_6 reacts with the moisture in the atmosphere to form HF and uranyl fluoride (UO_2F_2), both of which can cause adverse effects due to chemical toxicity (as opposed to radiation hazards) if exposures are high enough. The analysis shows that the probability of a severe transportation accident that released sufficient quantities of UF_6 that could pose a health risk is low, but that the consequences of such an accident, should it occur, are high. Based on the analysis, the impacts associated with such an accident as part of the proposed action are considered moderate. **Small Impact During D&D**. Traffic associated with material and equipment transportation to the site during this phase would be much lower than that during site preparation and construction. D&D activities, including waste generation and handling, would require almost 5,000 truck shipments for off-site disposal over the 5-year decommissioning period proposed by USEC. Because this volume of truck traffic is far less than the estimated 17,870 truck trips needed during the 5-year proposed ACP construction period, the transportation impacts associated with the decommissioning truck traffic should be far less than that described for site preparation and construction. The number of LCFs from the incident-free transportation of all D&D waste is estimated to be less than one, and there are no projected deaths resulting from the release of radioactive material as a result of accidents during such shipments.

Table 4-2. Summary of Impacts from American Centrifuge Plant Construction, Operation, and Decommissioning (continued)

Resource Area	Impact Summary
Public and Occupational Health and Safety	**Small Impact**. The proposed action would result in small increases in the current number of occupational injuries and illnesses at the site, though still less than historical levels. Construction and process areas would be segregated, and personnel monitoring programs would be implemented, to minimize worker exposures to annual radiation doses of less than the 10 CFR § 20.1201 limit of 5,000 mrem. The maximum dose to members of the public resulting from routine radiation exposures is estimated to be 1 mrem per year, for a hypothetical person living on the northern boundary of the DOE reservation. This estimated dose is significantly below the 10 CFR Part 20 regulatory limit of 100 mrem per year and 40 CFR Part 190 regulatory limit of 25 mrem per year for uranium fuel-cycle facilities. Analytical results also indicate that plausible radiological accidents at the proposed ACP pose low risks. In addition, public and occupational exposures to non-radiological contaminants are projected to be less than applicable limits. Occupational exposures during on-site D&D would be bounded by the potential exposures during operation. At the end of plant life, gas centrifuges containing residual uranium would be purged, leaving radioactive material in amounts significantly less than handled during operations. Because systems containing this residual contamination would be opened, decontaminated (with the removed radioactive material processed and packaged for disposal), and dismantled, an active environmental and dosimetry (external and internal) program would be conducted to maintain as low as reasonably achievable (ALARA) doses to workers and doses to individual members of the public as required by 10 CFR Part 20.
Waste Management	**Small Impact**. Site preparation, construction, and operations would generate varying amounts of low-level radioactive, low-level mixed, hazardous, sanitary/industrial, and recyclable wastes. All of these wastes would be managed in accordance with existing procedures for controlling contaminant releases and exposures. With the exception of the DU, all of the wastes would also be generated at volumes that are well within existing management capacities. The ACP would generate approximately 41,105 cylinders of DUF_6, containing approximately 512,730 MT (535,200 tons) of material. Production of DUF_6 for the 10 percent enrichment scenario would be less than this amount. All of this DUF_6 could be converted to a more stable chemical form at a new conversion facility that DOE is constructing near Piketon, which would require DOE to significantly extend the life of this facility. The converted material would then be shipped by rail to an acceptable western disposal site, where sufficient capacity exists and where the disposal impacts should be small.

Source: NRC 2006.

U.S. Department of Energy Analysis of Uranium Hexafluoride Conversion Facilities at Paducah and Portsmouth

In two EISs analyzing construction and operation of proposed UF_6 conversion facilities at DOE Paducah (DOE 2004a), and DOE Portsmouth (DOE 2004b), DOE found that environmental impacts associated with the proposed action alternatives would include (1) impacts to local air, water, soil, ecological, and cultural resources during conversion facility construction; (2) impacts to workers from facility construction and operations; (3) impacts from small amounts of DU and other hazardous compounds released to the environment through normal conversion plant air effluents; (4) impacts from the shipment of cylinders, conversion products, and waste products; and (5) impacts from potential accidents involving the release of radioactive material or hazardous chemicals. However, most of the identified impacts were associated with the construction (now complete at Portsmouth and nearly complete at Paducah) rather than the future operation of the new conversion facilities. As discussed in Section 2.3, the No Action Alternative for this EA relative to DU is the status quo; that is, DOE would implement the currently planned operation of these two new facilities rather than implementing either of the Proposed Action alternatives described in Sections 2.1 and 2.2. Consequently, the operational impacts DOE assessed in its two DU conversion facility EISs (DOE 2004a, 2004b) are tantamount to the impacts of the No Action Alternative for DU assessed in this EA. In addition, the two DU conversion facility EISs evaluated continued storage of NU and LEU cylinders as part of their no action alternatives, which is comparable to the No Action Alternative in this EA and is also comparable to the storage of NU and LEU cylinders after enrichment at Portsmouth and Paducah in the Proposed Action of this EA. Therefore, DOE anticipates no new or previously unrecognized or unanalyzed impacts. Table 4-3 summarizes the generally minor operational impacts for DU conversion assessed in the two conversion facility EISs.[15]

As seen in Table 4-3, the operational impacts assessed in these two EISs are very nearly identical. This reflects the fact that these two conversion facilities are physically and operationally very nearly identical and would be operated by the same firm.

Conclusion

In the context of impacts at enrichment facilities, DU feed is similar chemically and physically to NU feed. DU feed would have slightly lower radiological hazard than NU feed because of decreased ^{234}U and ^{235}U. Given equal amounts of DU or NU feed, there would also be a slightly lesser amount of DU tails with an assay of 0.20 percent than DU tails with an assay of 0.35 percent. In addition, DU tails with an assay of 0.20 percent would have a slightly lower radiological hazard than DU tails with an assay of 0.35 percent because of the decreased ^{234}U. Enrichment activities would also take place within the NRC-licensed capacities at the enrichment facilities. Therefore, DOE has determined that the impacts of enriching DU tails would be similar to or slightly less than the impacts of enriching NU.

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[15] A full description of these impacts is available online at http://web.ead.anl.gov/uranium/pdf/PAD-Summary.pdf (Paducah conversion facility) and http://web.ead.anl.gov/uranium/pdf/PORT-Summary.pdf (Portsmouth conversion facility).

Table 4-3. Summary of Expected Impacts from Operation of the Paducah and the Portsmouth Conversion Facilities

Resource Area	Impact
Human Health and Safety – Normal Operations	The estimated potential exposures of workers and members of the public to radiation and chemicals would be well within applicable public health standards and regulations during normal facility operations (including 10 CFR 835, 40 CFR 61 Subpart H, and DOE Order 5400.5). The estimated doses and risks from radiation and/or chemical exposures of the public and noninvolved workers would be very low, with zero LCFs expected among these groups over the time periods considered, and with minimal adverse health impacts from chemical exposures expected.
Human Health and Safety – Facility Accidents	Workers could be injured as a result of operational accidents unrelated to radiation or chemical exposure. About 8 injuries per year during operations could occur. It is possible that accidents could release radiation or chemicals to the environment, potentially affecting both the workers and members of the general public. Of all the accidents considered, those involving DUF_6 cylinders and those involving chemicals at the conversion facilities would have the largest potential effects.
Human Health and Safety - Transportation	During normal transportation operations, radioactive material and chemicals would be contained within their transport packages. Health impacts to crew members (i.e., workers) and members of the public along the routes could occur if they were exposed to low-level external radiation in the vicinity of uranium material shipments. In addition, exposure to vehicle emissions (engine exhaust and fugitive dust) could potentially cause latent fatalities from inhalation. Traffic accidents could occur during the transportation of radioactive materials and chemicals. These accidents could potentially affect the health of workers (i.e., crew members) and members of the public, either from the accident itself or from accidental releases of radioactive materials or chemicals. The total number of traffic fatalities (unrelated to the type of cargo) was estimated on the basis of national traffic statistics on shipments by both truck and rail. If the aqueous HF was sold, about 1 traffic facility would be estimated under both transportation modes. If HF were neutralized to calcium fluoride (CaF_2), about 2 fatalities would be estimated for the truck option and 1 fatality for the rail option. Severe transportation accidents could also result in a release of radioactive material or chemicals from a shipment. The consequences of such a release would depend on the material released, location of the accident, and atmospheric conditions at the time. Potential consequences would be greatest in urban areas because more people could be exposed.
Air Quality and Noise	During operations, it is estimated that total concentrations for all criteria pollutants (except for $PM_{2.5}$) would be well within standards. The background level of annual average $PM_{2.5}$ in the area of both sites approaches or exceeds the standard. The total concentrations of VOCs, uranium, and fluoride would also be well below applicable standards. Estimated operational noise levels at the nearest residence would be below the EPA guideline of 55 A-weighted decibels (dB[A]) as day-night average sound level for residential zones.

Table 4-3. Summary of Expected Impacts from Operation of the Paducah and the Portsmouth Conversion Facilities (continued)

Resource Area	Impact
Water and Soil	No appreciable impacts on surface water, groundwater, or soils would result from the conversion facilities because no contaminated liquid effluents are anticipated and because airborne emissions would be at very low levels (e.g., < 0.25 grams per year of uranium).
Ecological	Concentrations of contaminants in the environment during operations would be below harmful levels. Impacts to vegetation and wildlife would be negligible.
Waste Management	Waste generated during operations would have negligible impacts on the waste management operations at both sites, with the exception of possible impacts from disposal of CaF_2. Industrial experience indicates that HF, if produced, would contain only trace amounts of DU (less than 1 part per million). It is expected that HF would be sold for use. If sold, the sale would be subject to review and approval by DOE in coordination with the NRC, depending on the specific use.
Resource Requirements	Resource requirements include construction materials, fuel, electricity, process chemicals, and containers. In general, there would be a negligible effect on the local or national availability of these resources.
Land Use	Negligible.
Cultural Resources	None.
Socioeconomics	An estimated 150 jobs would be generated during construction of the cylinder yard, and an estimated 280 jobs would be generated during construction of the conversion facility. There would be an approximate 0.1 percent annual growth in jobs. With limited in-migration of population expected, there would be a marginal impact on local housing, public financing, or local service employment.
Environmental Justice	No disproportionately high and adverse human health or environmental impacts are expected to minority or low-income populations.
D&D Activities	D&D impacts to involved workers would be primarily from external radiation; expected exposures would be a small fraction of operational doses; no LCFs would be expected. It is estimated that no fatalities and up to five injuries would result from occupational accidents. Impacts from waste management would include a total generation of about 275 cubic yards (210 cubic meters) of LLW, 157 cubic yards (120 cubic meters) of LLMW, and 157 cubic yards (120 cubic meters) of hazardous waste; these volumes would result in low impacts compared with projected site annual generation volumes.

Table 4-3. Summary of Expected Impacts from Operation of the Paducah and the Portsmouth Conversion Facilities (continued)

Resource Area	Impact
Cumulative Impacts	The cumulative collective radiological exposure to the off-site population would be well below the maximum DOE dose limit of 100 mrem per year to the off-site MEI and below the limit of 25 mrem/yr specified in 40 CFR 190 for uranium fuel cycle facilities. Annual individual doses to involved workers would be monitored to maintain exposure below the regulatory limit of 5 rem per year. ▪ At Paducah, up to 6,000 rail shipments and 18,600 truck shipments of radioactive material could occur. The cumulative maximum dose to the MEI along the transportation route near the site entrance would be less than 1 mrem per year under for all transportation modes. At Portsmouth, up to 6,800 rail shipments and 12,3000 truck shipments of radioactive material could occur. The cumulative maximum dose to the MEI along the transportation route near the site entrance would be less than 1 mrem per year under for all transportation modes. ▪ The sites are located in attainment regions. However, the background annual-average $PM_{2.5}$ concentration is near (for Paducah) or exceeds (for Portsmouth) the regulatory standard. Cumulative impacts would not affect attainment status. ▪ Data from the 2000 annual groundwater monitoring showed that four pollutants (for Paducah) and five (for Portsmouth) exceeded primary drinking water regulation levels in groundwater. Good engineering and construction practices should ensure that indirect cumulative impacts on groundwater associated with the conversion facilities would be minimal. ▪ Cumulative ecological impacts on habitats and biotic communities, including wetlands, would be negligible to minor. ▪ Cumulative land use impacts are anticipated to be negligible to minor. ▪ Given the absence of high and adverse cumulative impacts for any impact area considered, no environmental justice cumulative impacts are anticipated despite the presence of disproportionately high percentages of low-income populations in the vicinity of both sites. ▪ Socioeconomic impacts under all alternatives considered are anticipated to be generally positive, often temporary, and relatively small.

Sources: DOE 2004a, 2004b.

$PM_{2.5}$ = particulate matter with a diameter of 2.5 microns or less; PM_{10} = particulate matter with a diameter of 10 microns or less.

In the context of impacts at conversion facilities, DU tails with an assay of 0.20 percent would have a slightly lower radiological hazard than DU tails with an assay of 0.35 percent, again because of decreased ^{234}U. In addition, given equal amounts of feed, there would also be a slightly lesser amount of DU tails with an assay of 0.20 percent than DU tails with an assay of 0.35 percent. Therefore, DOE has determined that the impacts of converting DU tails with an assay of 0.20 percent would be similar to or slightly less than the impacts of converting DU tails with an assay of 0.35 percent. At the Portsmouth conversion facility, the number of DU cylinders could increase slightly, from 20,931 to 21,086 (0.7 percent), as a result of the Proposed Action in this draft EA. At the Paducah conversion facility, the number of DU cylinders could also increase slightly, from 41,013 to 41,168 (0.4 percent), as a result of the Proposed Action in this draft EA. The impacts from these incremental changes would be minor.

Based on the nature of the Proposed Action and on DOE's review of existing NEPA documents as summarized above for the enrichment facilities and conversion facilities, DOE has determined that impacts to the human environment due to enrichment operations and conversion of DU tails from enrichment (1) have been adequately characterized in existing DOE and NRC documents and (2) are small to moderate in nature. In addition, DOE has determined that the primary potential for impacts under the Proposed Action is related to (1) health, safety, and accident impacts associated with additional and previously unanalyzed transportation of the excess inventory to proposed enrichment sites; (2) health, safety and accident impacts associated with transportation and storage of NU product and LEU product and transportation of DU tails; and (3) relevant socioeconomic impacts. These impact areas and the impacts associated with the No Action Alternative are assessed in the following sections.

4.2 Enrichment Alternative

4.2.1 Transportation Impacts under the Enrichment Alternative

DOE analyzed the potential impacts of shipping part of its excess NU, LEU, and DU feed from its current storage locations at the Portsmouth and Paducah GDPs to the location(s) where it could be enriched. Enrichment could occur at four sites: (1) the currently operating Paducah GDP in Paducah, Kentucky; (2) the ACP near Piketon, Ohio, which is scheduled to begin enrichment operations in late 2009 or 2010; (3) the NEF near Eunice, New Mexico, which is scheduled to begin enrichment operations in late 2009; and (4) the French enrichment facility operated by AREVA that is located at the Tricastin nuclear complex in south-central France on a diversion canal of the Rhone River, approximately 130 kilometers (80 miles) north of the port of Marseilles.

After enrichment, DOE could ship the LEU product to, and store it at, one or more of five sites: (1) the commercial nuclear FFF operated by AREVA in Richland, Washington; (2) the commercial nuclear FFF operated by WEC near Columbia, South Carolina; (3) the commercial nuclear FFF operated by GNF near Wilmington, North Carolina; (4) DOE Portsmouth; and (5) DOE Paducah. NU product could be stored at the enrichment site or it could be shipped to the DOE Paducah or Portsmouth facilities for storage. If the NU product was stored, it would be done so in accordance with the NRC licenses or DOE requirements at these facilities, as applicable.

The transportation impacts of shipping NU feed and product, LEU feed and product, DU feed, and DU tails were evaluated under both incident-free and accident conditions. Representative highway, rail, and barge routes from the enrichment, storage, and commercial nuclear FFFs were determined using the WebTRAGIS routing computer code (Johnson and Michelhaugh 2003). The routes conform with current routing practices and applicable routing regulations and guidelines. Route characteristics include the distances and population densities in rural, suburban, and urban population density zones. The populations that might be exposed along these routes were determined using data from the 2000 census. Table 4-4 lists the distances and the population densities for the transportation routes. Figure 4-1 illustrates the rail and truck routes. Barge traffic would be on the Mississippi River. Population data were extrapolated to the year 2035 to account for the duration of the Proposed Action.

Radiological dose during normal, incident-free transportation of radioactive materials result from exposure to the external radiation field that surrounds the shipping containers. The dose is a function of the number of people exposed, their proximity to the containers, their length of time of exposure, and the intensity of the radiation field surrounding the containers. The radiation dose rate at 1 meter from UF_6 containers ranges from about 0.2 to 1 mrem per hour (NRC 2005, NRC 2006). In this analysis, the radiation dose rate was estimated to be 1 mrem per hour at a distance of 1 meter (3 feet) from the cylinders used to ship the UF_6.

Radiological impacts were determined for crew workers and the general population during normal, incident-free transportation. For truck shipments, the crew were drivers of the shipment vehicles. For rail shipments, the crew were workers in close proximity to the shipping containers during railcar inspection or classification. The general population was the individuals within 800 meters (2,600 feet) of the road or railway (off-link), sharing the road or railway (on-link), and at stops. Collective doses for the crew and general population were calculated using the RADTRAN 5 computer code (Neuhauser and Kanipe 2000; Neuhauser et al. 2000). Individual radiation doses were also estimated for people along the route at a distance of 30 meters (100 feet) from the highway or railroad. Nonradiological incident-free impacts were also determined for exhaust and fugitive dust emissions from highway and rail traffic.

Human health impacts could also result from transportation accidents in which no radioactive material would be released (i.e., traffic fatalities), and from transportation accidents in which radioactive material could be released from a cylinder. For transportation accidents involving a release of radioactive material, DOE estimated radiological accident risks (probability of occurrence × consequence) expressed as the number of latent cancer fatalities (LCFs) summed over a complete spectrum of accidents. Impacts were evaluated for the population within 80 kilometers (50 miles) of the road or railway using the RADTRAN 5 computer code. DOE assumed that people would be exposed through inhalation, direct external dose from radioactive material that has deposited on the ground after being dispersed from the accident site (referred to as groundshine), and direct external dose from the passing cloud of dispersed radioactive material (referred to as cloudshine). In addition to transportation accident risks, the radiological and toxicological consequences of severe transportation accidents involving UF_6 releases were also evaluated.

Table 4-4. Transportation Distances and Population Densities

Origin	Destination	Distance (km)				Population Density (people/km^2)		
		Rural	Suburban	Urban	Total	Rural	Suburban	Urban
Truck Routes								
Portsmouth GDP/ACP	GNF FFF	546.5	408.8	33.8	989.0	18.3	359.6	2,150.2
Portsmouth GDP/ACP	WEC FFF	419.5	330.9	30.4	780.7	17.6	367.7	2,277.5
Portsmouth GDP/ACP	AREVA FFF	3,236.8	725.6	61.1	4,023.0	11.4	294.0	2,259.0
Portsmouth GDP/ACP	Paducah GDP	558.9	310.2	18.0	886.9	20.8	283.6	2,186.4
Portsmouth GDP/ACP	NEF	1,717.8	673.5	77.4	2,468.4	14.5	323.1	2,246.4
Paducah GDP	GNF FFF	729.1	555.2	31.5	1,315.8	19.1	331.9	2,086.5
Paducah GDP	WEC FFF	569.5	384.4	21.1	975.0	18.8	301.8	2,144.6
Paducah GDP	AREVA FFF	2,880.9	558.3	65.9	3,505.1	9.3	318.2	2,203.0
Paducah GDP	NEF	1,405.7	420.8	41.5	1,867.8	12.3	313.2	2,270.7
NEF	GNF FFF	1,907.8	838.9	68.0	2,814.6	14.5	306.4	2,191.0
NEF	WEC FFF	1,615.1	692.2	64.4	2,371.6	14.1	314.8	2,192.6
NEF	AREVA FFF	2,911.3	485.4	81.8	3,478.4	7.6	341.9	2,323.2
Rail Routes								
Portsmouth GDP/ACP	GNF FFF	733.3	349.9	25.7	1,109.1	17.5	367.1	2,013.5
Portsmouth GDP/ACP	WEC FFF	657.8	280.5	18.5	957.1	17.6	340.3	2,020.3
Portsmouth GDP/ACP	AREVA FFF	3,204.1	558.6	127.6	3,890.2	7.0	373.7	2,355.7
Portsmouth GDP/ACP	Paducah GDP	577.4	184.6	40.3	802.1	14.9	381.3	2,466.4
Portsmouth GDP/ACP	NEF	1,968.1	603.9	112.8	2,684.7	11.6	419.0	2,286.8
Paducah GDP	GNF FFF	899.6	505.6	62.0	1,467.2	14.9	403.9	2,101.7
Paducah GDP	WEC FFF	694.7	447.5	62.3	1,204.6	15.4	408.1	2,113.3
Paducah GDP	AREVA FFF	3,205.7	450.1	67.3	3,723.2	6.1	356.9	2,203.4
Paducah GDP	NEF	1,467.7	386.8	60.5	1,914.9	9.4	435.1	2,200.6
NEF	GNF FFF	2,169.6	808.4	122.6	3,100.5	11.2	413.8	2,225.7
NEF	WEC FFF	1,920.9	790.9	108.9	2,820.2	12.5	419.7	2,201.2
NEF	AREVA FFF	2,932.1	620.8	180.2	3,733.2	7.8	376.9	2,567.8
Barge Routes								
Portsmouth GDP	Port of New Orleans	2,081.9	119.0	21.4	2,222.4	5.1	296.4	2,566.6
Paducah GDP	Port of New Orleans	1,313.7	25.9	7.9	1,347.5	2.7	254.0	2,873.4

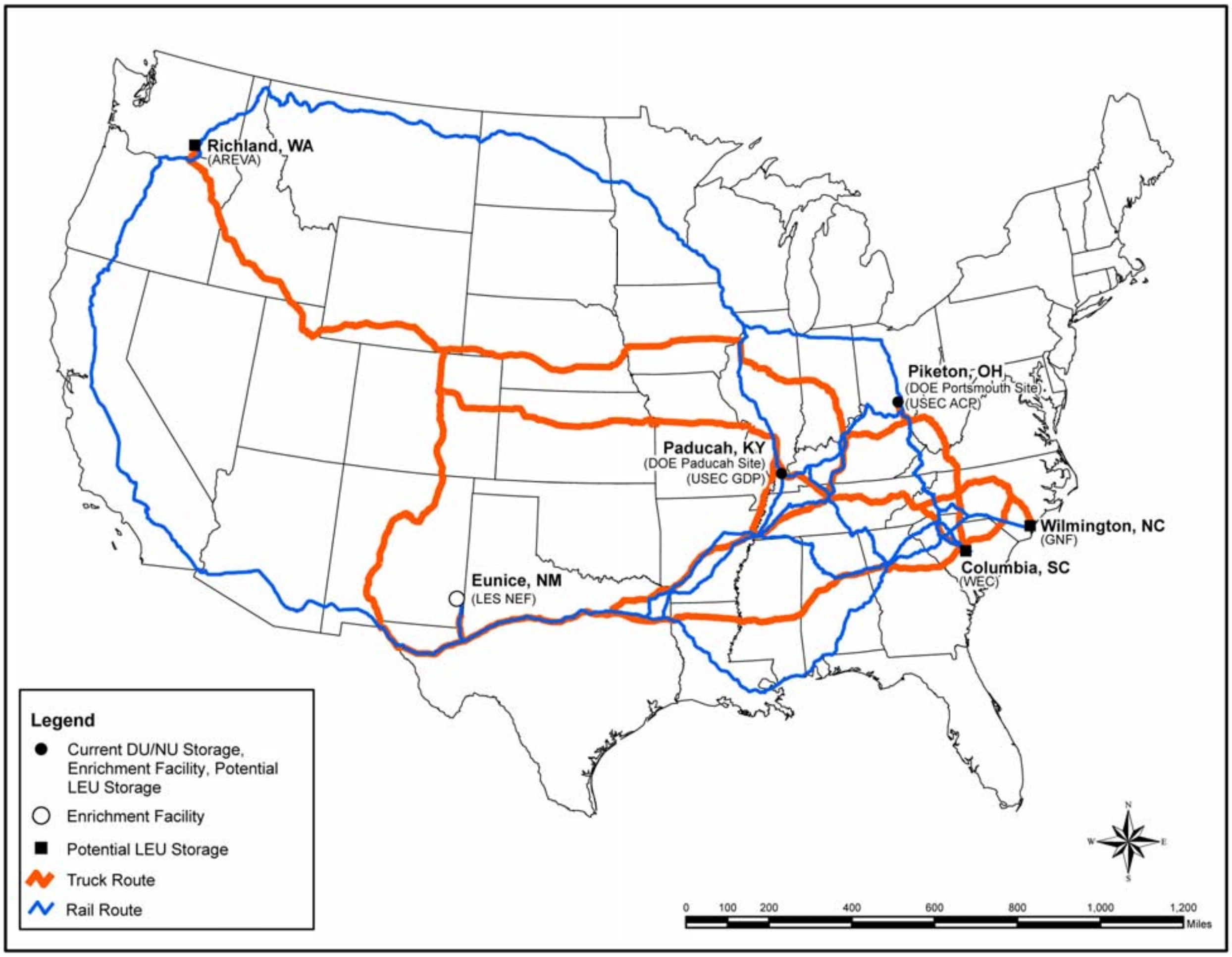

Figure 4-1. Rail and Truck Routes

The total impacts of transportation are the sum of the radiological and nonradiological incident-free and accident impacts. For incident-free transportation, the impacts are (1) the radiological impacts from exposure to low levels of radiation from the UF_6 cylinders, and (2) the nonradiological impacts from truck or train exhaust (vehicle emissions). For accidents, the impacts are (1) the radiological risks associated with the UF_6 being shipped, and (2) nonradiological traffic fatalities. The toxicological accident risks associated with the UF_6 being shipped were not included with the estimate of accident risk because these risks were previously shown to be small relative to radiological accident risks and nonradiological traffic fatalities (Biwer et al. 2001).

Cancer is the principal potential risk to human health from exposure to low or chronic levels of radiation. Radiological health impacts are expressed as the incremental changes in the number of expected fatal cancers (referred to as latent cancer fatalities, or LCFs) for populations and as the incremental increases in lifetime probabilities of contracting a fatal cancer for an individual. The estimates are based on the dose received and on dose-to-health-effect conversion factors recommended by the Interagency Steering Committee on Radiation Standards (Lawrence 2002). The steering committee consists of eight federal agencies (the EPA, NRC, DOE, Department of

Defense, Department of Homeland Security, DOT, Occupational Safety and Health Administration, and Department of Health and Human Services), three federal observer agencies (the Office of Science and Technology Policy, Office of Management and Budget, and Defense Nuclear Facilities Safety Board), and two state observer agencies (Illinois and Pennsylvania). The steering committee estimated that for the general population and workers, a collective dose of 1 person-rem would yield 6×10^{-4} excess LCFs.

Table 4-5 summarizes the characteristics of cylinders commonly used to ship UF_6, and Table 4-6 presents the number of cylinders that would be shipped under the Proposed Action. More information on these cylinders may be found in *The* UF_6 *Manual, Good Handling Practices for Uranium Hexafluoride* (USEC 2006).

The number of cylinders of NU feed, DU feed, and 1,100 MTU of LEU feed represent the actual number of cylinders in DOE's inventory. DU tails are typically stored in 48Y or 48G cylinders. The 48G cylinder is slightly smaller than the 48Y cylinder. Therefore, the number of DU tails cylinders was estimated using the 48G cylinder. An additional 900 MTU of LEU feed was also analyzed. This additional 900 MTU of LEU feed was assumed to have an enrichment of 1.7 percent. LEU with enrichment greater than 1.0 percent but less than 4.5 percent is typically shipped in 48X or 48Y cylinders. The 48X cylinder is slightly smaller than the 48Y cylinder. Therefore, the number of LEU feed cylinders was estimated using the 48X cylinder. NU is typically shipped in 48X or 48Y cylinders. The 48X cylinder is slightly smaller than the 48Y cylinder. Therefore, the number of NU product cylinders was estimated using the 48X cylinder. LEU enriched to 4.95 percent is typically shipped in 30B cylinders. Therefore, the 30B cylinder was used to estimate the number of LEU product cylinders.

To estimate the radiological impacts associated with transportation, the 48X, 48Y, and 48G cylinders were modeled as if they were 48Y cylinders. A 48Y cylinder is the longest of the cylinders commonly used to ship NU or DU, which tends to increase incident-free impacts, and is also the largest of the cylinders commonly used to ship NU and DU, which tends to increase radiological accident impacts.

The radionuclide content of UF_6 is due to the naturally occurring isotopes of uranium (^{234}U, ^{235}U, and ^{238}U) and their short-lived radioactive progeny. Table 4-7 lists the radionuclide inventories of ^{234}U, ^{235}U, and ^{238}U contained in the cylinders.

The numbers of cylinders that would be necessary to ship and store the feed, product, and tails are listed in Table 4-6. For 48X, 48Y, or 48G cylinders, one cylinder was assumed to be shipped on a truck. For 30B cylinders, three cylinders were assumed to be shipped on a truck. For rail shipments, four 48X, 48Y, or 48G cylinders or twelve 30B cylinders were assumed to be shipped on a railcar. For barge shipments, sixty-five 48X, 48Y, 48G, or 30B cylinders were assumed to be shipped on a barge based on the number of cylinders shipped in the barge illustrated in Figure 46 in USEC 2006.

Table 4-5. Characteristics of Uranium Cylinders

Parameter	48X Cylinder	48Y Cylinder	48G Cylinder	30B Cylinder
Material	Steel	Steel	Steel	Steel
Nominal length (inches)	119	150	146	81
Nominal diameter (inches)	48	48	48	30
Wall thickness (inches)	0.625	0.625	0.3125	0.5
Volume (ft^3)	108.9	142.7	139.0	26.0
Weight limit (MT UF$_6$)	9.539	12.501	12.174	2.277
Weight limit (MTU)	6.45	8.45	8.23	1.54
Maximum enrichment (weight percent ^{235}U)	4.5	4.5	1.0	5.0

Source: USEC 2006.

Table 4-6. Number of Cylinders and Truck, Rail, and Barge Shipments under the Proposed Action

Material	Number of Cylinders	Truck Shipments	Rail Shipments	Barge Shipments
NU feed	2,270	2,270	568	36
DU feed	10,776	10,776	2,695	167
LEU feed	296	296	75	7
LEU product	3,195	1,065	267	17
DU tails[a]	10,931	10,931	2,733	169
NU product	3,445	3,445	862	53
DU tails[b]	6,450	6,450	1,613	100

a DU tails from enrichment of NU feed, DU feed, and LEU feed to LEU product.

b. DU tails from enrichment of DU feed to NU product.

Table 4-7. Radionuclide Inventory of Uranium Cylinders

Material	^{234}U Inventory (Ci)	^{235}U Inventory (Ci)	^{238}U Inventory (Ci)
NU feed or product[a]	2.8	0.13	2.8
DU feed[b]	1.1	0.064	2.8
LEU feed[c]	7.4	0.31	2.8
LEU product[d]	4.4	0.16	0.49
DU tails[e]	0.50	0.037	2.8

a. NU feed or product assumed to be 0.711 weight percent ^{235}U.

b. DU feed has a range of enrichments from 0.35 to less than 0.711 weight percent ^{235}U. In this analysis, the DU feed enrichment was assumed to be 0.35 weight percent ^{235}U, which maximizes the amount of DU tails.

c. LEU feed assumed to be 1.7 weight percent ^{235}U.

d. LEU product assumed to be 4.95 weight percent ^{235}U.

e. DU tails assumed to be 0.20 weight percent ^{235}U.

4.2.1.1 Impacts from Truck Shipments

For truck shipments of UF_6, radiation doses were evaluated for workers and members of the public. Workers included the drivers of the trucks carrying the UF_6, workers involved in loading and unloading the UF_6 cylinders, and workers who inspected UF_6 shipments. For members of the public, radiation doses were estimated for people along the route, people sharing the route (in traffic), and people at stops. The number of health effects from vehicle emissions, the number of traffic fatalities, and the radiological accident risks were also estimated. The radiological and toxicological impacts of severe transportation accidents are discussed in Section 4.2.1.5.

Transportation impacts were estimated for enrichment of NU, DU, and LEU feed to LEU product, for enrichment of DU feed to NU product, and for enrichment of DU feed to NU product followed by subsequent enrichment of NU product to LEU product. Transportation impacts also include transportation of LEU product to FFFs. Impacts are presented for enriching the entire surplus DOE inventory, and for enriching the equivalent of 2,000 MTU of NU and enriching the equivalent of 4,000 MTU of NU in a given year.

The impacts from truck shipments of UF_6 are listed in Tables 4-8a, 4-8b, and 4-8c. Impacts are quantified in terms of total fatalities, which are the sum of radiation-related LCFs, vehicle emission health effects, and traffic fatalities. For enrichment of NU, DU, and LEU feed to LEU product, the estimated number of total fatalities ranged from 0.22 to 2.5, depending on where the enrichment of the NU, DU, and LEU feed occurred and where the LEU product and DU tails were shipped. The estimated number of fatalities from enriching the equivalent of 2,000 MTU of NU in a given year ranged from 0.0087 to 0.092, and the estimated number of fatalities from enriching the equivalent of 4,000 MTU of NU in a given year ranged from 0.018 to 0.21. For perspective, over the period 2002 to 2006, about 43,000 people were killed each year in motor vehicle accidents in the United States (DOT 2007).

For enrichment of DU feed to NU product, the estimated number of total fatalities ranged from 0.18 to 1.9, depending on where the enrichment of the DU feed occurred and where the NU product and DU tails were shipped. The estimated number of fatalities from enriching the equivalent of 2,000 MTU of NU in a given year ranged from 0.016 to 0.18, and the estimated number of fatalities from enriching the equivalent of 4,000 MTU of NU in a given year ranged from 0.030 to 0.32.

For enrichment of DU feed to NU product followed by subsequent enrichment of NU product to LEU product, enrichment at more than one enrichment facility could occur. The estimated number of total fatalities ranged from 0.19 to 2.7, depending on where the enrichment of the DU feed to NU product occurred, where the enrichment of the NU product to LEU product occurred, where DU tails were shipped, and where the LEU product was shipped. The estimated number of fatalities from enriching the equivalent of 2,000 MTU of NU in a given year ranged from 0.017 to 0.25, and the estimated number of fatalities from enriching the equivalent of 4,000 MTU of NU in a given year ranged from 0.031 to 0.45.

Table 4-8a. Total Transportation Impacts from Truck Shipments of Uranium Hexafluoride under the Proposed Action

Case	Public (LCFs)	Worker (LCFs)	Vehicle Emission Health Effects (LCFs)	Radiological Accident Risk (LCFs)	Traffic Fatalities	Total Fatalities
Enrichment to LEU at the Paducah GDP						
NU, DU, LEU feed	1.7×10^{-2}	8.3×10^{-2}	2.3×10^{-2}	8.7×10^{-2}	9.9×10^{-2}	3.1×10^{-1}
LEU product (on-site storage)	--	5.2×10^{-3}	--	--	--	5.2×10^{-3}
LEU product if shipped to FFFs[a]	4.0×10^{-3} to 1.0×10^{-2}	1.2×10^{-2} to 2.5×10^{-2}	3.7×10^{-3} to 7.5×10^{-3}	4.9×10^{-2} to 1.2×10^{-1}	1.4×10^{-2} to 5.2×10^{-2}	8.3×10^{-2} to 2.1×10^{-1}
Total	1.7×10^{-2} to 2.7×10^{-2}	8.9×10^{-2} to 1.1×10^{-1}	2.3×10^{-2} to 3.0×10^{-2}	8.7×10^{-2} to 2.1×10^{-1}	9.9×10^{-2} to 1.5×10^{-1}	3.1×10^{-1} to 5.2×10^{-1}
Enrichment of DU to NU at the Paducah GDP						
DU feed	1.3×10^{-2}	6.7×10^{-2}	1.8×10^{-2}	6.3×10^{-2}	7.9×10^{-2}	2.4×10^{-1}
NU product (on-site storage)	--	8.0×10^{-3}	--	--	--	8.0×10^{-3}
Total	1.3×10^{-2}	7.5×10^{-2}	1.8×10^{-2}	6.3×10^{-2}	7.9×10^{-2}	2.5×10^{-1}
Enrichment to LEU at the ACP (Portsmouth)						
NU, DU, LEU feed	1.1×10^{-2}	6.5×10^{-2}	1.5×10^{-2}	5.7×10^{-2}	6.5×10^{-2}	2.1×10^{-1}
LEU product (on-site storage)	--	5.2×10^{-3}	--	--	--	5.2×10^{-3}
LEU product if shipped to FFFs[a]	3.4×10^{-3} to 1.2×10^{-2}	1.3×10^{-2} to 2.8×10^{-2}	4.2×10^{-3} to 8.3×10^{-3}	6.3×10^{-2} to 1.2×10^{-1}	1.1×10^{-2} to 5.9×10^{-2}	9.4×10^{-2} to 2.3×10^{-1}
Total	1.1×10^{-2} to 2.3×10^{-2}	7.1×10^{-2} to 9.3×10^{-2}	1.5×10^{-2} to 2.3×10^{-2}	5.7×10^{-2} to 1.8×10^{-1}	6.5×10^{-2} to 1.2×10^{-1}	2.2×10^{-1} to 4.4×10^{-1}
Enrichment of DU to NU at the ACP (Portsmouth)						
DU feed	9.0×10^{-3}	5.3×10^{-2}	1.2×10^{-2}	4.2×10^{-2}	5.3×10^{-2}	1.7×10^{-1}
NU product (on-site storage)	--	8.0×10^{-3}	--	--	--	8.0×10^{-3}
Total	9.0×10^{-3}	6.1×10^{-2}	1.2×10^{-2}	4.2×10^{-2}	5.3×10^{-2}	1.8×10^{-1}
Enrichment to LEU at the NEF						
NU, DU, LEU feed	6.6×10^{-2}	2.2×10^{-1}	9.3×10^{-2}	4.2×10^{-1}	4.1×10^{-1}	1.2
LEU product[a]	6.1×10^{-3} to 1.0×10^{-2}	1.6×10^{-2} to 2.4×10^{-2}	5.2×10^{-3} to 8.1×10^{-3}	8.0×10^{-2} to 1.4×10^{-1}	2.7×10^{-2} to 5.1×10^{-2}	1.4×10^{-1} to 2.3×10^{-1}
DU tails (to Portsmouth or Paducah)	4.0×10^{-2} to 6.3×10^{-2}	1.6×10^{-1} to 2.0×10^{-1}	5.3×10^{-2} to 9.1×10^{-2}	1.8×10^{-1} to 3.1×10^{-1}	2.8×10^{-1} to 3.7×10^{-1}	7.1×10^{-1} to 1.0
Total	1.1×10^{-1} to 1.4×10^{-1}	3.9×10^{-1} to 4.4×10^{-1}	1.5×10^{-1} to 1.9×10^{-1}	6.7×10^{-1} to 8.7×10^{-1}	7.2×10^{-1} to 8.3×10^{-1}	2.0 to 2.5
Enrichment to NU at the NEF						
DU feed	5.3×10^{-2}	1.8×10^{-1}	7.5×10^{-2}	3.0×10^{-1}	3.3×10^{-1}	9.4×10^{-1}
NU product[a]	1.3×10^{-2} to 2.0×10^{-2}	4.9×10^{-2} to 6.2×10^{-2}	1.7×10^{-2} to 2.9×10^{-2}	9.6×10^{-2} to 1.7×10^{-1}	8.9×10^{-2} to 1.2×10^{-1}	2.6×10^{-1} to 4.0×10^{-1}
DU tails (to Portsmouth or Paducah)	2.4×10^{-2} to 3.7×10^{-2}	9.2×10^{-2} to 1.2×10^{-1}	3.2×10^{-2} to 5.4×10^{-2}	1.0×10^{-1} to 1.8×10^{-1}	1.7×10^{-1} to 2.2×10^{-1}	4.2×10^{-1} to 6.1×10^{-1}
Total	8.9×10^{-2} to 1.1×10^{-1}	3.2×10^{-1} to 3.5×10^{-1}	1.2×10^{-1} to 1.6×10^{-1}	5.0×10^{-1} to 6.5×10^{-1}	5.9×10^{-1} to 6.7×10^{-1}	1.6 to 1.9
Enrichment of DU to NU Followed By Subsequent Enrichment of NU to LEU						
Total	0.0090 to 0.15	0.072 to 0.49	0.012 to 0.21	0.042 to 0.96	0.053 to 0.89	0.19 to 2.7

a. Range in product results is due to shipping product to various off-site storage locations.

Table 4-8b. Transportation Impacts from Truck Shipments of 2,000 MTU of Uranium Hexafluoride in a Given Year under the Proposed Action

Case	Public (LCFs)	Worker (LCFs)	Vehicle Emission Health Effects (LCFs)	Radiological Accident Risk (LCFs)	Traffic Fatalities	Total Fatalities
Enrichment to LEU at the Paducah GDP						
NU, DU, LEU feed	6.7×10^{-4}	3.3×10^{-3}	9.0×10^{-4}	3.5×10^{-3}	3.9×10^{-3}	1.2×10^{-2}
LEU product (on-site storage)	--	2.1×10^{-4}	--	--	--	2.1×10^{-4}
LEU product if shipped to FFFs[a]	1.6×10^{-4} to 4.1×10^{-4}	4.8×10^{-4} to 9.9×10^{-4}	1.5×10^{-4} to 3.0×10^{-4}	2.0×10^{-3} to 4.7×10^{-3}	5.7×10^{-4} to 2.1×10^{-3}	3.3×10^{-3} to 8.5×10^{-3}
Total	6.7×10^{-4} to 1.1×10^{-3}	3.5×10^{-3} to 4.3×10^{-3}	9.0×10^{-4} to 1.2×10^{-3}	3.5×10^{-3} to 8.2×10^{-3}	3.9×10^{-3} to 6.0×10^{-3}	1.3×10^{-2} to 2.1×10^{-2}
Enrichment of DU to NU at the Paducah GDP						
DU feed	1.2×10^{-3}	6.1×10^{-3}	1.6×10^{-3}	5.7×10^{-3}	7.2×10^{-3}	2.2×10^{-2}
NU product (on-site storage)	--	7.3×10^{-4}	--	--	--	7.3×10^{-4}
Total	1.2×10^{-3}	6.8×10^{-3}	1.6×10^{-3}	5.7×10^{-3}	7.2×10^{-3}	2.3×10^{-2}
Enrichment to LEU at the ACP (Portsmouth)						
NU, DU, LEU feed	4.4×10^{-4}	2.6×10^{-3}	5.9×10^{-4}	2.3×10^{-3}	2.6×10^{-3}	8.5×10^{-3}
LEU product (on-site storage)	--	2.1×10^{-4}	--	--	--	2.1×10^{-4}
LEU product if shipped to FFFs[a]	1.4×10^{-4} to 4.9×10^{-4}	5.1×10^{-4} to 1.1×10^{-3}	1.7×10^{-4} to 3.3×10^{-4}	2.5×10^{-3} to 4.9×10^{-3}	4.6×10^{-4} to 2.4×10^{-3}	3.8×10^{-3} to 9.2×10^{-3}
Total	4.4×10^{-4} to 9.3×10^{-4}	2.8×10^{-3} to 3.7×10^{-3}	5.9×10^{-4} to 9.2×10^{-4}	2.3×10^{-3} to 7.2×10^{-3}	2.6×10^{-3} to 5.0×10^{-3}	8.7×10^{-3} to 1.8×10^{-2}
Enrichment of DU to NU at the ACP (Portsmouth)						
DU feed	8.2×10^{-4}	4.8×10^{-3}	1.1×10^{-3}	3.8×10^{-3}	4.8×10^{-3}	1.5×10^{-2}
NU product (on-site storage)	--	7.3×10^{-4}	--	--	--	7.3×10^{-4}
Total	8.2×10^{-4}	5.6×10^{-3}	1.1×10^{-3}	3.8×10^{-3}	4.8×10^{-3}	1.6×10^{-2}
Enrichment to LEU at the NEF						
NU, DU, LEU feed	2.6×10^{-3}	8.8×10^{-3}	3.7×10^{-3}	1.7×10^{-2}	1.6×10^{-2}	4.8×10^{-2}
LEU product[a]	2.5×10^{-4} to 4.1×10^{-4}	6.5×10^{-4} to 9.5×10^{-4}	2.1×10^{-4} to 3.2×10^{-4}	3.2×10^{-3} to 5.6×10^{-3}	1.1×10^{-3} to 2.0×10^{-3}	5.4×10^{-3} to 9.3×10^{-3}
DU tails (to Portsmouth or Paducah)	1.6×10^{-3} to 2.5×10^{-3}	6.2×10^{-3} to 7.8×10^{-3}	2.1×10^{-3} to 3.7×10^{-3}	7.0×10^{-3} to 1.2×10^{-2}	1.1×10^{-2} to 1.5×10^{-2}	2.8×10^{-2} to 4.1×10^{-2}
Total	4.5×10^{-3} to 5.6×10^{-3}	1.6×10^{-2} to 1.8×10^{-2}	6.1×10^{-3} to 7.7×10^{-3}	2.7×10^{-2} to 3.5×10^{-2}	2.9×10^{-2} to 3.3×10^{-2}	8.2×10^{-2} to 9.9×10^{-2}
Enrichment of DU to NU at the NEF						
DU feed	4.8×10^{-3}	1.6×10^{-2}	6.8×10^{-3}	2.7×10^{-2}	3.0×10^{-2}	8.5×10^{-2}
NU product[a]	1.2×10^{-3} to 1.8×10^{-3}	4.5×10^{-3} to 5.6×10^{-3}	1.5×10^{-3} to 2.6×10^{-3}	8.8×10^{-3} to 1.5×10^{-2}	8.1×10^{-3} to 1.1×10^{-2}	2.4×10^{-2} to 3.6×10^{-2}
DU tails (to Portsmouth or Paducah)	2.2×10^{-3} to 3.4×10^{-3}	8.4×10^{-3} to 1.1×10^{-2}	2.9×10^{-3} to 4.9×10^{-3}	9.4×10^{-3} to 1.7×10^{-2}	1.5×10^{-2} to 2.0×10^{-2}	3.8×10^{-2} to 5.5×10^{-2}
Total	8.1×10^{-3} to 1.0×10^{-2}	2.9×10^{-2} to 3.2×10^{-2}	1.1×10^{-2} to 1.4×10^{-2}	4.6×10^{-2} to 6.0×10^{-2}	5.3×10^{-2} to 6.1×10^{-2}	1.5×10^{-1} to 1.8×10^{-1}
Enrichment of DU to NU Followed By Subsequent Enrichment of NU to LEU						
Total	8.2×10^{-4} to 1.4×10^{-2}	6.5×10^{-3} to 4.4×10^{-2}	1.1×10^{-3} to 1.9×10^{-2}	3.8×10^{-3} to 8.7×10^{-2}	4.8×10^{-3} to 8.1×10^{-2}	1.7×10^{-2} to 2.5×10^{-1}

[a] Range in product results is due to shipping product to various off-site storage locations.

Table 4-8c. Transportation Impacts from Truck Shipments of 4,000 MTU of Uranium Hexafluoride in a Given Year under the Proposed Action

Case	Public (LCFs)	Worker (LCFs)	Vehicle Emission Health Effects (LCFs)	Radiological Accident Risk (LCFs)	Traffic Fatalities	Total Fatalities
Enrichment to LEU at the Paducah GDP						
NU, DU, LEU feed	1.4×10^{-3}	6.9×10^{-3}	1.9×10^{-3}	7.3×10^{-3}	8.2×10^{-3}	2.6×10^{-2}
LEU product (on-site storage)	--	4.4×10^{-4}	--	--	--	4.4×10^{-4}
LEU product if shipped to FFFs[a]	3.3×10^{-4} to 8.6×10^{-4}	9.9×10^{-4} to 2.1×10^{-3}	3.1×10^{-4} to 6.2×10^{-4}	4.1×10^{-3} to 9.9×10^{-3}	1.2×10^{-3} to 4.3×10^{-3}	6.9×10^{-3} to 1.8×10^{-2}
Total	1.4×10^{-3} to 2.3×10^{-3}	7.4×10^{-3} to 9.0×10^{-3}	1.9×10^{-3} to 2.5×10^{-3}	7.3×10^{-3} to 1.7×10^{-2}	8.2×10^{-3} to 1.3×10^{-2}	2.6×10^{-2} to 4.3×10^{-2}
Enrichment of DU to NU at the Paducah GDP						
DU feed	2.2×10^{-3}	1.1×10^{-2}	3.0×10^{-3}	1.0×10^{-2}	1.3×10^{-2}	4.0×10^{-2}
NU product (on-site storage)	--	1.3×10^{-3}	--	--	--	1.3×10^{-3}
Total	2.2×10^{-3}	1.2×10^{-2}	3.0×10^{-3}	1.0×10^{-2}	1.3×10^{-2}	4.1×10^{-2}
Enrichment to LEU at the ACP (Portsmouth)						
NU, DU, LEU feed	9.1×10^{-4}	5.4×10^{-3}	1.2×10^{-3}	4.8×10^{-3}	5.4×10^{-3}	1.8×10^{-2}
LEU product (on-site storage)	--	4.4×10^{-4}	--	--	--	4.4×10^{-4}
LEU product if shipped to FFFs[a]	2.8×10^{-4} to 1.0×10^{-3}	1.1×10^{-3} to 2.3×10^{-3}	3.5×10^{-4} to 6.9×10^{-4}	5.2×10^{-3} to 1.0×10^{-2}	9.6×10^{-4} to 4.9×10^{-3}	7.9×10^{-3} to 1.9×10^{-2}
Total	9.1×10^{-4} to 1.9×10^{-3}	5.9×10^{-3} to 7.7×10^{-3}	1.2×10^{-3} to 1.9×10^{-3}	4.8×10^{-3} to 1.5×10^{-2}	5.4×10^{-3} to 1.0×10^{-2}	1.8×10^{-2} to 3.7×10^{-2}
Enrichment of DU to NU at the ACP (Portsmouth)						
DU feed	1.5×10^{-3}	8.9×10^{-3}	2.0×10^{-3}	7.0×10^{-3}	8.8×10^{-3}	2.8×10^{-2}
NU product (on-site storage)	--	1.3×10^{-3}	--	--	--	1.3×10^{-3}
Total	1.5×10^{-3}	1.0×10^{-2}	2.0×10^{-3}	7.0×10^{-3}	8.8×10^{-3}	3.0×10^{-2}
Enrichment to LEU at the NEF						
NU, DU, LEU feed	5.5×10^{-3}	1.8×10^{-2}	7.8×10^{-3}	3.5×10^{-2}	3.4×10^{-2}	$1.0 \times 10^{-}1$
LEU product[a]	5.1×10^{-4} to 8.6×10^{-4}	1.4×10^{-3} to 2.0×10^{-3}	4.3×10^{-4} to 6.7×10^{-4}	6.7×10^{-3} to 1.2×10^{-2}	2.3×10^{-3} to 4.3×10^{-3}	1.1×10^{-2} to 1.9×10^{-2}
DU tails (to Portsmouth or Paducah)	3.3×10^{-3} to 5.2×10^{-3}	1.3×10^{-2} to 1.6×10^{-2}	4.5×10^{-3} to 7.6×10^{-3}	1.5×10^{-2} to 2.6×10^{-2}	2.3×10^{-2} to 3.1×10^{-2}	5.9×10^{-2} to 8.6×10^{-2}
Total	9.3×10^{-3} to 1.2×10^{-2}	3.3×10^{-2} to 3.7×10^{-2}	1.3×10^{-2} to 1.6×10^{-2}	5.6×10^{-2} to 7.2×10^{-2}	6.0×10^{-2} to 7.0×10^{-2}	1.7×10^{-1} to 2.1×10^{-1}
Enrichment of DU to NU at the NEF						
DU feed	8.8×10^{-3}	3.0×10^{-2}	1.3×10^{-2}	5.0×10^{-2}	5.5×10^{-2}	1.6×10^{-1}
NU product[a]	2.1×10^{-3} to 3.3×10^{-3}	8.2×10^{-3} to 1.0×10^{-2}	2.8×10^{-3} to 4.8×10^{-3}	1.6×10^{-2} to 2.8×10^{-2}	1.5×10^{-2} to 2.0×10^{-2}	4.4×10^{-2} to 6.6×10^{-2}
DU tails (to Portsmouth or Paducah)	4.0×10^{-3} to 6.2×10^{-3}	1.5×10^{-2} to 1.9×10^{-2}	5.3×10^{-3} to 9.0×10^{-3}	1.7×10^{-2} to 3.0×10^{-2}	2.8×10^{-2} to 3.7×10^{-2}	7.0×10^{-2} to 1.0×10^{-1}
Total	1.5×10^{-2} to 1.8×10^{-2}	5.3×10^{-2} to 5.9×10^{-2}	2.1×10^{-2} to 2.6×10^{-2}	8.4×10^{-2} to 1.1×10^{-1}	9.8×10^{-2} to 1.1×10^{-1}	2.7×10^{-1} to 3.2×10^{-1}
Enrichment of DU to NU Followed By Subsequent Enrichment of NU to LEU						
Total	1.5×10^{-3} to 2.5×10^{-2}	1.2×10^{-2} to 8.1×10^{-2}	2.0×10^{-3} to 3.5×10^{-2}	7.0×10^{-3} to 1.6×10^{-1}	8.8×10^{-3} to 1.5×10^{-1}	3.1×10^{-2} to 4.5×10^{-1}

a. Range in product results is due to shipping product to various off-site storage locations.

For enrichment at the Paducah GDP or the ACP, transportation impacts would be lower if the NU, DU, or LEU feed were obtained on-site and the NU or LEU product were stored on-site, and the only impacts would be for workers who loaded and unloaded cylinders for on-site movements. In addition, DU tails and NU product would not be shipped, resulting in lower transportation impacts.

For enrichment at the NEF, transportation impacts would be slightly higher because the NU, DU, or LEU feed would be shipped from DOE Paducah or DOE Portsmouth to Eunice, New Mexico, and the DU tails would be dispositioned by the enrichment facility or potentially shipped back to DOE Paducah or DOE Portsmouth. In addition, NU product could be shipped back to Paducah or Portsmouth, resulting in higher transportation impacts.

Table 4-9 lists the impacts for the MEI along the transportation route. This individual was assumed to be located 30 meters (100 feet) from the route and to be exposed to all shipments of UF_6 (i.e., NU feed, NU product, DU feed, DU tails, LEU feed, and LEU product). The shipments were assumed to travel at a speed of 24 kilometers (15 miles) per hour, which is representative of speeds in urban areas. The probability of an LCF for the MEI along the transportation route was estimated to range from 8.3×10^{-8} to 5.3×10^{-7}.

Table 4-9. Maximum Individual Impacts from Truck Shipments[a]

Case	Mode	LCFs
Enrichment to LEU at Paducah GDP	Truck	1.9×10^{-7}
Enrichment of DU to NU at Paducah GDP	Truck	1.2×10^{-7}
Enrichment to LEU at Portsmouth ACP	Truck	1.3×10^{-7}
Enrichment of DU to NU at Portsmouth ACP	Truck	8.3×10^{-8}
Enrichment to LEU at NEF	Truck	5.0×10^{-7}
Enrichment of DU to NU at NEF	Truck	4.0×10^{-7}
Enrichment of DU to NU followed by subsequent enrichment of NU to LEU	Truck	9.9×10^{-8} to 5.3×10^{-7}

a. Impacts are based on a person located 30 meters from the highway. The person was assumed to be exposed to all shipments of UF_6. The shipments were assumed to travel at a speed of 24 kilometers per hour.

4.2.1.2 Impacts from Rail Shipments

Rail shipments were assumed to be made using general freight; dedicated trains have not historically been used for UF_6 shipments. For rail shipments of UF_6, radiation doses were estimated for workers and members of the public. Workers included workers involved with the classification of railcars at stops and workers involved in loading and unloading the UF_6 cylinders. For members of the public, radiation doses were estimated for people along the route and people sharing the route (in other trains). The number of health effects from vehicle emissions, the number of traffic fatalities, and the radiological accident risks were also estimated. The radiological and toxicological impacts of severe transportation accidents are discussed in Section 4.2.1.5.

Transportation impacts were estimated for enrichment of NU, DU, and LEU feed to LEU product, for enrichment of DU feed to NU product, and for enrichment of DU feed to NU product followed by subsequent enrichment of NU product to LEU product. Transportation impacts also include the transportation of LEU product to FFFs. Impacts are presented for enriching the entire surplus DOE inventory, and for enriching the equivalent of 2,000 MTU of NU and enriching the equivalent of 4,000 MTU of NU in a given year.

The impacts from rail shipments of UF_6 are listed in Tables 4-10a, 4-10b, and 4-10c. Impacts are quantified in terms of total fatalities, which are the sum of radiation-related LCFs, vehicle emission health effects, and traffic fatalities. For enrichment of NU, DU, and LEU feed to LEU product, the estimated number of total fatalities ranged from 0.20 to 2.4, depending on where the enrichment of the NU, DU, and LEU feed occurred and where the LEU product and DU tails were shipped. The estimated number of fatalities from enriching the equivalent of 2,000 MTU of NU in a given year ranged from 0.0080 to 0.096, and the estimated number of fatalities from enriching the equivalent of 4,000 MTU of NU in a given year ranged from 0.017 to 0.20. For perspective, over the period 2002 to 2006, about 900 people were killed each year in railroad accidents and incidents in the United States (DOT 2007).

For enrichment of DU feed to NU product, the estimated number of total fatalities ranged from 0.16 to 1.8, depending on where the enrichment of the DU feed occurred and where the NU product and DU tails were shipped. The estimated number of fatalities from enriching the equivalent of 2,000 MTU of NU in a given year ranged from 0.015 to 0.17, and the estimated number of fatalities from enriching the equivalent of 4,000 MTU of NU in a given year ranged from 0.027 to 0.30.

For enrichment of DU feed to NU product followed by subsequent enrichment of NU product to LEU product, enrichment at more than one enrichment facility could occur. The estimated number of total fatalities ranged from 0.17 to 2.6, depending on where the enrichment of the DU feed to NU product occurred, where the enrichment of the NU product to LEU product occurred, where DU tails were shipped, and where the LEU product was shipped. The estimated number of fatalities from enriching the equivalent of 2,000 MTU of NU in a given year ranged from 0.016 to 0.23, and the estimated number of fatalities from enriching the equivalent of 4,000 MTU of NU in a given year ranged from 0.029 to 0.43.

For enrichment at the Paducah GDP or the ACP, transportation impacts were lower if the NU, DU, or LEU feed were obtained on-site and the NU or LEU product were stored on-site, and the only impacts were for workers who loaded and unloaded cylinders for on-site movements. In addition, DU tails and NU product would not be shipped, resulting in lower transportation impacts.

For enrichment at the NEF, transportation impacts were slightly higher because the NU, DU, or LEU feed would be shipped from DOE Paducah or DOE Portsmouth to Eunice, New Mexico, and the DU tails would be dispositioned by the enrichment facility or shipped back to DOE Paducah or DOE Portsmouth. In addition, NU product could be shipped back to Paducah or Portsmouth, resulting in higher transportation impacts.

Table 4-10a. Total Transportation Impacts from Rail Shipments of Uranium Hexafluoride under the Proposed Action

Case	Public (LCFs)	Worker (LCFs)	Vehicle Emission Health Effects (LCFs)	Radiological Accident Risk (LCFs)	Traffic Fatalities	Total Fatalities
Enrichment to LEU at the Paducah GDP						
NU, DU, LEU feed	2.1×10^{-3}	3.5×10^{-2}	1.3×10^{-2}	1.1×10^{-1}	1.3×10^{-1}	2.8×10^{-1}
LEU product (on-site storage)	--	5.3×10^{-3}	--	--	--	5.3×10^{-3}
LEU product if shipped to FFFs[a]	1.2×10^{-3} to 1.1×10^{-3}	6.1×10^{-3} to 7.1×10^{-3}	3.0×10^{-3} to 3.1×10^{-3}	7.7×10^{-2} to 8.2×10^{-2}	2.5×10^{-2} to 7.8×10^{-2}	1.1×10^{-1} to 1.7×10^{-1}
Total	2.1×10^{-3} to 3.2×10^{-3}	4.0×10^{-2} to 4.2×10^{-2}	1.3×10^{-2} to 1.6×10^{-2}	1.1×10^{-1} to 1.9×10^{-1}	1.3×10^{-1} to 2.0×10^{-1}	2.9×10^{-1} to 4.5×10^{-1}
Enrichment of DU to NU at the Paducah GDP						
DU feed	1.6×10^{-3}	2.8×10^{-2}	1.0×10^{-2}	7.6×10^{-2}	1.0×10^{-1}	2.2×10^{-1}
NU product (on-site storage)	--	8.0×10^{-3}	--	--	--	8.0×10^{-3}
Total	1.6×10^{-3}	3.6×10^{-2}	1.0×10^{-2}	7.6×10^{-2}	1.0×10^{-1}	2.2×10^{-1}
Enrichment to LEU at the ACP (Portsmouth)						
NU, DU, LEU feed	1.3×10^{-3}	3.4×10^{-2}	8.2×10^{-3}	7.0×10^{-2}	8.3×10^{-2}	2.0×10^{-1}
LEU product (on-site storage)	--	5.3×10^{-3}	--	--	--	5.3×10^{-3}
LEU product if shipped to FFFs[a]	6.5×10^{-4} to 1.5×10^{-3}	6.0×10^{-3} to 7.2×10^{-3}	1.3×10^{-3} to 4.9×10^{-3}	2.9×10^{-2} to 1.5×10^{-1}	2.0×10^{-2} to 8.1×10^{-2}	5.7×10^{-2} to 2.4×10^{-1}
Total	1.3×10^{-3} to 2.8×10^{-3}	3.9×10^{-2} to 4.1×10^{-2}	8.2×10^{-3} to 1.3×10^{-2}	7.0×10^{-2} to 2.2×10^{-1}	8.3×10^{-2} to 1.6×10^{-1}	2.0×10^{-1} to 4.4×10^{-1}
Enrichment of DU to NU at the ACP (Portsmouth)						
DU feed	1.1×10^{-3}	2.7×10^{-2}	6.7×10^{-3}	5.1×10^{-2}	6.8×10^{-2}	1.5×10^{-1}
NU product (on-site storage)	--	8.0×10^{-3}	--	--	--	8.0×10^{-3}
Total	1.1×10^{-3}	3.5×10^{-2}	6.7×10^{-3}	5.1×10^{-2}	6.8×10^{-2}	1.6×10^{-1}
Enrichment to LEU at the NEF						
NU, DU, LEU feed	1.0×10^{-2}	4.3×10^{-2}	5.2×10^{-2}	4.0×10^{-1}	6.2×10^{-1}	1.1
LEU product[a]	1.1×10^{-3} to 1.7×10^{-3}	6.4×10^{-3} to 7.1×10^{-3}	2.9×10^{-3} to 6.7×10^{-3}	7.7×10^{-2} to 2.2×10^{-1}	4.0×10^{-2} to 7.8×10^{-2}	1.3×10^{-1} to 3.1×10^{-1}
DU tails (to Portsmouth or Paducah)	6.3×10^{-3} to 9.6×10^{-3}	3.4×10^{-2} to 3.6×10^{-2}	3.0×10^{-2} to 5.1×10^{-2}	1.7×10^{-1} to 3.0×10^{-1}	4.1×10^{-1} to 5.7×10^{-1}	6.5×10^{-1} to 9.7×10^{-1}
Total	1.8×10^{-2} to 2.1×10^{-2}	8.4×10^{-2} to 8.7×10^{-2}	8.5×10^{-2} to 1.1×10^{-1}	6.4×10^{-1} to 9.2×10^{-1}	1.1 to 1.3	1.9 to 2.4
Enrichment of DU to NU at the NEF						
DU feed	8.2×10^{-3}	3.5×10^{-2}	4.2×10^{-2}	2.9×10^{-1}	5.0×10^{-1}	8.8×10^{-1}
NU product[a]	2.0×10^{-3} to 3.0×10^{-3}	1.1×10^{-2} to 1.1×10^{-2}	9.5×10^{-3} to 1.6×10^{-2}	9.1×10^{-2} to 1.6×10^{-1}	1.3×10^{-1} to 1.8×10^{-1}	2.4×10^{-1} to 3.8×10^{-1}
DU tails (to Portsmouth or Paducah)	3.7×10^{-3} to 5.7×10^{-3}	2.0×10^{-2} to 2.1×10^{-2}	1.8×10^{-2} to 3.0×10^{-2}	9.8×10^{-2} to 1.8×10^{-1}	2.4×10^{-1} to 3.4×10^{-1}	3.8×10^{-1} to 5.7×10^{-1}
Total	1.4×10^{-2} to 1.7×10^{-2}	6.6×10^{-2} to 6.8×10^{-2}	6.9×10^{-2} to 8.8×10^{-2}	4.8×10^{-1} to 6.3×10^{-1}	8.7×10^{-1} to 1.0	1.5 to 1.8
Enrichment of DU to NU Followed By Subsequent Enrichment of NU to LEU						
Total	0.0011 to 0.023	0.046 to 0.11	0.0067 to 0.12	0.051 to 0.97	0.068 to 1.4	0.17 to 2.6

a. Range in product results is due to shipping product to various off-site storage locations.

Table 4-10b. Transportation Impacts from Rail Shipments of 2,000 MTU of Uranium Hexafluoride in a Given Year under the Proposed Action

Case	Public (LCFs)	Worker (LCFs)	Vehicle Emission Health Effects (LCFs)	Radiological Accident Risk (LCFs)	Traffic Fatalities	Total Fatalities
Enrichment to LEU at the Paducah GDP						
NU, DU, LEU feed	8.2×10^{-5}	1.4×10^{-3}	5.0×10^{-4}	4.2×10^{-3}	5.1×10^{-3}	1.1×10^{-2}
LEU product (on-site storage)	--	2.1×10^{-4}	--	--	--	2.1×10^{-4}
LEU product if shipped to FFFs[a]	4.8×10^{-5} to 4.6×10^{-5}	2.5×10^{-4} to 2.8×10^{-4}	1.2×10^{-4} to 1.2×10^{-4}	3.1×10^{-3} to 3.3×10^{-3}	1.0×10^{-3} to 3.1×10^{-3}	4.5×10^{-3} to 6.8×10^{-3}
Total	8.2×10^{-5} to 1.3×10^{-4}	1.6×10^{-3} to 1.7×10^{-3}	5.0×10^{-4} to 6.2×10^{-4}	4.2×10^{-3} to 7.5×10^{-3}	5.1×10^{-3} to 8.2×10^{-3}	1.1×10^{-2} to 1.8×10^{-2}
Enrichment of DU to NU at the Paducah GDP						
DU feed	1.5×10^{-4}	2.6×10^{-3}	9.1×10^{-4}	6.9×10^{-3}	9.2×10^{-3}	2.0×10^{-2}
NU product (on-site storage)	--	7.3×10^{-4}	--	--	--	7.3×10^{-4}
Total	1.5×10^{-4}	3.3×10^{-3}	9.1×10^{-4}	6.9×10^{-3}	9.2×10^{-3}	2.0×10^{-2}
Enrichment to LEU at the ACP (Portsmouth)						
NU, DU, LEU feed	5.4×10^{-5}	1.3×10^{-3}	3.3×10^{-4}	2.8×10^{-3}	3.3×10^{-3}	7.8×10^{-3}
LEU product (on-site storage)	--	2.1×10^{-4}	--	--	--	2.1×10^{-4}
LEU product if shipped to FFFs[a]	2.6×10^{-5} to 6.0×10^{-5}	2.4×10^{-4} to 2.9×10^{-4}	5.4×10^{-5} to 2.0×10^{-4}	1.2×10^{-3} to 5.9×10^{-3}	8.0×10^{-4} to 3.2×10^{-3}	2.3×10^{-3} to 9.7×10^{-3}
Total	5.4×10^{-5} to 1.1×10^{-4}	1.6×10^{-3} to 1.6×10^{-3}	3.3×10^{-4} to 5.3×10^{-4}	2.8×10^{-3} to 8.7×10^{-3}	3.3×10^{-3} to 6.6×10^{-3}	8.0×10^{-3} to 1.8×10^{-2}
Enrichment of DU to NU at the ACP (Portsmouth)						
DU feed	1.0×10^{-4}	2.5×10^{-3}	6.1×10^{-4}	4.6×10^{-3}	6.2×10^{-3}	1.4×10^{-2}
NU product (on-site storage)	--	7.3×10^{-4}	--	--	--	7.3×10^{-4}
Total	1.0×10^{-4}	3.2×10^{-3}	6.1×10^{-4}	4.6×10^{-3}	6.2×10^{-3}	1.5×10^{-2}
Enrichment to LEU at the NEF						
NU, DU, LEU feed	4.1×10^{-4}	1.7×10^{-3}	2.1×10^{-3}	1.6×10^{-2}	2.5×10^{-2}	4.5×10^{-2}
LEU product[a]	4.6×10^{-5} to 6.8×10^{-5}	2.6×10^{-4} to 2.8×10^{-4}	1.2×10^{-4} to 2.7×10^{-4}	3.1×10^{-3} to 8.6×10^{-3}	1.6×10^{-3} to 3.1×10^{-3}	5.1×10^{-3} to 1.2×10^{-2}
DU tails (to Portsmouth or Paducah)	2.5×10^{-4} to 3.8×10^{-4}	1.4×10^{-3} to 1.5×10^{-3}	1.2×10^{-3} to 2.0×10^{-3}	6.6×10^{-3} to 1.2×10^{-2}	1.6×10^{-2} to 2.3×10^{-2}	2.6×10^{-2} to 3.9×10^{-2}
Total	7.0×10^{-4} to 8.6×10^{-4}	3.4×10^{-3} to 3.5×10^{-3}	3.4×10^{-3} to 4.4×10^{-3}	2.6×10^{-2} to 3.7×10^{-2}	4.3×10^{-2} to 5.1×10^{-2}	7.6×10^{-2} to 9.6×10^{-2}
Enrichment of DU to NU at the NEF						
DU feed	7.4×10^{-4}	3.2×10^{-3}	3.8×10^{-3}	2.6×10^{-2}	4.6×10^{-2}	8.0×10^{-2}
NU product[a]	1.8×10^{-4} to 2.8×10^{-4}	9.8×10^{-4} to 1.0×10^{-3}	8.6×10^{-4} to 1.5×10^{-3}	8.3×10^{-3} to 1.5×10^{-2}	1.2×10^{-2} to 1.6×10^{-2}	2.2×10^{-2} to 3.4×10^{-2}
DU tails (to Portsmouth or Paducah)	3.4×10^{-4} to 5.2×10^{-4}	1.8×10^{-3} to 1.9×10^{-3}	1.6×10^{-3} to 2.7×10^{-3}	8.9×10^{-3} to 1.6×10^{-2}	2.2×10^{-2} to 3.1×10^{-2}	3.5×10^{-2} to 5.2×10^{-2}
Total	1.3×10^{-3} to 1.5×10^{-3}	6.0×10^{-3} to 6.2×10^{-3}	6.3×10^{-3} to 8.0×10^{-3}	4.4×10^{-2} to 5.7×10^{-2}	7.9×10^{-2} to 9.3×10^{-2}	1.4×10^{-1} to 1.7×10^{-1}
Enrichment of DU to NU Followed By Subsequent Enrichment of NU to LEU						
Total	1.0×10^{-4} to 2.1×10^{-3}	4.2×10^{-3} to 9.7×10^{-3}	6.1×10^{-4} to 1.1×10^{-2}	4.6×10^{-3} to 8.8×10^{-2}	6.2×10^{-3} to 1.2×10^{-1}	1.6×10^{-2} to 2.3×10^{-1}

[a] Range in product results is due to shipping product to various off-site storage locations.

Table 4-10c. Transportation Impacts from Rail Shipments of 4,000 MTU of Uranium Hexafluoride in a Given Year under the Proposed Action

Case	Public (LCFs)	Worker (LCFs)	Vehicle Emission Health Effects (LCFs)	Radiological Accident Risk (LCFs)	Traffic Fatalities	Total Fatalities
Enrichment to LEU at the Paducah GDP						
NU, DU, LEU feed	1.7×10^{-4}	2.9×10^{-3}	1.0×10^{-3}	8.8×10^{-3}	1.1×10^{-2}	2.3×10^{-2}
LEU product (on-site storage)	0.0	4.4×10^{-4}	0.0	0.0	0.0	4.4×10^{-4}
LEU product if shipped to FFFs[a]	1.0×10^{-4} to 9.5×10^{-5}	5.1×10^{-4} to 5.9×10^{-4}	2.5×10^{-4} to 2.5×10^{-4}	6.5×10^{-3} to 6.8×10^{-3}	2.1×10^{-3} to 6.5×10^{-3}	9.4×10^{-3} to 1.4×10^{-2}
Total	1.7×10^{-4} to 2.7×10^{-4}	3.4×10^{-3} to 3.5×10^{-3}	1.0×10^{-3} to 1.3×10^{-3}	8.8×10^{-3} to 1.6×10^{-2}	1.1×10^{-2} to 1.7×10^{-2}	2.4×10^{-2} to 3.8×10^{-2}
Enrichment of DU to NU at the Paducah GDP						
DU feed	2.7×10^{-4}	4.7×10^{-3}	1.7×10^{-3}	1.3×10^{-2}	1.7×10^{-2}	3.6×10^{-2}
NU product (on-site storage)	--	1.3×10^{-3}	--	--	--	1.3×10^{-3}
Total	2.7×10^{-4}	6.0×10^{-3}	1.7×10^{-3}	1.3×10^{-2}	1.7×10^{-2}	3.7×10^{-2}
Enrichment to LEU at the ACP (Portsmouth)						
NU, DU, LEU feed	1.1×10^{-4}	2.8×10^{-3}	6.9×10^{-4}	5.8×10^{-3}	6.9×10^{-3}	1.6×10^{-2}
LEU product (on-site storage)	0.0	4.4×10^{-4}	0.0	0.0	0.0	4.4×10^{-4}
LEU product if shipped to FFFs[a]	5.5×10^{-5} to 1.2×10^{-4}	5.0×10^{-4} to 6.0×10^{-4}	1.1×10^{-4} to 4.1×10^{-4}	2.4×10^{-3} to 1.2×10^{-2}	1.7×10^{-3} to 6.8×10^{-3}	4.8×10^{-3} to 2.0×10^{-2}
Total	1.1×10^{-4} to 2.4×10^{-4}	3.2×10^{-3} to 3.4×10^{-3}	6.9×10^{-4} to 1.1×10^{-3}	5.8×10^{-3} to 1.8×10^{-2}	6.9×10^{-3} to 1.4×10^{-2}	1.7×10^{-2} to 3.7×10^{-2}
Enrichment of DU to NU at the ACP (Portsmouth)						
DU feed	1.8×10^{-4}	4.5×10^{-3}	1.1×10^{-3}	8.5×10^{-3}	1.1×10^{-2}	2.6×10^{-2}
NU product (on-site storage)	--	1.3×10^{-3}	--	--	--	1.3×10^{-3}
Total	1.8×10^{-4}	5.9×10^{-3}	1.1×10^{-3}	8.5×10^{-3}	1.1×10^{-2}	2.7×10^{-2}
Enrichment to LEU at the NEF						
NU, DU, LEU feed	8.4×10^{-4}	3.6×10^{-3}	4.3×10^{-3}	3.4×10^{-2}	5.2×10^{-2}	9.4×10^{-2}
LEU product[a]	9.5×10^{-5} to 1.4×10^{-4}	5.3×10^{-4} to 5.9×10^{-4}	2.4×10^{-4} to 5.6×10^{-4}	6.4×10^{-3} to 1.8×10^{-2}	3.3×10^{-3} to 6.5×10^{-3}	1.1×10^{-2} to 2.6×10^{-2}
DU tails (to Portsmouth or Paducah)	5.2×10^{-4} to 8.0×10^{-4}	2.8×10^{-3} to 3.0×10^{-3}	2.5×10^{-3} to 4.2×10^{-3}	1.4×10^{-2} to 2.5×10^{-2}	3.4×10^{-2} to 4.8×10^{-2}	5.4×10^{-2} to 8.1×10^{-2}
Total	1.5×10^{-3} to 1.8×10^{-3}	7.0×10^{-3} to 7.2×10^{-3}	7.1×10^{-3} to 9.1×10^{-3}	5.4×10^{-2} to 7.6×10^{-2}	8.9×10^{-2} to 1.1×10^{-1}	1.6×10^{-1} to 2.0×10^{-1}
Enrichment of DU to NU at the NEF						
DU feed	1.4×10^{-3}	5.8×10^{-3}	7.0×10^{-3}	4.8×10^{-2}	8.3×10^{-2}	1.5×10^{-1}
NU product[a]	3.3×10^{-4} to 5.1×10^{-4}	1.8×10^{-3} to 1.9×10^{-3}	1.6×10^{-3} to 2.7×10^{-3}	1.5×10^{-2} to 2.7×10^{-2}	2.2×10^{-2} to 3.0×10^{-2}	4.0×10^{-2} to 6.3×10^{-2}
DU tails (to Portsmouth or Paducah)	6.2×10^{-4} to 9.5×10^{-4}	3.4×10^{-3} to 3.6×10^{-3}	3.0×10^{-3} to 5.0×10^{-3}	1.6×10^{-2} to 2.9×10^{-2}	4.0×10^{-2} to 5.6×10^{-2}	6.4×10^{-2} to 9.5×10^{-2}
Total	2.3×10^{-3} to 2.8×10^{-3}	1.1×10^{-2} to 1.1×10^{-2}	1.2×10^{-2} to 1.5×10^{-2}	8.0×10^{-2} to 1.1×10^{-1}	1.5×10^{-1} to 1.7×10^{-1}	2.5×10^{-1} to 3.0×10^{-1}
Enrichment of DU to NU Followed By Subsequent Enrichment of NU to LEU						
Total	1.8×10^{-4} to 3.8×10^{-3}	7.7×10^{-3} to 1.8×10^{-2}	1.1×10^{-3} to 2.0×10^{-2}	8.5×10^{-3} to 1.6×10^{-1}	1.1×10^{-2} to 2.3×10^{-1}	2.9×10^{-2} to 4.3×10^{-1}

[a] Range in product results is due to shipping product to various off-site storage locations.

Table 4-11 lists the impacts for the MEI along the transportation route. This individual was assumed to be located 30 meters (100 feet) from the route and to be exposed to all shipments of UF_6 (i.e., NU feed, NU product, DU feed, DU tails, LEU feed, and LEU product). The shipments were assumed to travel at a speed of 24 kilometers (15 miles) per hour, which is representative of speeds in urban areas. The probability of an LCF for the MEI along the transportation route was estimated to range from 8.2×10^{-8} to 5.2×10^{-7}.

Table 4-11. Maximum Individual Impacts from Rail Shipments[a]

Case	Mode	LCFs
Enrichment to LEU at Paducah GDP	Rail	1.9×10^{-7}
Enrichment of DU to NU at Paducah GDP	Rail	1.2×10^{-7}
Enrichment to LEU at Portsmouth ACP	Rail	1.4×10^{-7}
Enrichment of DU to NU at Portsmouth ACP	Rail	8.2×10^{-8}
Enrichment to LEU at NEF	Rail	5.0×10^{-7}
Enrichment of DU to NU at NEF	Rail	3.9×10^{-7}
Enrichment of DU to NU followed by subsequent enrichment of NU to LEU	Rail	1.0×10^{-7} to 5.2×10^{-7}

a. Impacts are based on a person located 30 meters from the railroad. The person was assumed to be exposed to all shipments of UF_6. The shipments were assumed to travel at a speed of 24 kilometers per hour.

4.2.1.3 Impacts from Overseas Shipments

DOE (1999a) evaluated the impacts of shipping 135,000 MTU of NU as UF_6 from the Portsmouth and Paducah GDPs to the Russian Federation. In addition, DOE (1994) evaluated the impacts of shipping 15,250 MTU of LEU as UF_6 from the Russian Federation to the Portsmouth and Paducah GDPs. The total amount of UF_6 evaluated in the Proposed Action, would be 99,810 MTU[16], assuming that the DU tails would not be shipped back to the United States, which is the standard industry practice.

Based on these analyses and using the Port of Houston, Texas, as an example, it was estimated that there would be 2.8 transportation-related fatalities from shipping 135,000 MTU of NU from the United States to the Russian Federation and 0.054 transportation-related fatalities from shipping 15,250 MTU of LEU from the Russian Federation to the United States. These impacts included sea transit, port operations, and overland truck transport[17] and were estimated to result in 2.9 total fatalities. In addition, based on the radiological and nonradiological impacts presented in DOE (1999a) and DOE (1994), the impacts of using New Orleans or other ports would be similar to the impacts of using the Port of Houston, Texas. The impacts of transporting DU tails were not included in the above analyses.

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[16] The 99,810 MTU consists of 17,595 MTU of NU feed, 75,296 MTU of DU feed, 2,000 MTU of LEU feed, and 4,919 MTU of LEU product. Only the LEU product would be shipped back to the United States. If DU feed were enriched to NU product, the amount of UF_6 shipped would be slightly less, about 98,000 MTU (75,296 MTU of DU feed, and 22,213 MTU of NU product), and only the NU product would be shipped back to the United States.

[17] These impacts have been updated to use the current dose-to-health effects conversion factor of 0.0006 LCFs per person-rem (Lawrence 2002).

Shipping NU, LEU, or DU from the United States to the Tricastin nuclear complex, and shipping NU or LEU product from the Tricastin nuclear complex to the United States, would involve activities similar to those associated with shipping NU from the United States to the Russian Federation and LEU from the Russian Federation to the United States.

Based on the analyses presented in DOE (1999a) and DOE (1994), there would be an estimated 2 fatalities from shipping 99,810 MTU of NU feed, DU feed, and LEU feed to the Tricastin nuclear complex, and NU or LEU product back to the United States. These impacts were based on shipping UF_6 to DOE's Portsmouth or Paducah facilities. If the UF_6 were subsequently shipped to a FFF, it is estimated that the number of fatalities would increase slightly, from about 2.0 fatalities to about 2.2 fatalities. If the UF_6 were shipped directly to an FFF instead of having an intermediate stop at the Portsmouth or Paducah GDPs, the impacts would likely be less because the total shipping distance would be less.

If barges were used to transport the uranium to the Port of New Orleans for shipment to the Tricastin nuclear complex for enrichment, and from the Port of New Orleans to Portsmouth or Paducah after enrichment at the Tricastin nuclear complex, the number of barge shipments would be less than the number of truck shipments (see Table 4-6). In addition, the exposed population using barge routes would be less than the exposed population using truck routes (Table 4-12). Therefore, the impacts of transporting the uranium by barge would be less than the impacts of transporting the uranium by truck. Because the impacts of shipping by barge were lower than the impacts of shipping by truck, the impacts of shipping by barge were not quantified.

Table 4-12. Exposed Populations along Barge and Truck Routes

Route	Exposed Population from Barge Route	Exposed Population from Truck Route
Paducah to New Orleans	53,000	240,000
Portsmouth to New Orleans	150,000	340,000

4.2.1.4 Global Commons

Shipments of UF_6 to the Tricastin nuclear complex require that impacts on the global commons be assessed. In accordance with DOE's implementation guidance for Executive Order 12114 (46 FR 1007), DOE (1994) analyzed impacts on the global commons of shipping 15,250 MTU of LEU as UF_6 from the Russian Federation to the Portsmouth and Paducah GDPs. DOE (1999a) also analyzed the impacts on global commons of shipping 135,000 MTU of NU as UF_6 from the Portsmouth and Paducah GDPs to the Russian Federation. Informal consultation with the National Marine Fisheries Service indicated that, under normal transport conditions, shipment of LEU by commercial vessel would be indistinguishable from any other commercial shipment and that there would be no impact on the marine environment, since marine flora and fauna would not be exposed to UF_6.

The North Atlantic right whale (*Eubalaena glacialis*) is on the federal endangered species list and is also protected internationally under the Convention for the Regulation of Whaling. There are currently about 300 right whales in the North Atlantic, with ship strikes accounting for about 50 percent of their known deaths. Calving right whales usually winter in the waters between Savannah, Georgia, and West Palm Beach, Florida, with an area of high density between Brunswick, Georgia, and St. Augustine, Florida (DOE 2008a). The Maritime Safety Committee of the International Maritime Organization adopted a mandatory ship-reporting system that took effect in 1999. Under this system, ships off the southeastern coast of the United States are required to report whale sightings in the major shipping lanes from November 15 to April 15, so as to include the calving season for the right whales in this area, and ships off the northeastern coast, where the whales have been sighted year-round, are required to report sightings throughout the year. In addition, the National Marine Fisheries Service has established regulations to implement speed restrictions of no more than 10 knots applying to all vessels 65 feet (19.8 meters) or greater in overall length in certain locations and at certain times of the year along the east coast of the U.S. Atlantic seaboard. The purpose of the regulations is to reduce the likelihood of deaths and serious injuries to endangered North Atlantic right whales that result from collisions with ships (73 FR 60173).

The sperm whale and all six species of sea turtles are on the federal endangered species list and are found throughout the equatorial region of the Atlantic Ocean. Sperm whales migrate between mating and calving grounds near the equator and feeding areas in higher latitudes. Generally, however, females and their young stay in latitudes less than 40, and only the males venture into the polar waters. The total number of sperm whales in the world is not well known, with estimates ranging from 200,000 to 2 million. The sea turtle is found throughout the Atlantic Ocean but is usually vulnerable to harm only on coastal shores. In the United States, the sea turtle is most prevalent on and just off the central Florida coast (DOE 2008a).

It is also extremely unlikely, if not impossible, that the proposed shipments would present any significant risk from an accident to the marine environment, as discussed in the following paragraphs. In 1984, the French cargo ship Mont-Louis sank after colliding with a ferry. The cargo included thirty (30) Type 48Y cylinders of UF_6. In view of the nature of the cargo, particularly its value, it was decided to salvage the UF_6 cylinders as quickly as possible and to recover the material. All 30 containers were recovered. They were all intact except one, which had a slight leak in the valve.

Moreover, there is no significant risk to the marine environment even in the event that one or more cylinders were lost at sea and not retrieved. The oceans contain significant quantities of uranium and its daughter products due to naturally occurring processes. As a result, marine organisms are exposed to relatively high levels of background radiation. The cylinders that contain the UF_6 are designed, constructed, and tested to withstand a severe collision, so unretrieved cylinders lost as the result of an accident at sea are likely to remain intact.

Because uranium has not been found to bioamplify in fish (and only slightly in other marine organisms) in the marine environment, even in the extremely unlikely event that a cylinder failed, an accidental release would result in only slight increases in the exposure of marine organisms, which tend to be more radiation-resistant than terrestrial mammals and which are already exposed to similar concentrations of uranium.

As a result of the large volume of water, the mixing mechanisms within it, the background concentrations of uranium, and the radiation resistance of aquatic organisms, the radiological impact of the very low probability accident releasing uranium into the ocean would be localized and of short duration. Also, any cylinders accidentally lost in the ocean or coastal waters would be retrieved, if at all possible, because of the economic value of the UF_6. This would practically eliminate the possibility of multiple containers slowly corroding and releasing their contents over time. Even if a cylinder were not retrievable, the impact of a slow release would be even less severe than a catastrophic failure of a cylinder.

The second aspect of a marine accident is the chemical hazard. UF_6 reacts with water in an exothermic reaction that releases uranyl fluoride (UO_2F_2) and HF. The reaction is not explosive. The HF produced would dissolve very quickly in the sea water. When dissolved, the HF dissociates into H^+ and F^- ions. These ions and the UO_2F_2 are the toxicological agents responsible for physiologic effects from a potential release of UF_6 in ocean water. If an instantaneous, complete hydrolysis of the contents of a single cylinder is assumed, the peak concentrations of H^+ and F^- ions from a total release of UF_6 from a container would be approximately 2 micrograms per liter at a distance of 100 meters. These concentrations are below toxic levels. The UO_2F_2 formed would settle on the sea bed and slowly dissolve.

4.2.1.5 Consequences of Severe Transportation Accidents

DOE (2004a, 2004b) evaluated the radiological consequences of a severe transportation accident involving DUF_6. These accidents are characterized by extreme mechanical and thermal forces, and accidents of this severity would be expected to be extremely rare (Biwer et al. 2001). Because DOE postulated a hypothetical accident that could occur at any location, the results are not route-dependent. DOE evaluated the radiological consequences to people in rural areas (6 persons per square kilometer [15 persons per square mile]), suburban areas (719 persons per square kilometer [1,798 persons per square mile]), and urban areas (1,600 persons per square kilometer [4,000 persons per square mile]). Radiation doses were estimated under neutral atmospheric conditions (Stability Class D with a wind speed of 14 kilometers [9 miles] per hour) and stable atmospheric conditions (Stability Class F with a wind speed of 3.5 kilometers [2.2 miles] per hour).

Tables 4-13 and 4-14 list the radiological consequences of these severe transportation accidents based on the radionuclide inventories presented in Table 4-7. For a severe truck accident involving one cylinder of DUF_6, the population radiation dose could be as high as 32,000 person-rem in an urban area if stable atmospheric conditions existed at the time of the accident. Based on this population radiation dose, it was estimated that there could be 20 LCFs in the exposed population of about 3 million people. For comparison, in a population of 3 million people, approximately 700,000 would be expected to die from cancer of all causes. The radiation dose for the MEI was estimated to be as high as 0.91 rem if stable atmospheric conditions existed at the time of the accident. The probability of an LCF for this individual was estimated to be 0.0005.

Table 4-13. Radiological Consequences for the Population from Severe Transportation Accidents Involving Depleted Uranium Hexafluoride[a]

Mode	Neutral Atmospheric Conditions			Stable Atmospheric Conditions		
	Rural[b]	Suburban	Urban[c]	Rural[b]	Suburban	Urban[c]
Radiological Dose (person-rem)						
Truck	590	580	1,300	15,000	15,000	32,000
Rail	2,400	2,300	5,200	60,000	58,000	130,000
Radiological Risk (LCF)[d]						
Truck	0.4	0.3	0.8	9	9	20
Rail	1	1	3	40	30	80

Source: DOE (2004a, 2004b).

a. National average population densities were used for the accident consequence assessment, corresponding to densities of 6 persons per square kilometer for rural zones, 719 persons per square kilometer for suburban zones, and 1,600 persons per square kilometer for urban zones. Potential impacts were estimated for the population within a 50-mile (80-kilometer) radius, assuming a uniform population density for each zone.

b. The consequences in rural areas equal or exceed the consequences in suburban areas because the consequences in rural areas include the radiation dose from the ingestion of contaminated food stuffs. The consequences in suburban and urban areas do not include the radiation dose from the ingestion of contaminated food stuffs.

c. It is important to note that the urban population density generally applies to relatively small urbanized area—very few, if any, urban areas have a population density as high as 1,600 persons per square kilometer extending as far as 50 miles. That urban population density corresponds to approximately 32 million people within the 50-mile radius, well in excess of the total populations along the routes considered in this assessment.

d. LCFs are calculated by multiplying the radiation dose by the health risk conversion factor of 0.0006 fatal cancers per person-rem (Lawrence 2002).

Table 4-14. Radiological Consequences for the Maximally Exposed Individual from Severe Transportation Accidents Involving Depleted Uranium Hexafluoride

Mode	Neutral Atmospheric Conditions		Stable Atmospheric Conditions	
	Dose (rem)	Probability of LCF[a]	Dose (rem)	Probability of LCF[a]
Truck	0.43	0.0003	0.91	0.0005
Rail	1.7	0.001	3.7	0.002

Source: DOE (2004a, 2004b).

a. LCFs are calculated by multiplying the radiation dose by the health risk conversion factor of 0.0006 fatal cancers per person-rem (Lawrence 2002).

If the severe transportation accident involved NU feed or product, the radiological consequences would be higher—about 28 LCFs in the exposed population. For the MEI, the probability of an LCF would be 0.0008.

If the severe transportation accident involved LEU product, the radiological consequences would also be higher—about 75 LCFs in the exposed population, assuming that all three 30B cylinders in a truck shipment were breached during the severe accident. For the MEI, the probability of an LCF would be 0.002.

For a severe rail accident involving four cylinders of DUF_6, the population radiation dose could be as high as 130,000 person-rem in an urban area when stable atmospheric conditions exist at the time of the accident. Based on this population radiation dose, it was estimated that there could be 80 LCFs in the exposed population of 3 million people. For comparison, in a population of 3 million people, approximately 700,000 would be expected to die from cancer of all causes. The radiation dose for the MEI was estimated to be as high as 3.7 rem if stable atmospheric conditions existed at the time of the accident. The probability of an LCF for this individual was estimated to be 0.002.

If the severe rail transportation accident involved NU feed or product, the radiological consequences would be higher—about 110 LCFs in the exposed population. For the MEI, the probability of an LCF would be 0.003.

If the severe transportation accident involved LEU product, the radiological consequences would also be higher—about 310 LCFs in the exposed population, assuming that all twelve 30B cylinders in a rail shipment were breached during the severe accident. For the MEI, the probability of an LCF would be 0.009.

DOE (2004a, 2004b) evaluated the chemical consequences of a transportation accident involving DUF_6. If UF_6 is released to the atmosphere, it reacts with water vapor in the air to form HF and UO_2F_2, independent of the enrichment of the UF_6 (i.e., natural, enriched, or depleted). The products are chemically toxic to humans. HF is extremely corrosive; it can damage the lungs and cause death if inhaled at high enough concentrations. In addition, uranium is a heavy metal that, in addition to being radioactive, can have toxic chemical effects (primarily on the kidneys) if it enters the body by way of ingestion and/or inhalation.

Because DOE postulated a hypothetical accident that could occur at any location, the results are not route-dependent. DOE evaluated chemical impacts to rural areas (6 persons per square kilometer [15 persons per square mile]), suburban areas (719 persons per square kilometer [1,798 persons per square mile]), and urban areas (1,600 persons per square kilometer [4,000 persons per square mile]). Chemical impacts are not dependent on enrichment of the uranium, only on the amount of uranium in the container. For this reason, if the severe transportation accident involved NU or enriched uranium, the chemical consequences would be similar.

> The toxic effects, or chemical impacts, can be categorized as adverse health effects or irreversible adverse health effects. An adverse health effect includes respiratory irritation or skin rash associated with lower chemical concentrations. An irreversible adverse health effect generally occurs at higher chemical concentrations and is permanent in nature. Irreversible adverse health effects include death, impaired organ function (such as central nervous system or lung damage), and other effects that may impair daily functions. Of those individuals receiving an irreversible adverse health effect, approximately 1 percent or less would die from it.

Tables 4-15 and 4-16 list the chemical consequences of these severe transportation accidents. Severe rail accidents could have higher consequences than truck accidents because each railcar would carry four times as many cylinders relative to a truck. The consequences of such an accident were estimated on the basis of the assumption that the accident occurred in an urban area under stable atmospheric conditions (such as at night-time) when there is less dispersion of released material than during neutral atmospheric conditions. In such a case, it was estimated that approximately four persons might experience irreversible adverse effects (such as lung or kidney damage) from exposure to HF and uranium. The number of fatalities expected following an HF or uranium chemical exposure is expected to be somewhat less than 1 percent of those persons experiencing irreversible adverse effects. Thus, no fatalities would be expected (1 percent of 4).

Table 4-15. Chemical Consequences for the Population from Severe Transportation Accidents Involving Depleted Uranium Hexafluoride [a]

Mode	Neutral Atmospheric Conditions			Stable Atmospheric Conditions		
	Rural	Suburban	Urban[b]	Rural	Suburban	Urban[b]
Number of People with the Potential for Adverse Health Effects						
Truck	0	2	4	6	760	1,700
Rail	4	420	940	110	13,000	28,000
Number of People with the Potential for Irreversible Health Effects[c]						
Truck	0	1	2	0	1	3
Rail	0	1	3	0	2	4

Source: DOE (2004a, 2004b).

a. National average population densities were used for the accident consequence assessment, corresponding to densities of 6 persons per square kilometer for rural zones, 719 persons per square kilometer for suburban zones, and 1,600 persons per square kilometer for urban zones. Potential impacts were estimated for the population within a 50-mile (80-kilometer) radius, assuming a uniform population density for each zone.

b. It is important to note that the urban population density generally applies to relatively small urbanized area— very few, if any, urban areas have a population density as high as 1,600 persons per square kilometer extending as far as 50 miles. That urban population density corresponds to approximately 32 million people within the 50-mile radius, well in excess of the total populations along the routes considered in this assessment.

c. Exposure to HF or uranium compounds is estimated to result in fatality to approximately 1 percent or less of those persons experiencing irreversible adverse effects.

Table 4-16. Chemical Consequences for the Maximally Exposed Individual from Severe Transportation Accidents Involving Depleted Uranium Hexafluoride

Mode	Neutral Atmospheric Conditions		Stable Atmospheric Conditions	
	Adverse Effects	Irreversible Adverse Effects[a]	Adverse Effects	Irreversible Adverse Effects[a]
Truck	Yes	Yes	Yes	Yes
Rail	Yes	Yes	Yes	Yes

Source: DOE (2004a, 2004b).

a. Exposure to HF or uranium compounds is estimated to result in fatality to approximately 1 percent or less of those persons experiencing irreversible adverse effects.

4.2.1.6 Intentional Destructive Acts

DOE (1999a) evaluated the consequences of intentional destructive acts (sabotage, terrorism) involving the transport of NU. Three scenarios were evaluated: (1) exploding a bomb near a shipping cylinder (2) attacking a cylinder with a high-energy density device such as an armor-piercing weapon (i.e., an anti-tank weapon), and (3) hijacking (stealing) a shipping cylinder. DOE (1999a) concluded that the consequences of an intentional destructive act would be less than or similar to the consequences of severe transportation accidents for a given number of cylinders with similar contents.

4.2.2 Low-Enriched Uranium Storage Impacts under the Enrichment Alternative

In the two EISs analyzing construction and operation of proposed UF_6 conversion facilities at DOE Paducah (DOE 2004a) and DOE Portsmouth (DOE 2004b), DOE evaluated the continued storage of DU, NU, and LEU cylinders as part of the no action alternatives. At Paducah, a total of 44,077 cylinders (41,013 DUF_6 cylinders, 2,769 non-DUF_6 cylinders, and 295 empty cylinders) were evaluated. At Portsmouth, a total of 25,231 cylinders (20,931 DUF_6 cylinders, 3,795 non-DUF_6 cylinders, and 505 empty cylinders) were evaluated. As a result of enrichment activities analyzed in this EA, if DU feed, NU feed, and LEU feed were enriched to LEU product, the number of DU cylinders would increase slightly, from 10,776 to 10,931. The number of LEU cylinders would increase from 296[18] to 3,195, and the number of NU cylinders would decrease from 2,270[19] to 0. The total number of cylinders would increase from 13,342 to 14,126. These numbers of cylinders are well within the numbers of cylinders evaluated in the two EISs analyzing construction and operation of proposed UF_6 conversion facilities at DOE Paducah (DOE 2004a) and DOE Portsmouth (DOE 2004b).

If DU feed were enriched to NU product, the number of DU cylinders would decrease from 10,776 to 6,450. The number of NU cylinders would increase from 2,270 to 5,715, and the number of LEU cylinders would be unchanged. The total number of cylinders would decrease from 13,342 to 12,461. If DU feed were enriched to NU product followed by subsequent enrichment of this NU product to LEU product, the number of DU cylinders would decrease from 10,776 to 8,859. The number of NU feed cylinders would be unchanged, and the number of LEU cylinders would increase from 296 to 1,849. The total number of cylinders would decrease from 13,342 to 12,978. These numbers of cylinders are well within the numbers of cylinders evaluated in the two EISs analyzing construction and operation of proposed UF_6 conversion facilities at DOE Paducah (DOE 2004a) and DOE Portsmouth (DOE 2004b).

In the conversion facility EIS for the Portsmouth site, the average worker individual radiation dose was estimated to be about 600 mrem per year, which is equivalent to an LCF risk of 0.00036. For a worker engaged in cylinder maintenance activities for 40 years (the duration of

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[18] The Portsmouth and Paducah conversion facility EISs evaluated a total of 2,507 cylinders of LEU located at Portsmouth, Paducah, and the ETTP. Not all these cylinders would be part of the Proposed Action evaluated in this EA.

[19] The Portsmouth and Paducah conversion facility EISs evaluated a total of 2,955 cylinders of NU located at Portsmouth, Paducah, and the ETTP. Not all these cylinders would be part of the Proposed Action evaluated in this EA.

the no action alternative evaluated in DOE [2004b]), the risk of an LCF is estimated to be 0.014. The collective radiation dose for workers conducting cylinder maintenance activities at the Portsmouth site was estimated to be 460 person-rem over the time period 1999 through 2039. In the exposed population of workers, this collective radiation dose is estimated to result in 0.28 LCFs.

In the conversion facility EIS for the Portsmouth site, the maximum individual radiation dose to a person near the Portsmouth site boundary was estimated to be less than 0.1 mrem per year, which is equivalent to an LCF risk of 6.0×10^{-8}. Over 40 years, this would be equivalent to an LCF risk of 2.4×10^{-6}. The collective radiation dose for people around the Portsmouth site was estimated to be 0.07 person-rem over the time period 1999 through 2039. In the exposed population, this collective radiation dose is estimated to result in 4.2×10^{-5} LCFs.

Accidents involving cylinders were also evaluated in the conversion facility EIS for the Portsmouth site. The accident with the highest consequences was a fire resulting in the rupture of three 48G cylinders containing DUF_6. The radiation dose for an individual member of the public from this accident was estimated to be 0.013 rem, which is equivalent to an LCF risk of 7.8×10^{-6}. For the exposed population, the collective radiation dose from this accident was estimated to be 34 person-rem, which is equivalent to 0.020 LCFs in the exposed population. If this accident occurred at other sites, the results would vary depending on the enrichment of the UF_6, the exposed population, or atmospheric conditions.

If the accident involved NU, the radiological consequences would be higher—about 0.030 LCFs in the exposed population, assuming that three cylinders were involved in the accident. For the MEI, the probability of an LCF would be 1.1×10^{-5}. If the accident involved LEU, the radiological consequences would also be higher—about 0.055 LCFs in the exposed population, assuming that three cylinders were involved in the accident. For the MEI, the probability of an LCF would be 2.1×10^{-5}.

In the conversion facility EIS for the Paducah site, the average individual worker radiation dose was estimated to be 740 mrem per year, which is equivalent to an LCF risk of 0.00044. For a worker engaged in cylinder maintenance activities for 40 years (the duration of the no action alternative evaluated in DOE [2004a]), the risk of an LCF is estimated to be 0.018. The collective radiation dose for workers conducting cylinder maintenance activities at the Paducah site was estimated to be 1,300 person-rem over the time period 1999 through 2039. In the exposed population of workers, this collective radiation dose is estimated to result in 0.78 LCFs.

In the conversion facility EIS for the Paducah site, the maximum individual radiation dose to a person near the Paducah site boundary was estimated to be less than 0.1 mrem per year, which is equivalent to an LCF risk of 6.0×10^{-8}. Over 40 years, this would be equivalent to an LCF risk of 2.4×10^{-6}. The collective radiation dose for people around the Paducah site was estimated to be 0.3 person-rem over the time period 1999 through 2039. In the exposed population, this collective radiation dose is estimated to result in 1.8×10^{-4} LCFs.

Accidents involving cylinders were also evaluated in the conversion facility EIS for the Paducah site. The accident with the highest consequences was a fire resulting in the rupture of three

48G cylinders containing DUF_6. The radiation dose for an individual member of the public from this accident was estimated to be 0.015 rem, which is equivalent to an LCF risk of 9.0×10^{-6}. For the exposed population, the collective radiation dose from this accident was estimated to be 29 person-rem, which is equivalent to 0.017 LCFs in the exposed population. If this accident occurred at other sites, the results would vary depending on the enrichment of the UF_6, the exposed population, or atmospheric conditions.

If the accident involved NU, the radiological consequences would be higher—about 0.025 LCFs in the exposed population, assuming that three cylinders were involved in the accident. For the MEI, the probability of an LCF would be 1.3×10^{-5}. If the accident involved LEU, the radiological consequences would also be higher—about 0.047 LCFs in the exposed population, assuming that three cylinders were involved in the accident. For the MEI, the probability of an LCF would be 2.4×10^{-5}.

In the enrichment facility EIS for the NEF site, the NRC evaluated the radiation doses from direct gamma exposures for members of the public from storage of UF_6 cylinders at the NEF (NRC 2005). The radiation dose from storage of UF_6 cylinders for a person located at one of three nearby businesses was found to be less than 3 mrem per year, which is equivalent to an LCF probability of 2×10^{-6}. Collective radiation doses from direct gamma exposures were not estimated.

In the enrichment facility EIS for the NEF site, the radiation dose for a worker involved with cylinder handling at the NEF was estimated to be 300 mrem per year, which is equivalent to an LCF risk of 0.00018. Collective radiation doses from direct gamma exposures were not estimated.

In the enrichment facility EIS for the NEF site, cylinder storage accidents were not evaluated. However, an accident involving the hydraulic rupture of a single 48Y UF_6 cylinder containing LEU product in the blending and liquid sampling area was evaluated. The radiation dose to an individual located at the controlled area boundary was estimated to be 0.97 rem, which is equivalent to an LCF risk of 0.00058. For the exposed population, the collective radiation dose from this accident was estimated to be 12,000 person-rem, which is equivalent to 7.2 LCFs in the exposed population. If this accident occurred at other sites, the results would vary depending on the enrichment of the UF_6, the exposed population, or atmospheric conditions.

In the enrichment facility EIS for the ACP site, the NRC also evaluated the radiation doses from direct gamma exposures for members of the public from storage of UF_6 cylinders at the ACP (NRC 2006). At the ACP, the presence of existing storage yards was found to have a minimal effect, if any, on the exposure rate at the site boundary. Along the northern boundary near an existing cylinder storage yard, where a member of the public might actually stand, the maximum amount of radiation exposure above the ambient background amounts over the course of a year was estimated to be less than 13 mrem for an unshielded receptor spending 100 percent of the year standing at that location. If a person were actually living at that northern boundary location near this location (nobody currently resides in that area), that person would receive on the order of 0.87 mrem per year additional exposure when the effects of shielding and residence time are included. Collective radiation doses from direct gamma exposures were not estimated.

Occupational radiation doses at the ACP were not estimated in the enrichment facility EIS for the ACP site (NRC 2006). However, NRC (2006) states that the average dose to cylinder workers at the Portsmouth reservation in 2003 was 29 mrem, which is equivalent to an LCF risk of 1.7×10^{-5}. Collective radiation doses from direct gamma exposures were not estimated.

Accidents at the ACP were also evaluated in the enrichment facility EIS for the ACP site (NRC 2006), which states that the most significant accident consequences are those associated with the release of UF_6 caused by a breach of an overpressurized cylinder. Consequences are not presented for accidents; however, NRC (2006) states that accidents at the proposed ACP would result in small to moderate impacts to workers, the environment, and the public.

Table 4-17 lists the occupational radiation doses reported to the NRC by the FFFs in 2006 (NRC 2007b). These radiation doses include all activities at the FFFs, including cylinder storage activities. Because DOE's LEU would not differ from other LEU that would be stored at the FFFs, it is not expected that storage of DOE LEU would appreciably alter these occupational radiation doses. Direct radiation data for members of the public are not reported for the AREVA FFF (NRC 1995), WEC FFF (NRC 2007a), and GNF FFF (NRC 1997).

Table 4-17. Occupational Radiation Doses at FFFs in 2006

Facility	Average Individual Dose (rem)	LCFs	Collective Dose (person-rem)	LCFs
AREVA FFF	0.230	0.00014	80.347	0.048
GNF FFF	0.094	0.000056	58.994	0.035
WEC FFF	0.370	0.00022	262.457	0.16

Source: NRC (2007b).

Accidents at the AREVA FFF, WEC FFF, and GNF FFF were evaluated by the NRC. For the WEC FFF (NRC 2007a), one accident was identified, but the details of the accident were not provided and accident consequences were not reported. For the AREVA FFF (NRC 1995), four accidents were evaluated, but none of the accidents were related to cylinder storage. For the GNF FFF (NRC 1997), seven accidents were evaluated. One accident was relevant to cylinder storage, a fire involving a single 30B UF_6 cylinder containing LEU product on a storage pad. This accident was estimated to result in a population radiation dose of 29,000 person-rem. In the exposed population, this radiation dose is estimated to result in 17 LCFs. The radiation dose for an individual located 2 kilometers from the facility was estimated to be 5 rem. The probability of an LCF for this person is estimated to be 0.003. If this accident occurred at other sites, the results would vary depending on the enrichment of the UF_6, the exposed population, or atmospheric conditions.

Section 4.2.1.6 discusses the consequences of intentional destructive acts involving the transport of NU. As discussed in Section 4.2.1.6, the consequences of such an event would be less than or similar to the consequences of severe transportation accidents discussed in Section 4.2.1.5 for a given number of cylinders with similar contents.

4.2.3 Impacts on the Uranium Market Under the Enrichment Alternative

Because the annual amount of excess inventory that would be introduced into the domestic uranium market would be the same (see Section 2.1.2) under the Enrichment Alternative as under the Direct Sale Alternative, or a combination of the two, the economic impacts would be essentially identical for the Enrichment Alternative and the Direct Sale Alternative.

4.3 Direct Sale Alternative

4.3.1 Transportation, Enrichment, and Storage Impacts under the Direct Sale Alternative

Under the Direct Sale Alternative, DOE assumes that purchasers would take delivery, transport and enrich the excess inventory, and transport and store the LEU product in essentially the same manner and using essentially the same facilities as would DOE under the Enrichment Alternative. Tails resulting from the ultimate enrichment of DOE's sold excess inventory would be disposed of in a manner consistent with existing practices at the enrichment facilities, and DU tail (waste) disposal practices are analyzed in existing enrichment facility and DUF_6 conversion facility NEPA documents and NRC licenses. For that reason, DOE assumes that the transportation, enrichment, and storage impacts of the Direct Sale Alternative would be essentially identical to those of the Enrichment Alternative.

4.3.2 Impacts on the Uranium Market under the Direct Sale Alternative

DOE is authorized to sell the government's excess uranium under the Atomic Energy Act of 1954, as amended, and consistent with the applicable provisions of the 1996 USEC Privatization Act, Public Law 104-134 (42 U.S.C. 2297h *et seq*.). Section 3112(d) of the USEC Privatization Act stipulates that prior to selling NU or LEU from DOE's excess inventory, the Secretary of Energy must make a determination that the sale will not have an "adverse material impact" on the domestic mining, conversion, and enrichment industry; DOE will receive not less than the fair market value for the materials; and the material is not necessary for national security needs.

In 2008, Energy Resources International (ERI) analyzed the potential effects on the domestic uranium production (mining and milling), conversion, and enrichment markets of the sale by the U.S. government of a portion of the government's excess uranium inventory during a 10-year period (2008-2017) that equates to about 2,000 MTU per year (ERI 2008). That impact analysis was based on (1) ERI's published supply and demand forecasts from April 2008, and (2) an implied assumption that DOE would introduce into the domestic market an amount of uranium that would not generally exceed 10 percent of the total annual fuel requirements of all licensed U.S. nuclear power plants.

For the purposes of its analysis, ERI (2008) assumed that the sale by DOE of approximately 10 percent of the average annual U.S. requirements for uranium concentrates (U_3O_8) and conversion services would represent just under 5 percent of the U.S. requirement for enrichment services on an average annual basis. The potential effects on long-term prices from the average annual DOE sale were estimated to be a reduction of 3.5 percent per pound of U_3O_8, 2 percent per kilogram of uranium for conversion services, and 1.4 percent per separative work unit (SWU) in enrichment services. The estimates by ERI (2008) do not reflect other events that could impact the market prices, nor do they reflect the fact that some of these DOE sales are already anticipated by market participants. ERI (2008) summarizes that the potential reductions in prices for conversion services are approximately equal to the change in price in the near term (generally 12 months or less) or in the long term (greater than 12 months). That is, the potential price impact from DOE sales was shown to be similar to the impact from routine market fluctuations for conversion services. The potential price impact from DOE sales for uranium concentrates was 19 percent of the near-term and 13 percent of the long-term prices compared to 2007. The potential price impact from DOE sales for enrichment services was estimated at 26 percent of the near-term and 30 percent of the long-term prices, also compared to 2007.

ERI (2008) discusses three industry activities that will provide a mitigating effect on the market impacts of any DOE actions. First, the domestic industries of uranium concentrates, conversion of uranium, and enrichment have already committed to production levels and sales through 2009 with some amount of additional forward sales. DOE sales would not displace those committed actions. Second, there is a reasonable expectation that the domestic services for uranium concentrates, conversion, and enrichment will increase. ERI (2008) notes that the domestic uranium concentrate production may double by 2011, domestic conversion may see a 30 percent increase over the next 7 years, and domestic enrichment services may double over the next 7 years. Finally, ERI (2008) acknowledges that each of these industries operate on an international basis so they are not entirely reliant upon, or subject to, fluctuations in the domestic market. Domestic producers are not the high-cost option and should be able to sell their annual production in a competitive market. Domestic conversion services are in similar position in a competitive market. DOE sales of enrichment services are not expected to displace only domestic enrichment supply. U.S. buyers use multiple international sources as well as domestic. Nearly 100 percent of competitively priced domestic enrichment is under contract through 2009, and 50 to 60 percent of domestic enrichment capacity is committed through 2017 (ERI 2008).

ERI (2008) notes a perceived uncertainty regarding DOE’s potential future sales or enrichment transactions. This perception of risk may pose the greatest impact on the uranium markets. However, DOE has mitigated this perceived risk of uncertainty by preparing and releasing to the public its *Excess Uranium Inventory Management Plan* (DOE 2008b), which identifies DOE’s plans for disposition of certain excess uranium inventories that are currently ongoing and/or planned, are under consideration, or may be considered by DOE in the future.

DOE’s Proposed Action would not involve construction or operation of new uranium conversion facilities, enrichment facilities, or FFFs. The potential socioeconomic impacts related to the construction or operation of existing or other facilities currently under development have been analyzed in prior NEPA documents. To the extent there are potential socioeconomic impacts under the Proposed Action, such impacts would be derived from the potential uranium market impacts associated with the direct sale or enrichment of DOE’s excess uranium inventory.

Consistent with the Secretarial Policy Statement, DOE will manage its excess uranium inventory in a manner that meets its national security and energy missions and is supportive of the maintenance of a strong domestic nuclear industry. In addition, consistent with section 3112(d) of the USEC Privatization Act, the Department would proceed with a particular sale or transfer for NU or LEU following a determination by the Secretary that there would be no material adverse impact to the domestic mining, conversion, or enrichment industries. Further, to mitigate any adverse impacts from the sale or transfer of its DU in accordance with NEPA requirements, and in furtherance of Departmental policies, DOE would conduct an analysis prior to any sales or transfers of DU to ensure there would be no adverse material impacts to the domestic uranium industries.

In years where sales or enrichment activities were limited to 2,000 MTU per year, and assuming there have been Secretarial determination(s) or other appropriate analyses by the Department that the particular sales or transfers would not result in adverse material impacts (ERI 2008) to the domestic uranium industries, the potential impacts to the domestic uranium markets (including socioeconomic impacts) are expected to be small. While there may be some temporary adjustments in uranium prices related to the DOE uranium transactions, the impacts to the uranium industries are expected to be small. The potential impacts to tax revenues are also expected to be small. Finally, in the geographic regions where the transactions took place, corresponding impacts to area housing, community services, and public utilities are also expected to be small.

In years where sales or enrichment activities would exceed 2,000 MTU, any such transactions also would be preceded by applicable Secretarial determination(s) or other appropriate analyses by the Department that the particular sales or transfers would not result in adverse material impacts to the domestic uranium industries. Accordingly, the potential impacts to the domestic uranium markets would be expected to be small.

4.4 No Action Alternative

4.4.1 Environmental Impacts under the No Action Alternative

As described in Section 2.3, the No Action Alternative is defined as the status quo. The environmental impacts that would result under the No Action Alternative assessed in this draft EA have been assessed and documented in the two EISs that DOE issued in 2004 (DOE 2004a, 2004b) for the two new DU conversion facilities at the Portsmouth and Paducah sites. A text box on page S-16 of both of these two EISs specifies that the No Action Alternative is storage of DUF_6 and non-DUF_6 cylinders indefinitely in yards at the Paducah and Portsmouth sites, with continued cylinder surveillance and maintenance activities. These non-DUF_6 cylinders contain LEU or NU. The impacts associated with the No Action alternatives evaluated in the two DU conversion facility EISs are delineated in Summary Table S-6 (DOE 2004a) for the Paducah conversion facility[20] and Summary Table S-6 (DOE 2004b) for the Portsmouth conversion facility,[21] and include the impacts of storing DU, NU, and LEU cylinders, although the impacts are not delineated separately for DU, NU, and LEU cylinders.

Based on the numbers of cylinders evaluated in the two DU conversion EISs, the environmental impacts identified and assessed in these EISs bound the impacts under the No Action Alternative for this draft EA and are incorporated into it by reference.

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[20] Available online at http://web.ead.anl.gov/uranium/pdf/PAD-Summary.pdf.

[21] Available online at http://web.ead.anl.gov/uranium/pdf/PORT-Summary.pdf.

4.4.2 Impacts on the Uranium Market under the No Action Alternative

If DOE decided not to enrich or to sell any of the excess inventory but to continue with plans to convert it to a more stable chemical form at two new conversion facilities, there would be no noticeable impact, either beneficial or adverse, to the current uranium production, conversion, or enrichment industries; nor to associated employment; nor to the price of uranium other than the socioeconomic impacts identified in Table 4-3 for operation of the new conversion facilities at Portsmouth and Paducah.

4.5 Cumulative Impacts

Cumulative impacts are the impacts that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR § 1508.7). The following sections summarize and generally incorporate by reference, based on review of existing NEPA documents, relevant cumulative impacts analyses that were performed as part of those NEPA analyses. These existing NEPA documents address the enrichment of uranium, conversion of DU tails, fuel fabrication, or the transportation of radioactive material.

4.5.1 Enrichment Alternative

4.5.1.1 Facilities

American Centrifuge Plant

Cumulative impacts that could occur as a result of construction and operation of the ACP were extensively analyzed by NRC in Section 4.3 of the 2006 ACP EIS (NRC 2006). This analysis considered all reasonably foreseeable future activities, including construction and operation of new DU conversion facilities at DOE Paducah and Portsmouth. With the exception of socioeconomics, for all resource areas where NRC identified the potential for cumulative impacts, NRC determined the cumulative impact would be “small”. For socioeconomics, the potential cumulative impact was considered to be small to medium and generally positive. If the DOE chose to enrich NU feed, DU feed, or LEU feed at the ACP, these enrichment services would be a part of the enrichment services normally provided by the ACP and would not add to the enrichment capacity or throughput provided at the ACP. Because enriching DOE's uranium inventory would not increase the enrichment capacity or throughput at ACP, the cumulative impacts evaluated in NRC 2006 would not be changed by the cumulative impacts expected to occur at ACP under the Enrichment Alternative assessed in this EA.

National Enrichment Facility

Cumulative impacts that could occur as a result of construction and operation of the NEF were extensively analyzed by NRC in Section 4.4 of the NEF EIS (NRC 2005). These analyses considered all reasonably foreseeable future activities, including construction and operation of new DU conversion facilities at DOE Paducah and Portsmouth. With the exception of socioeconomics, for all resource areas where NRC identified the potential for cumulative impacts, NRC determined the cumulative impact would be “small”. For socioeconomics, the potential cumulative impact was considered to be small to medium and generally positive. If the DOE chose to enrich NU feed, DU feed, or LEU feed at the NEF, these enrichment services would be a part of the enrichment services normally provided by the NEF and would not add to the enrichment capacity or throughput provided at the NEF. Because enriching DOE's uranium inventory would not increase the enrichment capacity or throughput at NEF, the cumulative impacts evaluated in NRC 2005 would not be changed by the cumulative impacts expected to occur at NEF under the Enrichment Alternative assessed in this EA.

Paducah Site

Section S.5.16 of DOE’s *Final EIS for Construction and Operation of a Depleted Uranium Hexafluoride Conversion Facility at the Paducah, Kentucky, Site* (DOE 2004a) considered cumulative impacts in the vicinity of the Paducah site. Actions planned at the Paducah site included the continuation of uranium enrichment operations by USEC, waste management activities, waste disposal activities, environmental restoration activities, and DUF_6 management activities. Actions occurring near the Paducah site that, because of their diffuse nature, could contribute to existing or future impacts on the site include continued operation of the Tennessee Valley Authority’s Shawnee power plant; the Joppa, Illinois, power plant; and the Honeywell International uranium conversion plant in Metropolis, Illinois.

- The cumulative collective radiological exposure to the off-site population would be well below the maximum DOE dose limit of 100 mrem per year to the off-site MEI and below the limit of 25 mrem per year specified in 40 CFR 190 for uranium fuel cycle facilities. Annual individual doses to involved workers would be monitored to maintain exposure below the regulatory limit of 5 rem per year.

- Under the EIS’s no action alternative cumulative impacts assessment, although less than 1 shipment per year of radioactive wastes is expected from cylinder management activities, up to 14,400 truck shipments could be associated with existing and planned actions (no rail shipments are expected). Under the EIS’s action alternatives, up to 6,000 rail shipments and 18,600 truck shipments of radioactive material could occur. The cumulative maximum dose to the MEI along the transportation route near the site entrance would be less than 1 mrem per year under all alternatives and for all transportation modes.

- The Paducah site is located in an attainment region. However, the background annual-average concentration of particulate matter less than 2.5 microns in diameter ($PM_{2.5}$) is near the regulatory standard. Cumulative impacts would not affect attainment status.

- Data from the 2000 annual groundwater monitoring showed that four pollutants exceeded primary drinking water regulation levels in groundwater at the Paducah site. Good engineering and construction practices should ensure that indirect cumulative impacts on groundwater associated with the conversion facility would be minimal.

- Cumulative ecological impacts on habitats and biotic communities, including wetlands, would be negligible to minor under all alternatives. Construction of a conversion facility might remove a type of tree preferred by the Indiana bat; however, this federal- and state-listed endangered species is not known to utilize these areas.
- No cumulative land use impacts are anticipated for any of the alternatives.
- It is unlikely that any noteworthy cumulative impacts on cultural resources would occur under any alternative, and any such impacts would be adequately mitigated before activities for the chosen action would begin.
- Given the absence of high and adverse cumulative impacts for any impact area considered in the Paducah EIS, no environmental justice cumulative impacts are anticipated for the Paducah site, despite the presence of disproportionately high percentages of low-income populations in the vicinity.
- Socioeconomic impacts under all alternatives considered are anticipated to be generally positive, often temporary, and relatively small.

If the DOE chose to enrich NU feed, DU feed, or LEU feed at the Paducah GDP, these enrichment services would be a part of the enrichment services normally provided by the Paducah GDP and would not add to the enrichment capacity or throughput provided at the Paducah GDP. Because enriching DOE’s uranium inventory would not increase the enrichment capacity or throughput at the Paducah GDP, the cumulative impacts evaluated in DOE 2004a would not be changed by the cumulative impacts expected to occur at the Paducah GDP under the Enrichment Alternative assessed in this EA.

AREVA Fuel Fabrication Facility

In 2007, DOE prepared an EA that assessed the impacts, including cumulative impacts, associated with proposed construction and operation of a large research complex on DOE property located about 1.6 kilometers (1 mile) from the AREVA FFF: *Construction and Operation of a Physical Sciences Facility (PSF) at the Pacific Northwest National Laboratory, Richland, Washington* (DOE 2007c).[22] In January 2007, DOE issued a FONSI for the PSF EA[23] which found that “no noticeable cumulative impacts” with other ongoing operations in the region were expected.

The PSF EA specifically cited the AREVA FFF as a neighboring, potentially affected operation. The Proposed Action assessed in this EA would likely result in delivery of fewer than 3,195 30B cylinders of LEU product to the AREVA FFF. About 3,200 LEU product cylinders would be produced during the enrichment of NU feed, DU feed, and LEU feed evaluated in this draft EA. Based on a 25-year duration of the Proposed Action, about 130 LEU product cylinders would be shipped annually to the AREVA FFF. Such deliveries are consistent with current

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[22] Available online at http://gc.energy.gov/NEPA/nepa_documents/ea/ea1562/EA_1562.pdf.
[23] Available online at http://gc.energy.gov/NEPA/nepa_documents/ea/ea1562/FONSI.pdf.

AREVA FFF operations.[24] Because construction and operation of the PSF (which included assessments of radiological safety and environmental impacts) essentially adjacent to AREVA FFF would have no cumulative impacts on the neighboring facilities or region, and because the Proposed Action would not impact or expand AREVA FFF operations, the cumulative impacts evaluated in DOE 2007c would not be changed by the cumulative impacts expected to occur at the AREVA FFF under the Enrichment Alternative assessed in this EA.

Westinghouse Electric Corporation Fuel Fabrication Facility

In April 2007, the NRC issued an EA for the renewal of the WEC FFF license (License No. SNM-1107) (NRC 2007a). The EA included the following assessment of cumulative impacts:

> "The NRC staff has evaluated whether cumulative environmental effects could result from the incremental impacts of the SNM–1107 license renewal for the site when added to relevant past, present, or reasonably foreseeable future actions in the area. No significant cumulative effects were identified for the areas within the affected environments described. For example, the water usage for the Congaree River is less than 1 percent of the total water usage in the watershed. The site is in compliance with relevant environmental standards and regulations, as well as NRC regulations related to radiation dose to the public and facility workers. Further, the facility utilizes an as low as reasonably achievable (ALARA) program, routine environmental and radiation monitoring, a radiation safety program, a chemical safety program, and an environmental protection program to minimize the associated direct, indirect, and cumulative effects. Finally, WEC also conducts program audits and self-assessments as a way to minimize adverse environmental effects."

The Proposed Action assessed in this EA would likely result in delivery of fewer than 3,195 30B cylinders of LEU product to the WEC FFF. About 3,200 LEU product cylinders would be produced during the enrichment of NU feed, DU feed, and LEU feed evaluated in this draft EA. Based on a 25-year duration of the Proposed Action, about 130 LEU product cylinders would be shipped annually to the WEC FFF. Such deliveries are consistent with current WEC FFF operations. Because the Proposed Action would not impact or expand the WEC FFF operations, the cumulative impacts evaluated in NRC 2007a would not be changed by the cumulative impacts expected to occur at the WEC FFF under the Enrichment Alternative assessed in this EA.

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[24] Because the actual annual amounts of excess inventory enriched would likely be less than the maximum annual amount, and because it would probably change from year to year, DOE is not limiting the Proposed Action to a particular number of years. However, for purposes of modeling the impacts of processing the entire inventory, 25 years is used.

Global Nuclear Fuel Company Fuel Fabrication Facility

To assess the potential for cumulative impacts to the area surrounding the GNF FFF, DOE reviewed GNF's March 2008 response to an NRC *Environmental Assessment Request for Additional Information* (RAI) to support GNF's application for a 40-year license renewal (GNF 2008). Among other things, the RAI requested that GNF identify reasonably foreseeable future actions and cumulative impacts. GNF responded to this RAI as follows:

> "Most of the industrial development in the vicinity of the Wilmington site is on the northeast side of the Northeast Cape Fear River. No new industrial developments are known to be planned in the immediate vicinity of the Wilmington site on the east side of the river. A developer is proposing a new 237-acre (95-hectares) continuing care retirement community (River Bluffs subdivision) that would be built on the undeveloped land parcel bounded by the Wilmington site's southern property line, I-140, and the Northeast Cape Fear River.
>
> "There are four on-site planned future actions not related to fuel fabrication operations that may cumulatively impact the affected areas. These actions include the ATC II Complex, the Tooling Development Center, the Global Laser Enrichment Test Loop and Commercial Facility. The ATC II office complex will be located adjacent to the existing ATC I office building in the southeastern portion of the Eastern Site Sector, near the south gate Wilmington site entrance. The entire project will disturb approximately 30 acres (12 hectares) of the Wilmington site. In preparation for the new office complex, the site has constructed a stormwater retention pond and has installed a new parking lot and a set of temporary trailers in front of the existing ATC I building. The temporary trailers will serve as offices until the new complex is completed. There will be no effluents from these activities aside from those associated with construction and sanitary waste. The facility will require an estimated 7,500 gallons (28,400 liters) of potable water, and it is conservatively assumed that there will be no consumptive losses and that the same volumes of sanitary wastewater would be generated for treatment in the existing Wilmington site sanitary WTF, which can accommodate the increase. The Tooling Development Center will be located in the southwestern portion of the Eastern Site Sector. It will consist of five new buildings and will disturb approximately 30 acres (12 hectares) of the Wilmington site.
>
> "The facility will require an estimated 5,000 gallons (18,900 liters) of process water and 11,000 gallons (41,600 liters) of potable water, and it is conservatively assumed that there will be no consumptive losses and that the same volumes of process and sanitary wastewaters would be generated for treatment in the existing Wilmington site final process lagoon facility and sanitary WTF, respectively which can be accommodated by the treatment facilities. No radioactive material will be used in the Tooling Development Center buildings, and no air permits will be required. Approximately 0.75 mile (1.2 kilometers) of new road will be constructed in the Eastern Site Sector in order to access the Center.

> "The cumulative impacts of the GLE Test Loop are minimal as discussed in the SNM-1097 Test Loop license amendment request. The impacts from the Commercial Facility are expected to be small and will be addressed in a separate Environmental Report submittal for the GLE Commercial Facility license application.
>
> "The cumulative impacts of the facilities and actions described above are anticipated to be small."

The Proposed Action assessed in this EA would likely result in delivery of fewer than 3,195 30B cylinders of LEU product to the GNF FFF. About 3,200 LEU product cylinders would be produced during the enrichment of NU feed, DU feed, and LEU feed evaluated in this draft EA. Based on a 25-year duration of the Proposed Action, about 130 LEU product cylinders would be shipped annually to the GNF FFF. Such deliveries are consistent with current GNF FFF operations. Because the Proposed Action would not impact or expand the GNF FFF operations, the cumulative impacts described in the RAI would not be changed by the cumulative impacts expected to occur at the GNF FFF under the Enrichment Alternative assessed in this EA.

4.5.1.2 Cumulative Transportation Impacts

In Section 8.4.1.5 in DOE (2008c), cumulative impacts of transporting radioactive material were evaluated for the period 1943 through 2073. Over this time, DOE estimated that there could be 240 LCFs for workers, 210 LCFs for members of the public, and 130 traffic fatalities. In this EA, less than 1 LCF would be estimated to occur for workers and for members of the public, and about 1 traffic fatality would be estimated to occur.

4.5.1.3 Cumulative Storage Impacts

The possession limits for uranium at NRC-licensed FFFs are typically given in terms of kilograms of ^{235}U. At an enrichment of 4.95 percent, 1 kilogram of uranium contains 0.0495 kilograms of ^{235}U. NRC licenses allow for the possession of 75,000 kilograms of ^{235}U at the AREVA FFF, 50,000 kilograms of ^{235}U at the GNF FFF, and 75,000 kilograms of ^{235}U at the WEC FFF. DOE would not store ^{235}U at the FFFs in excess of these amounts without NRC approval. About 4,900 MT of LEU product would be produced by enriching all the surplus NU, DU, and LEU feed. This LEU product would contain about 240,000 kilograms of ^{235}U, or about 9,700 kilograms per year of ^{235}U over the 25-year time period of the Proposed Action. Therefore, the enrichment of the surplus NU, DU, and LEU feed would account for only about 13 to 19 percent of the storage capacity at the FFFs on an annual basis.

It is also possible that DOE would store up to 670 MTU of LEU containing about 33,200 kilograms of ^{235}U at the FFFs as an inventory for future DOE use in accordance with applicable DOE policies and the Secretarial Policy Statement. This would account for 44 to 66 percent of the licensed storage capacity at an FFF. This entire inventory is unlikely to be stored at a single FFF, and a portion could be stored at the DOE Portsmouth and/or DOE Paducah facilities.

In the two EISs analyzing construction and operation of proposed UF_6 conversion facilities at DOE Paducah (DOE 2004a) and DOE Portsmouth (DOE 2004b), DOE evaluated the continued storage of DU, NU, and LEU cylinders as part of the no action alternatives. At the Portsmouth site, about 210,000 MT of UF_6 (140,000 MTU)[25] was analyzed; at the Paducah site, about 450,000 MT of UF_6 (310,000 MTU) was analyzed. The 4,900 MTU of LEU product that would be produced under the Proposed Action described in this EA is about 3 percent of the uranium analyzed at Portsmouth and about 2 percent of the uranium analyzed at Paducah. Furthermore, the LEU would be the result of enrichment of UF_6 stored at DOE Paducah and DOE Portsmouth and would not represent a net increase in the uranium managed at the combined facilities.

4.5.2 Direct Sale Alternative

Under the Direct Sale Alternative, DOE assumes that purchasers would take delivery, transport and enrich the NU, DU, and LEU feed material, and transport and store the resultant NU and LEU product and DU tails in essentially the same manner and using essentially the same facilities as would DOE under the Enrichment Alternative. For that reason, DOE finds that the cumulative transportation, enrichment, and storage impacts of the Direct Sale Alternative would be essentially identical to those of the Enrichment Alternative.

4.5.3 No Action Alternative

Under the No Action Alternative, DOE would not enrich and/or sell any of the excess inventory but rather would continue with existing plans to convert the excess DU stored at Portsmouth and Paducah to a more stable chemical form at the two new conversion facilities and would continue to store excess NU and LEU as it is currently being stored at these two sites. The cumulative impacts that would occur under the No Action Alternative assessed in this EA are the same as the cumulative impacts identified for the two new conversion facilities in Table 4.3, Summary of Expected Impacts from Operation of the Paducah and the Portsmouth Conversion Facilities.

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[25] To convert MT of UF_6 to MTU, multiply by 0.67612 (USEC 2006, Table 5).

5.0 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES AND SHORT-TERM USES OF THE ENVIRONMENT VS. LONG-TERM PRODUCTIVITY

5.1 Irreversible and Irretrievable Commitment of Resources

An *irreversible* commitment of resources is defined as the loss of future options. The term applies primarily to the effects of using nonrenewable resources (such as minerals or cultural resources) or resources that are renewable only over long periods (such as soil productivity). It could also apply to the loss of an experience as an indirect effect of a “permanent” change in the nature or character of the land. An *irretrievable* commitment of resources is defined as the loss of production, harvest, or use of natural resources. The amount of production forgone is irretrievable, but the action is not irreversible. If the use changes, it is possible to resume production.

Under both alternatives in DOE’s Proposed Action, DOE assumes that the excess inventory would be enriched to NU and/or up to LEU and then, presumably, used to manufacture nuclear reactor fuel. Therefore, these alternatives contemplate the potential use of DU, that otherwise would be disposed, to produce nuclear reactor fuel.

The irreversible and irretrievable commitments of resources associated with the Proposed Action are the use and cost of transportation fuel, energy to run nuclear fuel cycle plants, the use of uranium fuel in nuclear reactors to produce electricity, labor, materials, and funds. There would be no irretrievable commitments of biological productivity or resources.

Currently, the United States uses an open (or once-through) nuclear energy fuel cycle, in which nuclear fuel is used in a power reactor one time and the resulting spent nuclear fuel is stored for eventual disposal in a geologic repository. However, as part of the President’s Advanced Energy Initiative, the Global Nuclear Energy Partnership (GNEP) program has proposed that spent fuel could, in the future, be recycled and reused as new fuel. This proposal is being evaluated in the GNEP *Programmatic Environmental Impact Statement* (DOE 2008a).

5.2 The Relationship between Local Short-Term Uses of the Human Environment and the Maintenance and Enhancement of Long-Term Productivity

The Proposed Action does not involve major new construction. It would be implemented at existing sites or sites currently under construction, and over existing transportation corridors. There would be no incremental loss of long-term biological productivity or open-space values. The Proposed Action could reduce reliance on fossil fuels.

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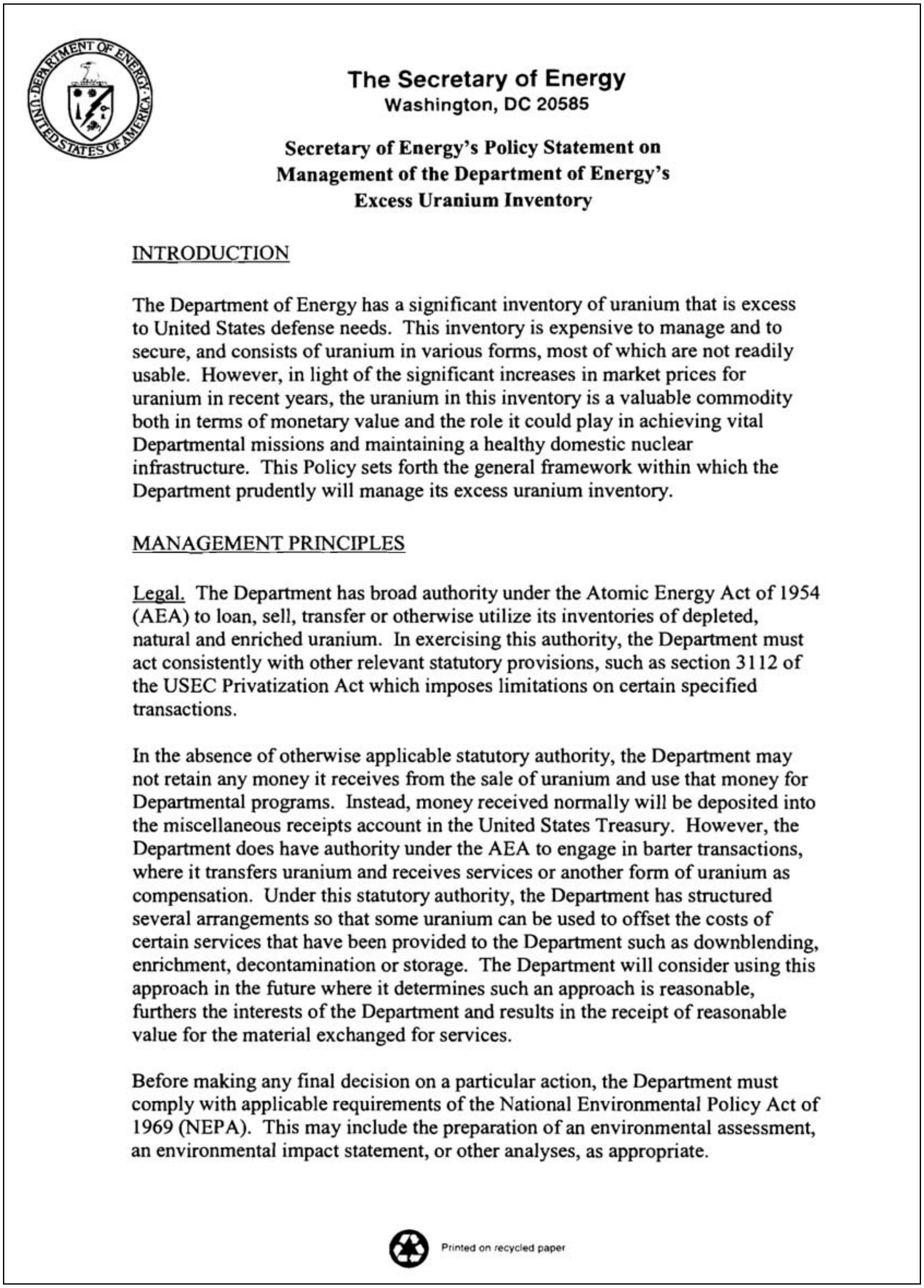
APPENDIX A: SECRETARY OF ENERGY'S MARCH 2008 POLICY STATEMENT



The Secretary of Energy
Washington, DC 20585

Secretary of Energy's Policy Statement on Management of the Department of Energy's Excess Uranium Inventory

INTRODUCTION

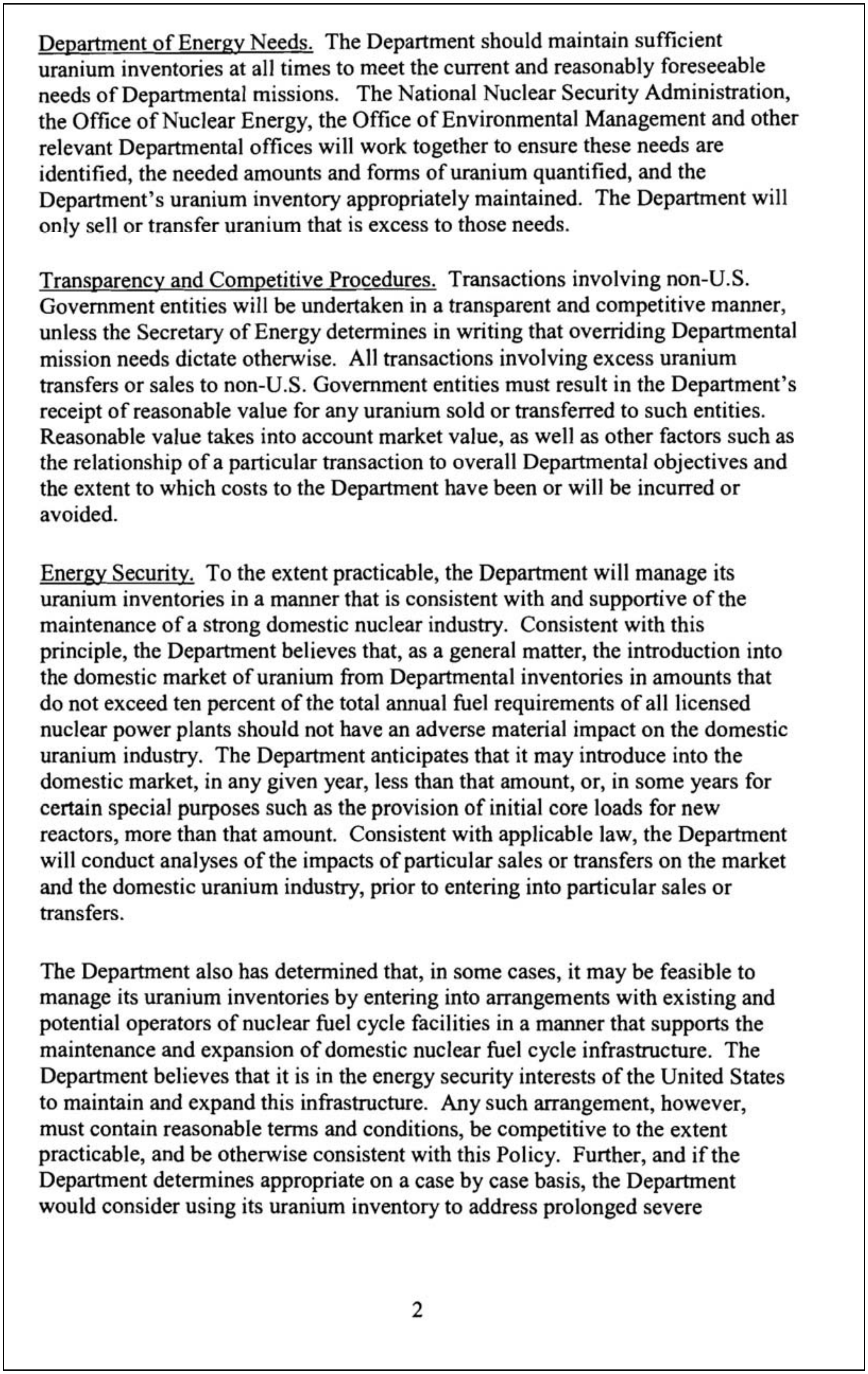
The Department of Energy has a significant inventory of uranium that is excess to United States defense needs. This inventory is expensive to manage and to secure, and consists of uranium in various forms, most of which are not readily usable. However, in light of the significant increases in market prices for uranium in recent years, the uranium in this inventory is a valuable commodity both in terms of monetary value and the role it could play in achieving vital Departmental missions and maintaining a healthy domestic nuclear infrastructure. This Policy sets forth the general framework within which the Department prudently will manage its excess uranium inventory.

MANAGEMENT PRINCIPLES

Legal. The Department has broad authority under the Atomic Energy Act of 1954 (AEA) to loan, sell, transfer or otherwise utilize its inventories of depleted, natural and enriched uranium. In exercising this authority, the Department must act consistently with other relevant statutory provisions, such as section 3112 of the USEC Privatization Act which imposes limitations on certain specified transactions.

In the absence of otherwise applicable statutory authority, the Department may not retain any money it receives from the sale of uranium and use that money for Departmental programs. Instead, money received normally will be deposited into the miscellaneous receipts account in the United States Treasury. However, the Department does have authority under the AEA to engage in barter transactions, where it transfers uranium and receives services or another form of uranium as compensation. Under this statutory authority, the Department has structured several arrangements so that some uranium can be used to offset the costs of certain services that have been provided to the Department such as downblending, enrichment, decontamination or storage. The Department will consider using this approach in the future where it determines such an approach is reasonable, furthers the interests of the Department and results in the receipt of reasonable value for the material exchanged for services.

Before making any final decision on a particular action, the Department must comply with applicable requirements of the National Environmental Policy Act of 1969 (NEPA). This may include the preparation of an environmental assessment, an environmental impact statement, or other analyses, as appropriate.

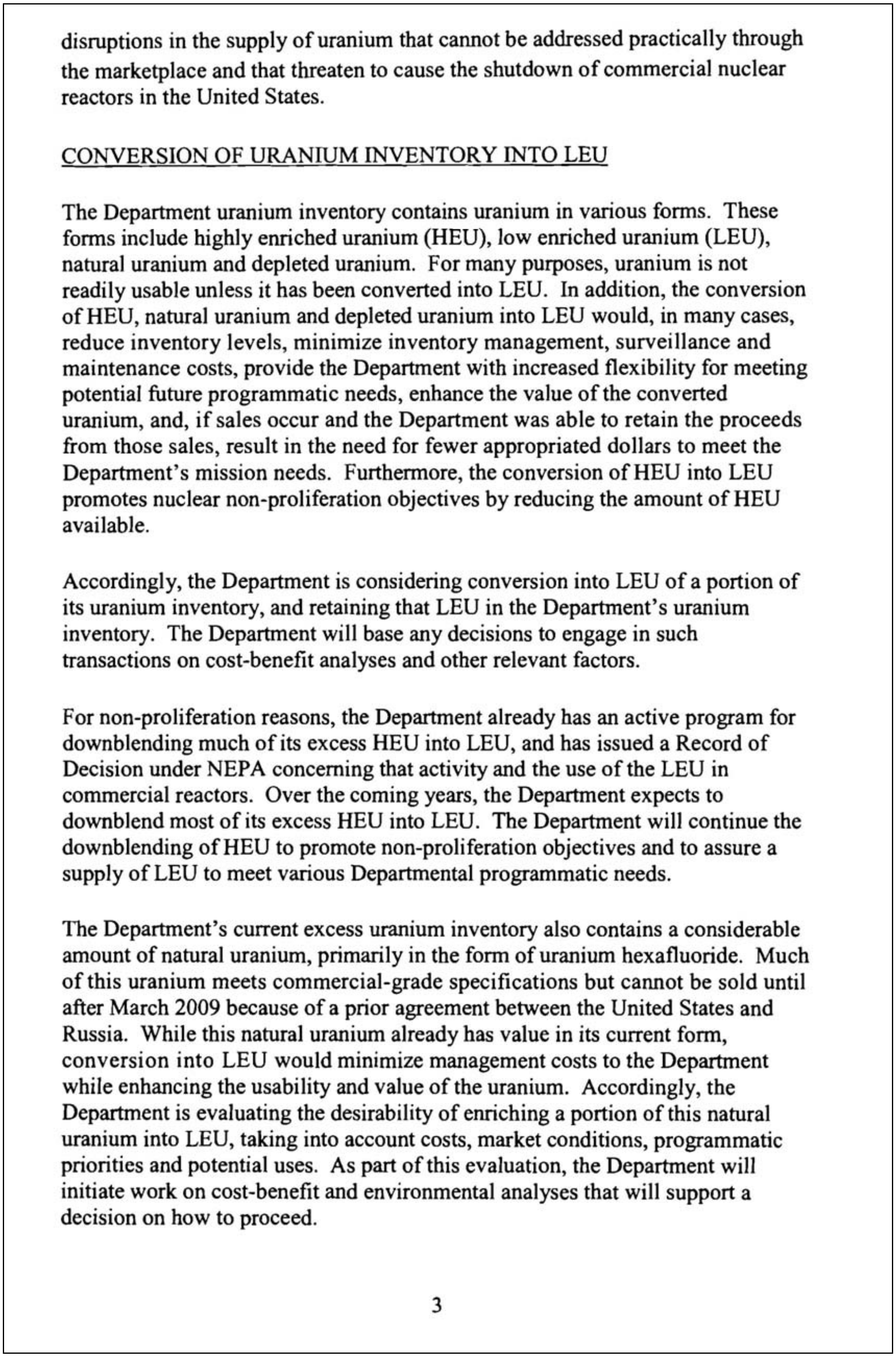


Department of Energy Needs. The Department should maintain sufficient uranium inventories at all times to meet the current and reasonably foreseeable needs of Departmental missions. The National Nuclear Security Administration, the Office of Nuclear Energy, the Office of Environmental Management and other relevant Departmental offices will work together to ensure these needs are identified, the needed amounts and forms of uranium quantified, and the Department's uranium inventory appropriately maintained. The Department will only sell or transfer uranium that is excess to those needs.

Transparency and Competitive Procedures. Transactions involving non-U.S. Government entities will be undertaken in a transparent and competitive manner, unless the Secretary of Energy determines in writing that overriding Departmental mission needs dictate otherwise. All transactions involving excess uranium transfers or sales to non-U.S. Government entities must result in the Department's receipt of reasonable value for any uranium sold or transferred to such entities. Reasonable value takes into account market value, as well as other factors such as the relationship of a particular transaction to overall Departmental objectives and the extent to which costs to the Department have been or will be incurred or avoided.

Energy Security. To the extent practicable, the Department will manage its uranium inventories in a manner that is consistent with and supportive of the maintenance of a strong domestic nuclear industry. Consistent with this principle, the Department believes that, as a general matter, the introduction into the domestic market of uranium from Departmental inventories in amounts that do not exceed ten percent of the total annual fuel requirements of all licensed nuclear power plants should not have an adverse material impact on the domestic uranium industry. The Department anticipates that it may introduce into the domestic market, in any given year, less than that amount, or, in some years for certain special purposes such as the provision of initial core loads for new reactors, more than that amount. Consistent with applicable law, the Department will conduct analyses of the impacts of particular sales or transfers on the market and the domestic uranium industry, prior to entering into particular sales or transfers.

The Department also has determined that, in some cases, it may be feasible to manage its uranium inventories by entering into arrangements with existing and potential operators of nuclear fuel cycle facilities in a manner that supports the maintenance and expansion of domestic nuclear fuel cycle infrastructure. The Department believes that it is in the energy security interests of the United States to maintain and expand this infrastructure. Any such arrangement, however, must contain reasonable terms and conditions, be competitive to the extent practicable, and be otherwise consistent with this Policy. Further, and if the Department determines appropriate on a case by case basis, the Department would consider using its uranium inventory to address prolonged severe



disruptions in the supply of uranium that cannot be addressed practically through the marketplace and that threaten to cause the shutdown of commercial nuclear reactors in the United States.

CONVERSION OF URANIUM INVENTORY INTO LEU

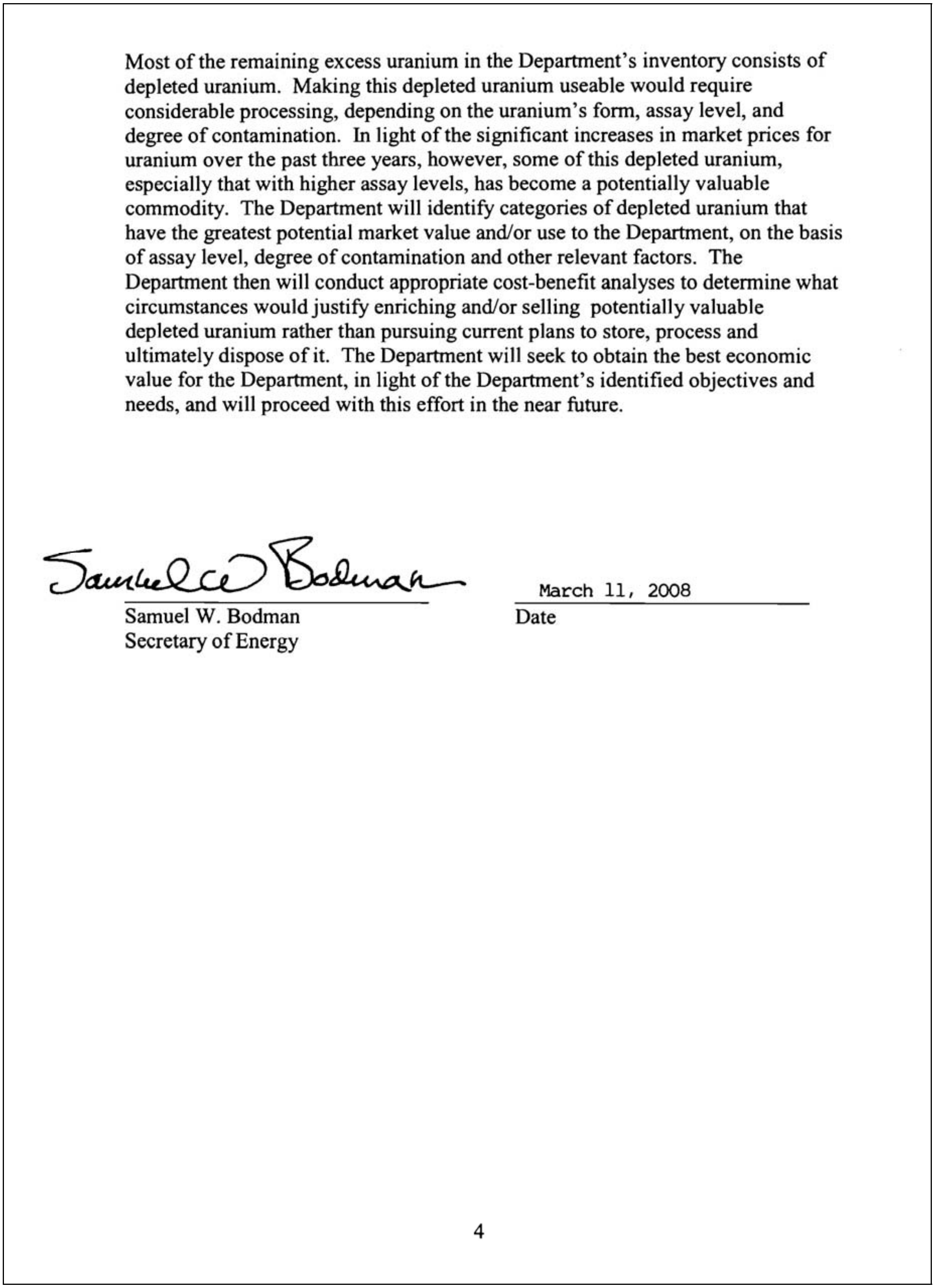
The Department uranium inventory contains uranium in various forms. These forms include highly enriched uranium (HEU), low enriched uranium (LEU), natural uranium and depleted uranium. For many purposes, uranium is not readily usable unless it has been converted into LEU. In addition, the conversion of HEU, natural uranium and depleted uranium into LEU would, in many cases, reduce inventory levels, minimize inventory management, surveillance and maintenance costs, provide the Department with increased flexibility for meeting potential future programmatic needs, enhance the value of the converted uranium, and, if sales occur and the Department was able to retain the proceeds from those sales, result in the need for fewer appropriated dollars to meet the Department's mission needs. Furthermore, the conversion of HEU into LEU promotes nuclear non-proliferation objectives by reducing the amount of HEU available.

Accordingly, the Department is considering conversion into LEU of a portion of its uranium inventory, and retaining that LEU in the Department's uranium inventory. The Department will base any decisions to engage in such transactions on cost-benefit analyses and other relevant factors.

For non-proliferation reasons, the Department already has an active program for downblending much of its excess HEU into LEU, and has issued a Record of Decision under NEPA concerning that activity and the use of the LEU in commercial reactors. Over the coming years, the Department expects to downblend most of its excess HEU into LEU. The Department will continue the downblending of HEU to promote non-proliferation objectives and to assure a supply of LEU to meet various Departmental programmatic needs.

The Department's current excess uranium inventory also contains a considerable amount of natural uranium, primarily in the form of uranium hexafluoride. Much of this uranium meets commercial-grade specifications but cannot be sold until after March 2009 because of a prior agreement between the United States and Russia. While this natural uranium already has value in its current form, conversion into LEU would minimize management costs to the Department while enhancing the usability and value of the uranium. Accordingly, the Department is evaluating the desirability of enriching a portion of this natural uranium into LEU, taking into account costs, market conditions, programmatic priorities and potential uses. As part of this evaluation, the Department will initiate work on cost-benefit and environmental analyses that will support a decision on how to proceed.

3



Most of the remaining excess uranium in the Department's inventory consists of depleted uranium. Making this depleted uranium useable would require considerable processing, depending on the uranium's form, assay level, and degree of contamination. In light of the significant increases in market prices for uranium over the past three years, however, some of this depleted uranium, especially that with higher assay levels, has become a potentially valuable commodity. The Department will identify categories of depleted uranium that have the greatest potential market value and/or use to the Department, on the basis of assay level, degree of contamination and other relevant factors. The Department then will conduct appropriate cost-benefit analyses to determine what circumstances would justify enriching and/or selling potentially valuable depleted uranium rather than pursuing current plans to store, process and ultimately dispose of it. The Department will seek to obtain the best economic value for the Department, in light of the Department's identified objectives and needs, and will proceed with this effort in the near future.

Samuel W Bodman

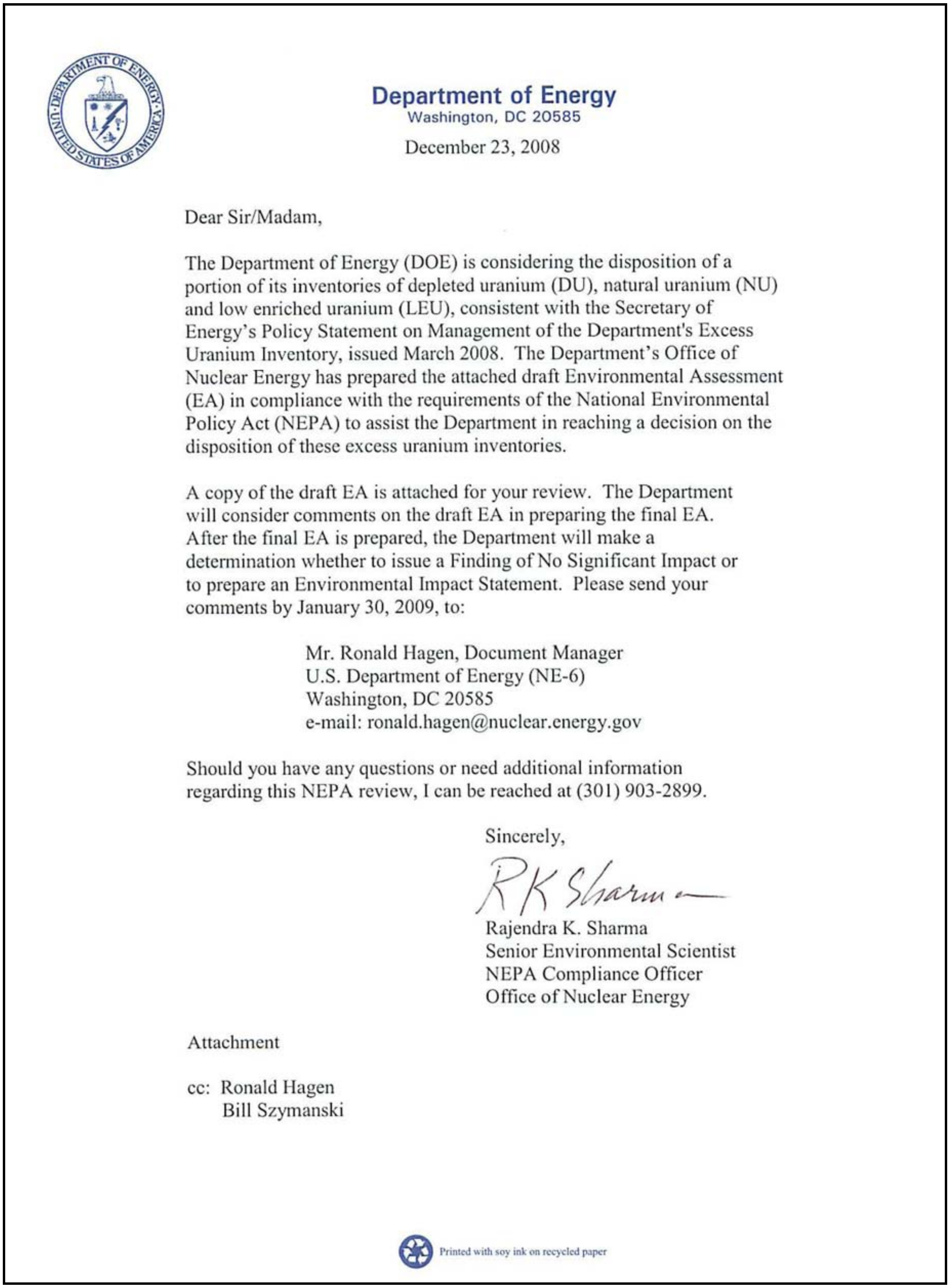
Samuel W. Bodman
Secretary of Energy

March 11, 2008
Date

APPENDIX B: TRANSMITTAL LETTERS AND DISTRIBUTION LISTS

This appendix contains (1) copies of the transmittal letters sent to the agencies, organizations, and individuals receiving this draft environmental assessment (EA), and (2) the distribution lists containing the names of those receiving the EA.

Transmittal Letters



Department of Energy
Washington, DC 20585

December 23, 2008

Dear Sir/Madam,

The Department of Energy (DOE) is considering the disposition of a portion of its inventories of depleted uranium (DU), natural uranium (NU) and low enriched uranium (LEU), consistent with the Secretary of Energy's Policy Statement on Management of the Department's Excess Uranium Inventory, issued March 2008. The Department's Office of Nuclear Energy has prepared the attached draft Environmental Assessment (EA) in compliance with the requirements of the National Environmental Policy Act (NEPA) to assist the Department in reaching a decision on the disposition of these excess uranium inventories.

A copy of the draft EA is attached for your review. The Department will consider comments on the draft EA in preparing the final EA. After the final EA is prepared, the Department will make a determination whether to issue a Finding of No Significant Impact or to prepare an Environmental Impact Statement. Please send your comments by January 30, 2009, to:

Mr. Ronald Hagen, Document Manager
U.S. Department of Energy (NE-6)
Washington, DC 20585
e-mail: ronald.hagen@nuclear.energy.gov

Should you have any questions or need additional information regarding this NEPA review, I can be reached at (301) 903-2899.

Sincerely,

RK Sharma

Rajendra K. Sharma
Senior Environmental Scientist
NEPA Compliance Officer
Office of Nuclear Energy

Attachment

cc: Ronald Hagen
Bill Szymanski

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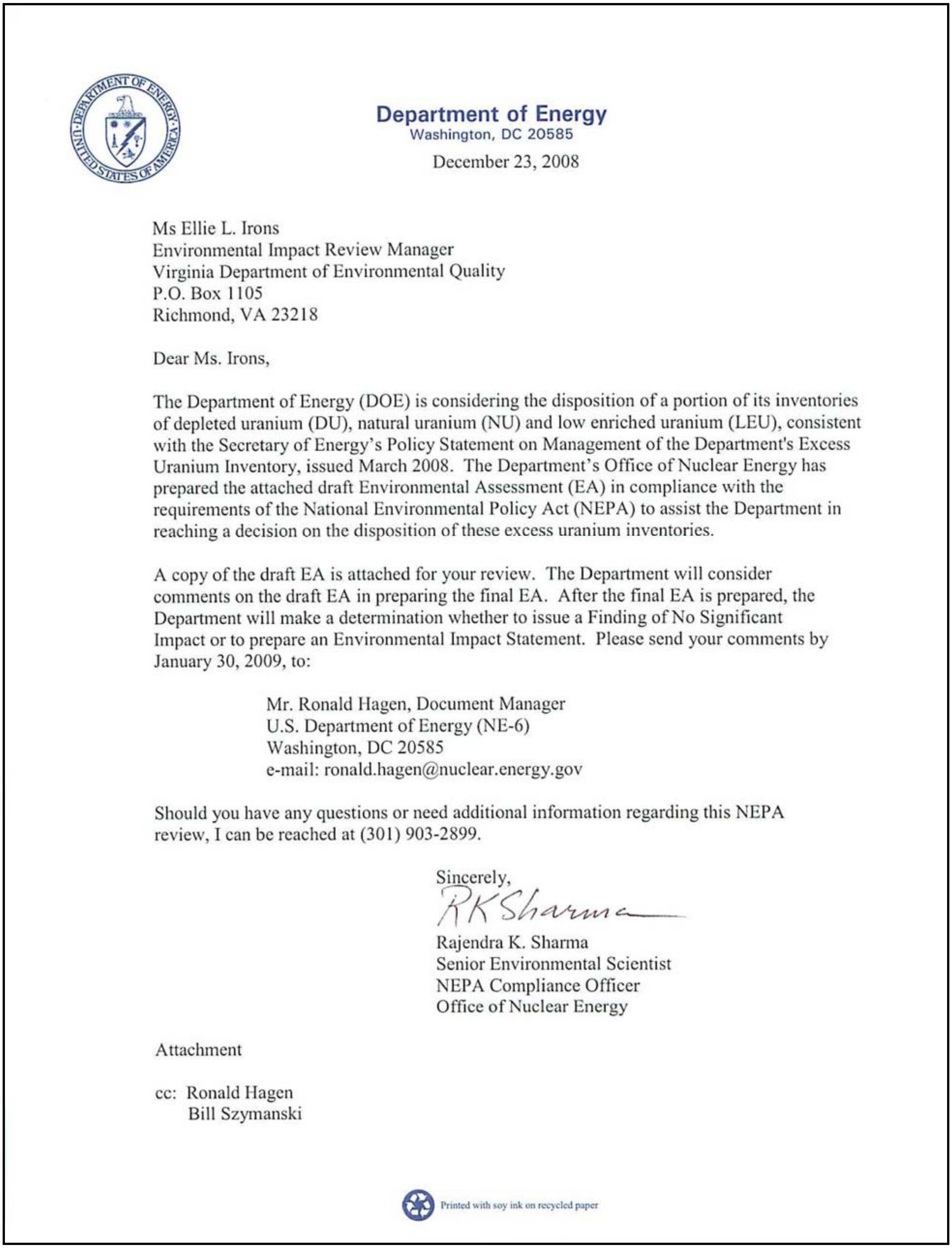

Department of Energy
Washington, DC 20585

December 23, 2008

Ms Ellie L. Irons
Environmental Impact Review Manager
Virginia Department of Environmental Quality
P.O. Box 1105
Richmond, VA 23218

Dear Ms. Irons,

The Department of Energy (DOE) is considering the disposition of a portion of its inventories of depleted uranium (DU), natural uranium (NU) and low enriched uranium (LEU), consistent with the Secretary of Energy's Policy Statement on Management of the Department's Excess Uranium Inventory, issued March 2008. The Department's Office of Nuclear Energy has prepared the attached draft Environmental Assessment (EA) in compliance with the requirements of the National Environmental Policy Act (NEPA) to assist the Department in reaching a decision on the disposition of these excess uranium inventories.

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Washington, DC 20585
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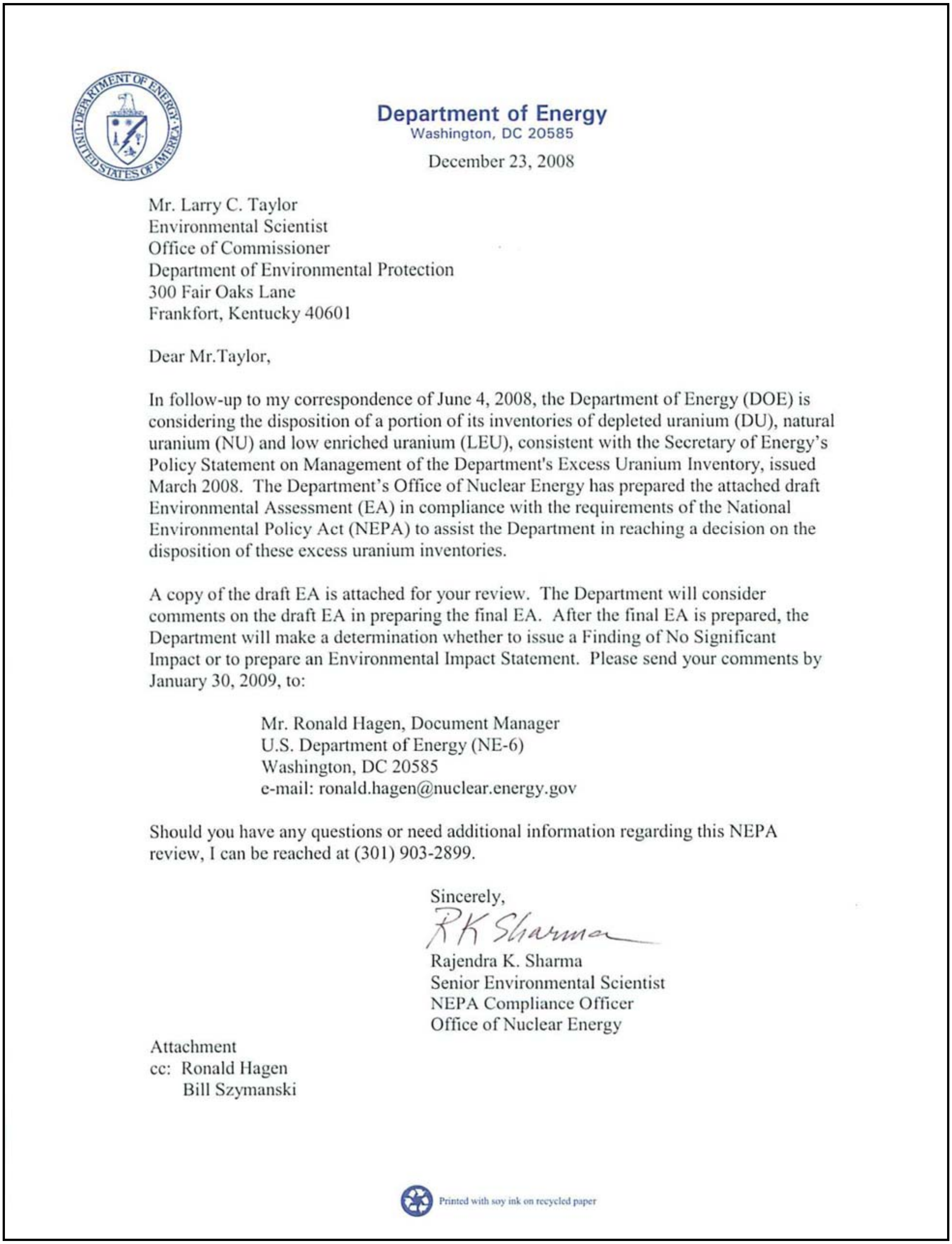
Sincerely,
RK Sharma
Rajendra K. Sharma
Senior Environmental Scientist
NEPA Compliance Officer
Office of Nuclear Energy

Attachment

cc: Ronald Hagen
Bill Szymanski



Department of Energy
Washington, DC 20585

December 23, 2008

Mr. Larry C. Taylor
Environmental Scientist
Office of Commissioner
Department of Environmental Protection
300 Fair Oaks Lane
Frankfort, Kentucky 40601

Dear Mr.Taylor,

In follow-up to my correspondence of June 4, 2008, the Department of Energy (DOE) is considering the disposition of a portion of its inventories of depleted uranium (DU), natural uranium (NU) and low enriched uranium (LEU), consistent with the Secretary of Energy's Policy Statement on Management of the Department's Excess Uranium Inventory, issued March 2008. The Department's Office of Nuclear Energy has prepared the attached draft Environmental Assessment (EA) in compliance with the requirements of the National Environmental Policy Act (NEPA) to assist the Department in reaching a decision on the disposition of these excess uranium inventories.

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e-mail: ronald.hagen@nuclear.energy.gov

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RK Sharma

Rajendra K. Sharma
Senior Environmental Scientist
NEPA Compliance Officer
Office of Nuclear Energy

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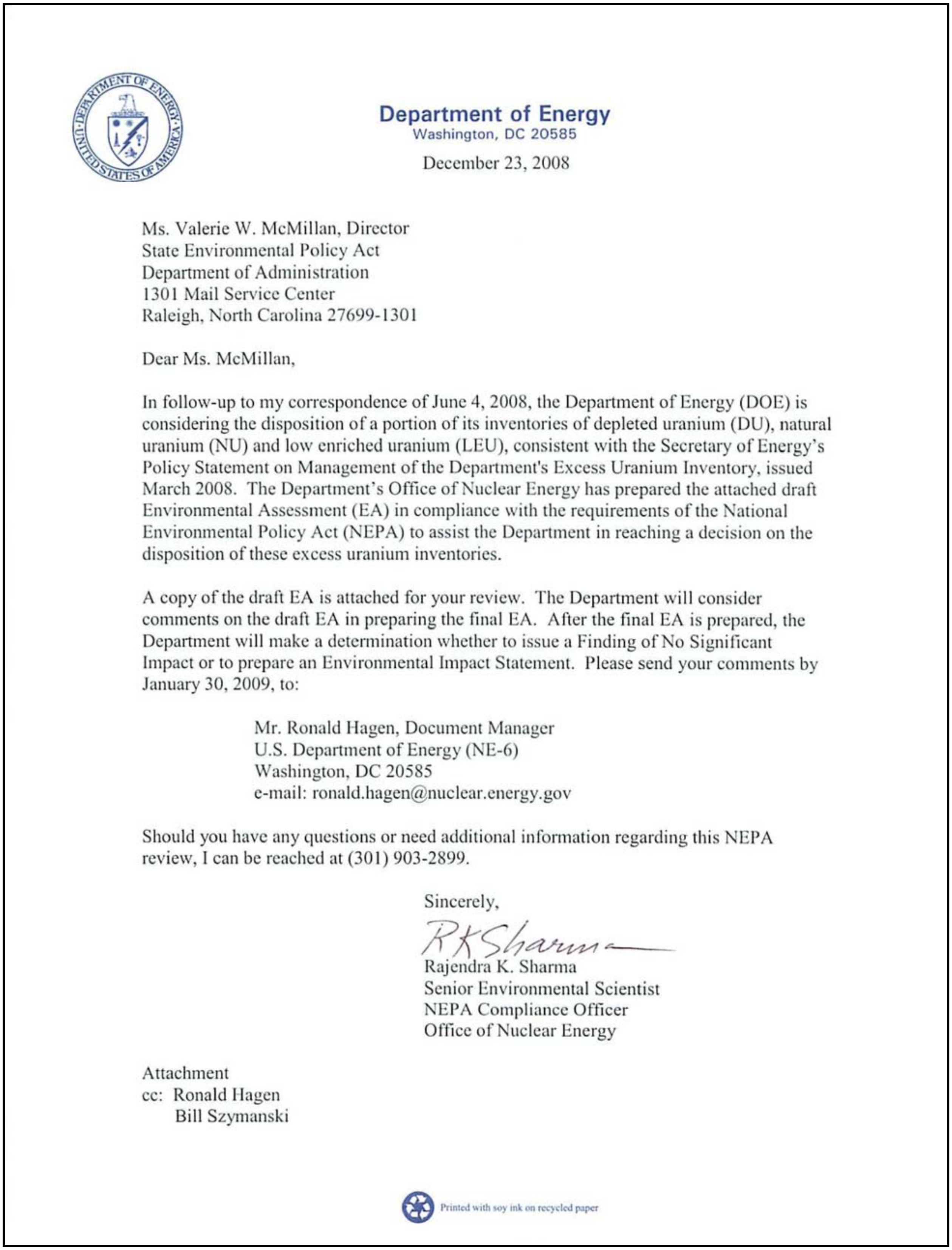

Department of Energy
Washington, DC 20585

December 23, 2008

Ms. Valerie W. McMillan, Director
State Environmental Policy Act
Department of Administration
1301 Mail Service Center
Raleigh, North Carolina 27699-1301

Dear Ms. McMillan,

In follow-up to my correspondence of June 4, 2008, the Department of Energy (DOE) is considering the disposition of a portion of its inventories of depleted uranium (DU), natural uranium (NU) and low enriched uranium (LEU), consistent with the Secretary of Energy's Policy Statement on Management of the Department's Excess Uranium Inventory, issued March 2008. The Department's Office of Nuclear Energy has prepared the attached draft Environmental Assessment (EA) in compliance with the requirements of the National Environmental Policy Act (NEPA) to assist the Department in reaching a decision on the disposition of these excess uranium inventories.

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Washington, DC 20585
e-mail: ronald.hagen@nuclear.energy.gov

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RKSharma

Rajendra K. Sharma
Senior Environmental Scientist
NEPA Compliance Officer
Office of Nuclear Energy

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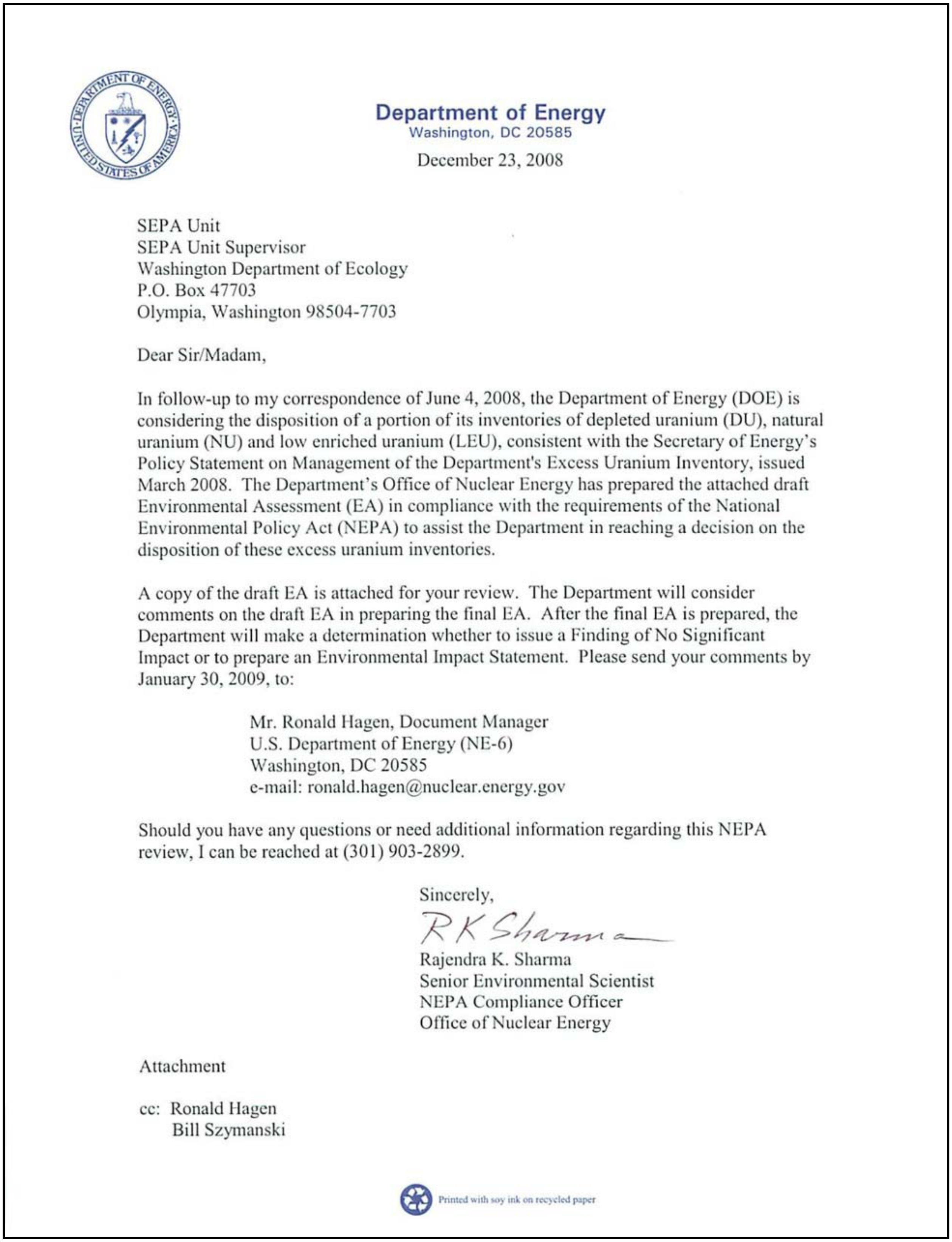

Department of Energy
Washington, DC 20585

December 23, 2008

SEPA Unit
SEPA Unit Supervisor
Washington Department of Ecology
P.O. Box 47703
Olympia, Washington 98504-7703

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Washington, DC 20585
e-mail: ronald.hagen@nuclear.energy.gov

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Sincerely,

R K Sharma

Rajendra K. Sharma
Senior Environmental Scientist
NEPA Compliance Officer
Office of Nuclear Energy

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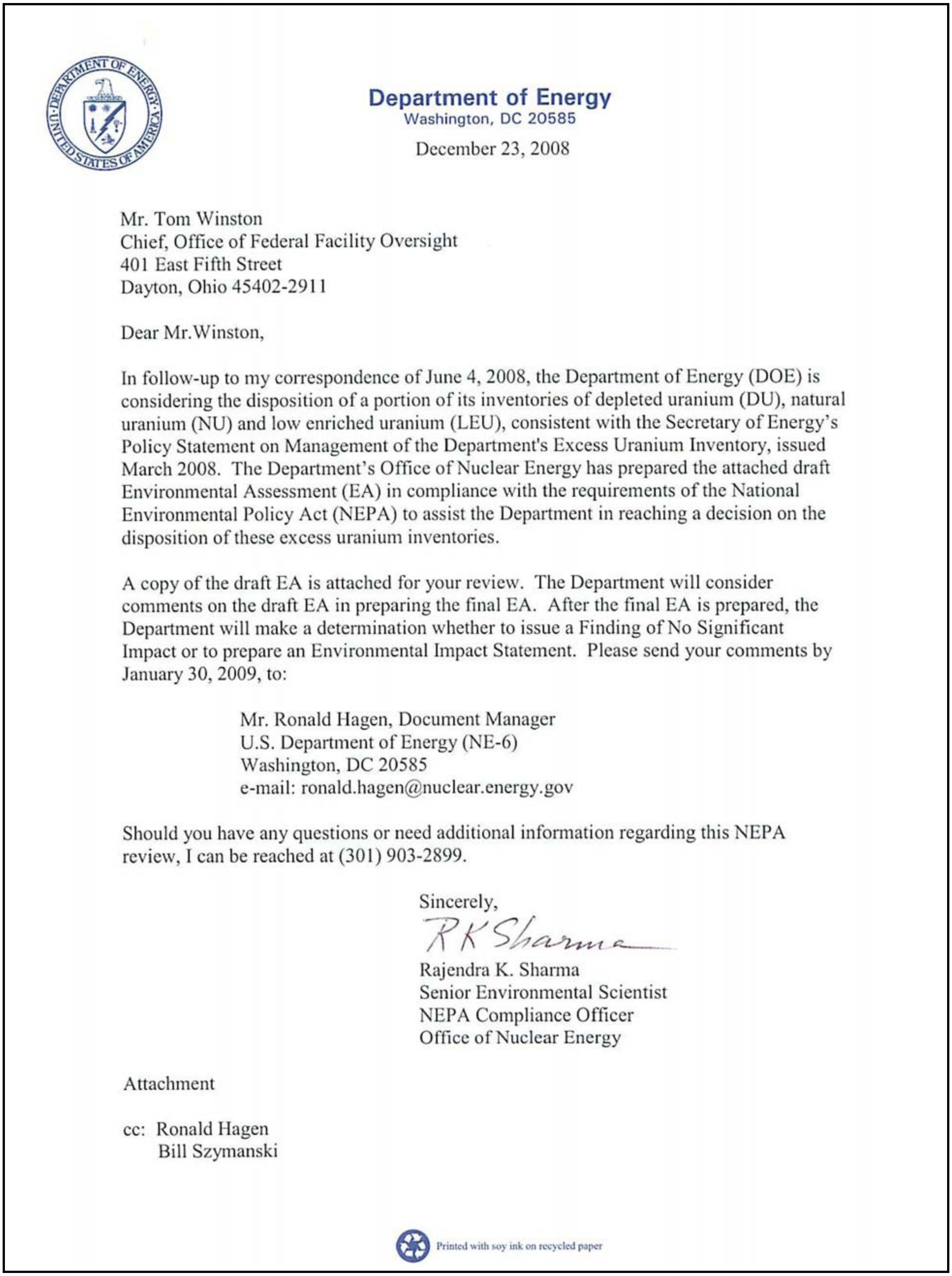

Department of Energy
Washington, DC 20585

December 23, 2008

Mr. Tom Winston
Chief, Office of Federal Facility Oversight
401 East Fifth Street
Dayton, Ohio 45402-2911

Dear Mr.Winston,

In follow-up to my correspondence of June 4, 2008, the Department of Energy (DOE) is considering the disposition of a portion of its inventories of depleted uranium (DU), natural uranium (NU) and low enriched uranium (LEU), consistent with the Secretary of Energy's Policy Statement on Management of the Department's Excess Uranium Inventory, issued March 2008. The Department's Office of Nuclear Energy has prepared the attached draft Environmental Assessment (EA) in compliance with the requirements of the National Environmental Policy Act (NEPA) to assist the Department in reaching a decision on the disposition of these excess uranium inventories.

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Washington, DC 20585
e-mail: ronald.hagen@nuclear.energy.gov

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Sincerely,

RK Sharma

Rajendra K. Sharma
Senior Environmental Scientist
NEPA Compliance Officer
Office of Nuclear Energy

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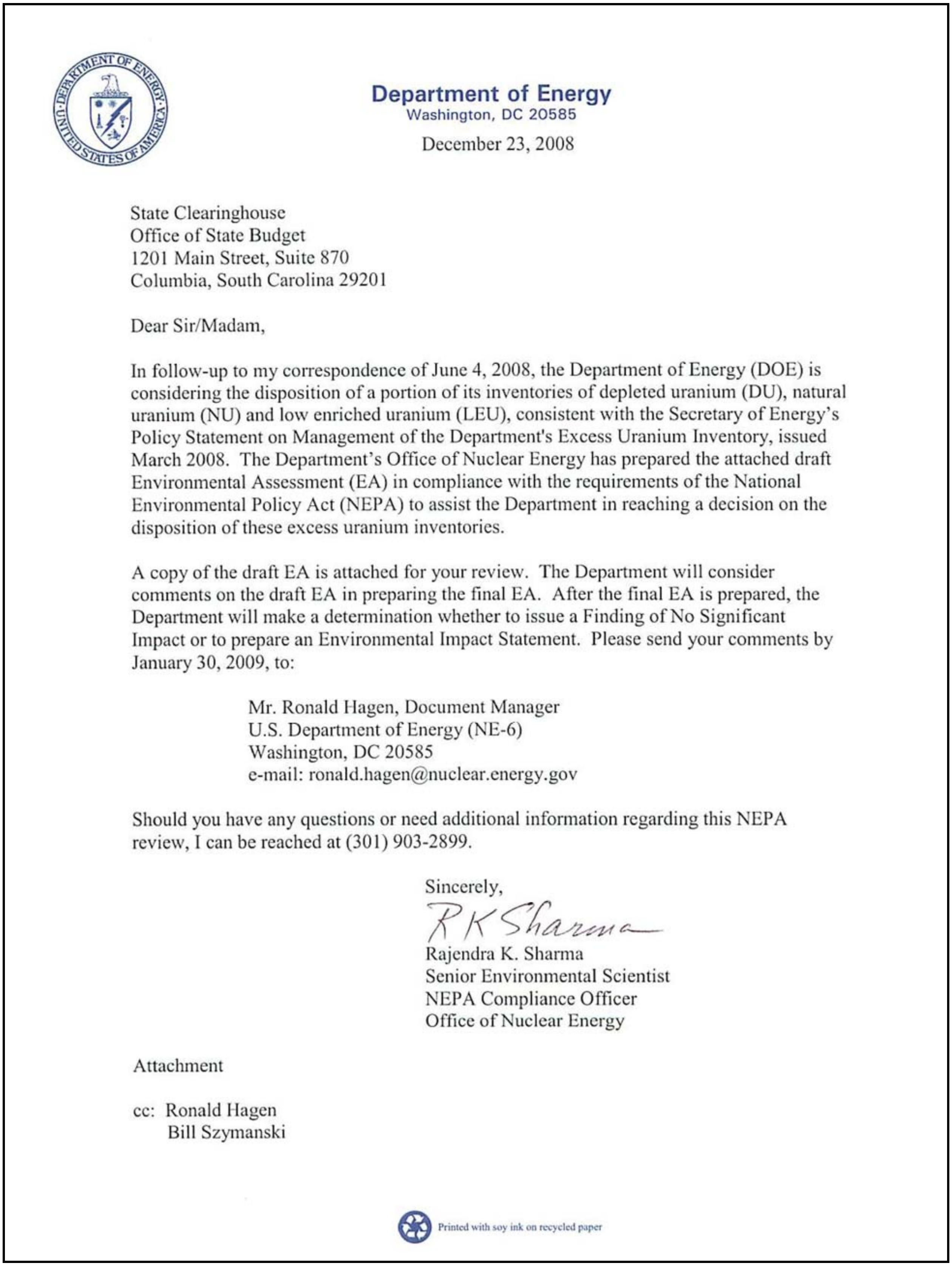
Bill Szymanski



Department of Energy
Washington, DC 20585

December 23, 2008

State Clearinghouse
Office of State Budget
1201 Main Street, Suite 870
Columbia, South Carolina 29201

Dear Sir/Madam,

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Washington, DC 20585
e-mail: ronald.hagen@nuclear.energy.gov

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R K Sharma

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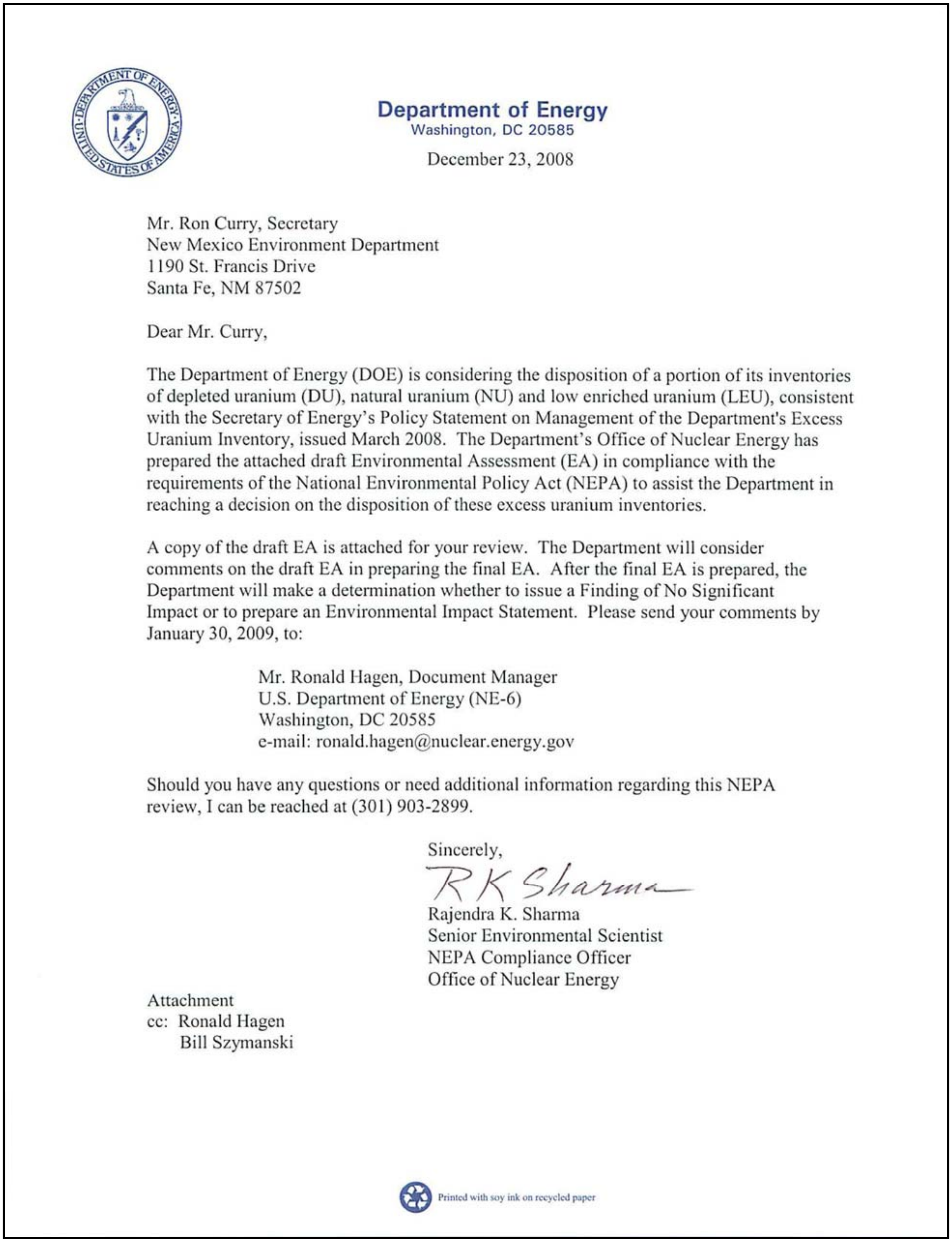

Department of Energy
Washington, DC 20585

December 23, 2008

Mr. Ron Curry, Secretary
New Mexico Environment Department
1190 St. Francis Drive
Santa Fe, NM 87502

Dear Mr. Curry,

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Washington, DC 20585
e-mail: ronald.hagen@nuclear.energy.gov

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R K Sharma

Rajendra K. Sharma
Senior Environmental Scientist
NEPA Compliance Officer
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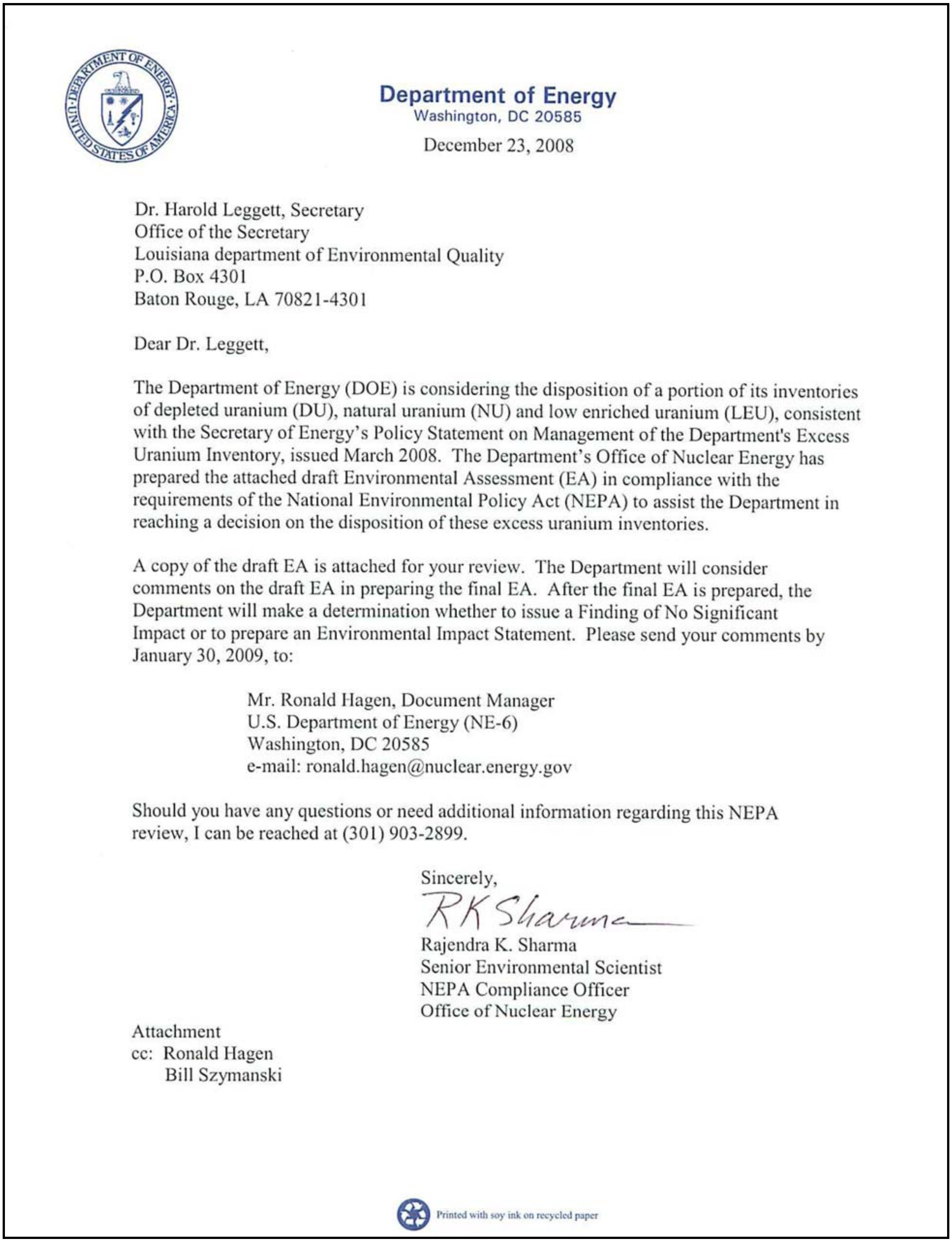

Department of Energy
Washington, DC 20585

December 23, 2008

Dr. Harold Leggett, Secretary
Office of the Secretary
Louisiana department of Environmental Quality
P.O. Box 4301
Baton Rouge, LA 70821-4301

Dear Dr. Leggett,

The Department of Energy (DOE) is considering the disposition of a portion of its inventories of depleted uranium (DU), natural uranium (NU) and low enriched uranium (LEU), consistent with the Secretary of Energy's Policy Statement on Management of the Department's Excess Uranium Inventory, issued March 2008. The Department's Office of Nuclear Energy has prepared the attached draft Environmental Assessment (EA) in compliance with the requirements of the National Environmental Policy Act (NEPA) to assist the Department in reaching a decision on the disposition of these excess uranium inventories.

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U.S. Department of Energy (NE-6)
Washington, DC 20585
e-mail: ronald.hagen@nuclear.energy.gov

Should you have any questions or need additional information regarding this NEPA review, I can be reached at (301) 903-2899.

Sincerely,

RK Sharma

Rajendra K. Sharma
Senior Environmental Scientist
NEPA Compliance Officer
Office of Nuclear Energy

Attachment
cc: Ronald Hagen
Bill Szymanski

Distribution List

State Agencies

Mr. Larry C. Taylor
Environmental Scientist IV
Office of the Commissioner
Department for Environmental Protection
300 Fair Oaks Lane
Frankfort, Kentucky 40601

Dr. Harold Leggett
Secretary
Office of the Secretary
Louisiana Dept. of Environmental Quality
PO Box 4301
Baton Rouge, LA 70821-4301

Mr. Ron Curry
Secretary
New Mexico Environment Department
1190 St. Francis Drive
Santa Fe, NM 87502

Ms. Valerie W. McMillan
Director, State Environmental Policy Act
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1301 Mail Service Center
Raleigh, North Carolina 27699-1301

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Chief, Office of Federal Facility Oversight
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1201 Main Street, Suite 870
Columbia, South Carolina 29201

Ms. Ellie L. Irons
Environmental Impact Review Manager
Virginia Department of Environmental Quality
P.O. Box 1105
Richmond, Virginia 23218

SEPA Unit
SEPA Unit Supervisor
Washington Department of Ecology
P.O. Box 47703
Olympia, Washington 98504-7703

General Distribution

Director
Office of Nuclear Materials Safety and Safeguards
Mail Stop EBB1-D2M
U. S. Nuclear Regulatory Commission
6003 Executive Boulevard
Rockville, MD 20852

Mr. Steve Penrod
General Manager
USEC
P.O. Box 1410-5600
Paducah, KY 142002-1410

Cheryl Collins
Uranium Management Services
GE Hitachi Nuclear Energy
3901 Castle Hayne Road
Mail Code J20
Wilmington, NC 28402

Frank Masseth
Commercial Project Manager
AREVA NP Inc.
An AREVA and Siemens company
3315 Old Forest Road OF-11
Lynchburg, Va. 24501

Jim Andreen
Westinghouse Electric Company
MS10
Drawer R
Columbia, SC 29250

Jim Andreen
Westinghouse Electric Company
MS10
5801 Bluff Rd
Hopkins, SC 29061

Mr. John Indall
P.O. Box 669
Santa Fe, NM 87504-0669

Mr. Jim Graham
President & CEO
ConverDyn
7800 East Dorado Place, Suite 200
Englewood, CO 80111

APPENDIX C: OTHER NEPA DOCUMENTS CONSIDERED

Table C-1. Other NEPA Documents Considered

Description of the Proposed Action	ROD	Comments
EISs for Uranium Enrichment and Conversion Facilities and Programmatic EIS for Managing DUF_6		
Final EIS for the Proposed American Centrifuge Plant in Piketon, Ohio **NUREG-1834 (April 2006)** http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1834/		
The proposed action considered in this 2006 EIS was for the NRC to issue a license authorizing the United States Enrichment Corporation (USEC) to possess and use special nuclear material (SNM), source material, and byproduct material at the proposed American Centrifuge Plant (ACP), a gas centrifuge uranium enrichment facility. If a license were issued, USEC would construct, operate, and decommission the proposed ACP. The ACP would be located at the same site as DOE's Portsmouth Gaseous Diffusion Plant (GDP), which has been shut down since May 2001. The ACP would consist of refurbished existing buildings, newly constructed facilities, and adjacent grounds owned by DOE and leased by USEC. The enriched uranium would be used in commercial nuclear power plants.	The NRC has issued a license to USEC.	This EA incorporates by reference the description of the ACP site environment and the impacts associated with operation of the ACP.
Final EIS for the Proposed National Enrichment Facility in Lea County, New Mexico **NUREG-1790 (June 2005)** http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1790/		
The proposed action considered in this 2005 EIS was for the NRC to issue a license authorizing Louisiana Energy Services (LES) to possess and use SNM, source material, and byproduct material at the proposed National Enrichment Facility (NEF), a gas centrifuge uranium enrichment facility proposed to be located at a site near the city of Eunice in Lea County, New Mexico. If a license were issued, LES would construct, operate, and decommission the proposed NEF. The proposed NEF property and facilities would remain the property of Lea County until they were deeded over to LES at license termination. The proposed NEF would produce enriched uranium-235 (^{235}U) up to 5 weight percent by the gas centrifuge process. The enriched uranium would be used in commercial nuclear power plants.	The NRC has issued a license to LES.	This EA incorporates by reference the description of the NEF site environment and the impacts associated with operation of the NEF.

Table C-1. Other NEPA Documents Considered (continued)

Description of the Proposed Action	ROD	Comments
Final EIS for Construction and Operation of a Depleted Uranium Hexafluoride Conversion Facility at the Paducah, Kentucky, Site **DOE/EIS-0359 (June 2004)** http://web.ead.anl.gov/uranium/documents/paddeis/index.cfm		
The proposed action evaluated in this 2004 EIS is for DOE to construct and operate a facility at the Paducah site for converting the Paducah DUF$_6$ inventory into DU oxide (primarily U_3O_8) and other conversion products. The action includes construction, operation, maintenance, and decontamination and decommissioning (D&D) of the proposed DUF$_6$ conversion facility at the Paducah site; transportation of DU conversion products and waste materials to a disposal facility; transportation and sale of the hydrogen fluoride (HF) produced as a conversion co-product; and neutralization of HF to CaF_2 and its sale or disposal in the event that the HF product is not sold.	DOE decided to construct and operate the conversion facility in the south-central portion of the Paducah site.	This EA incorporates by reference the description of the Paducah site and its DU/NU inventory. It also summarizes and incorporates operational impacts at the conversion facility as the impacts for the No Action Alternative for this EA.
Final EIS for Construction and Operation of a Depleted Uranium Hexafluoride Conversion Facility at Portsmouth, Ohio, Site **DOE/EIS-0360 (June 2004)** http://web.ead.anl.gov/uranium/documents/portdeis/index.cfm		
The proposed action evaluated in this 2004 EIS is for DOE to construct and operate a facility at the Portsmouth site for converting the Portsmouth DUF$_6$ inventory into DU oxide (primarily U_3O_8) and other conversion products. The action includes construction, operation, maintenance, and D&D of the proposed DUF$_6$ conversion facility at the Portsmouth site; transportation of DUF$_6$ cylinders from ETTP to Portsmouth for conversion, and transportation of non-DUF$_6$ cylinders from ETTP to Portsmouth; construction of a new cylinder storage yard at Portsmouth (if required) for ETTP cylinders; transportation of DU conversion products and waste materials to a disposal facility; transportation and sale of the HF produced as a conversion co-product; and neutralization of HF to CaF_2 and its sale or disposal if the HF product is not sold.	DOE decided to construct and operate the conversion facility in the west-central portion of the Portsmouth site.	This EA incorporates by reference the description of the Portsmouth site and its DU/NU inventory. It also summarizes and incorporates operational impacts at the conversion facility as the impacts for the No Action Alternative for this EA.

Table C-1. Other NEPA Documents Considered (continued)

Description of the Proposed Action	ROD	Comments
DOE EISs (2) Addressing Transportation Impacts		
Final Programmatic Environmental Impact Statement for Alternative Strategies for the Long-Term Management and Use of Depleted Uranium Hexafluoride **DOE/EIS-0269 (April 1999)** http://web.ead.anl.gov/uranium/documents/nepacomp/peis/index.cfm		
This 1999 PEIS assessed the potential impacts of alternative DOE management strategies for DUF$_6$ stored at three DOE sites: Paducah site near Paducah, Kentucky; Portsmouth site near Portsmouth, Ohio; and K-25 site on the Oak Ridge Reservation, Oak Ridge, Tennessee. The alternatives analyzed in the PEIS included no action, long-term storage as UF$_6$, long-term storage as uranium oxide, use as uranium oxide, use as uranium metal, and disposal.	DOE decided to promptly convert the DUF$_6$ inventory to DU oxide, DU metal, or a combination of both.	This EA considers the transportation risks that were evaluated for all of the materials that are relevant to this EA. Transportation impacts were estimated for shipment by both truck and rail modes for most materials.
Final EIS on Disposition of Surplus Highly Enriched Uranium **DOE/EIS-0240-S (June 1996)** http://www.fas.org/nuke/control/fmd/docs/summary.pdf; http://www.epa.gov/fedrgstr/EPA-IMPACT/1995/October/Day-26/pr-1440.html		
This 1996 EIS assessed environmental impacts of five reasonable alternatives identified for the disposition of up to nominal 200 MT of excess HEU. This included HEU that had already been declared excess (175 MT) as well as additional weapons-usable HEU that could be declared excess in the future. The material was located at facilities throughout the Department's nuclear weapons complex, but the majority was in, or was destined for, interim storage at the Department's Y-12 Plant in Oak Ridge, Tennessee. Except for the no action alternative, all reasonable alternatives involved blending HEU with depleted, natural, or low-enriched uranium (LEU) to make LEU, which is not weapons-usable, and the majority of which would have potential commercial value as non-defense, nuclear power plant fuel feed. The alternatives, except for the no action alternative, reflected blending different proportions of the HEU to LEU for commercial use versus blending it to LEU for disposal as waste. The alternatives also presented different combinations of blending sites and blending processes.	DOE decided to implement a program to make excess highly enriched uranium (HEU) non-weapons-usable by blending it down to low enriched uranium (LEU).	Although the 1996 EIS is not directly related to this EA, it was reviewed for background and transportation impact insights.

Table C-1. Other NEPA Documents Considered (continued)

Description of the Proposed Action	ROD	Comments
DOE EA (1) Addressing Transportation Impacts		
Environmental Assessment for the Purchase of Russian Low Enriched Uranium Derived from the Dismantlement of Nuclear Weapons in the Countries of the Former Soviet Union **DOE/EA-0837, January (USEC/EA 94001)** http://www.osti.gov/bridge/product.biblio.jsp?osti_id=10144278		
The United States proposed to purchase from the Russian Federation low enriched uranium (LEU) derived from highly enriched uranium (HEU) resulting from the dismantlement of nuclear weapons in the countries of the former Soviet Union. This 1994 EA assessed the following: (1) shipment of the LEU from St. Petersburg, Russia, via the Gulf of Finland, Baltic Sea, North Sea, and Atlantic Ocean to one or more of seven proposed ports of entry (Port of Hampton Roads, Virginia; Port of Baltimore, Maryland; Port of Philadelphia and South New Jersey, Pennsylvania and New Jersey; Port of New York and New Jersey, New York and New Jersey; Port of Houston, Texas; Port of Charleston, South Carolina; and Port of Savannah, Georgia) by commercial ocean freighter; (2) transport of the LEU by commercial truck from the port of entry to the Portsmouth GDP; and (3) placement of the LEU in the GDP inventory where it would be made available to USEC utility customers to be fabricated into fuel as orders were received.	N/A	This EA considers the overseas transportation impacts assessed in the 1994 EA.
DOE EA (1) Addressing Economic Impacts of Uranium Sales		
DOE Sale of Surplus Natural and Low Enriched Uranium **DOE/EA-1172** http://www.ne.doe.gov/pdfFiles/finalea.pdf		
This 1996 EA evaluated the economic impacts associated with the proposed sale or disposition of excess uranium, both natural and low enriched, stored at the Department's GDPs near Piketon, Ohio, and at Paducah, Kentucky. The uranium from the Department's inventory being considered for sale or disposition in the EA was declared excess to national security needs and therefore could be used for commercial purposes. In addition to this uranium, DOE proposed to sell "Russian" natural uranium (NU) transferred from the USEC pursuant to the USEC Privatization Act, which requires the Secretary to sell this material within 7 years of the date of enactment (April 26, 1996).	N/A	This EA considers and uses the economic analyses in the 1996 EA.

Table C-1. Other NEPA Documents Considered (continued)

Description of the Proposed Action	ROD	Comments
NRC EAs for Nuclear Fuel Company License Renewals and DOE EA for Research Facility near the AREVA FFF		
Environmental Assessment for the Renewal of NRC License No. SNM 1107 for Westinghouse Columbia Fuel Fabrication Facility, Columbia, South Carolina **(April 2007)** Current Licensee: Westinghouse Electric Company, LLC		
The proposed action in this 2007 EA is to renew the SNM-1107 license for a 20-year period, thereby authorizing WEC to continue manufacturing nuclear fuel at the WEC FFF. The current license authorizes WEC to receive, possess, use, and transfer SNM at the facility in accordance with the requirements of 10 CFR Part 70. The renewed license would provide the same continued authorization to WEC. The NRC staff concludes that the renewal of license SNM–1107 involving the continued operation of the facility will not result in a significant impact to the environment. The facility already exists, and no substantial changes to the facility or its operation are associated with the license renewal. The Proposed Action can be considered a continuation of impacts and was evaluated based on impacts from past operations. Gaseous emissions and liquid effluents are within regulatory limits for nonradiological and radiological components. Public and occupation radiological dose exposures are below 10 CFR Part 20 regulatory limits. The environmental impacts of the Proposed Action have been evaluated in accordance with the requirements presented in 10 CFR Part 51. The NRC staff has determined that the Proposed Action would not have a significant impact on the human environment. No environmental impact statement (EIS) is warranted, and a Finding of No Significant Impact (FONSI) is appropriate in accordance with 10 CFR 51.31.	N/A	This EA incorporates the description of the WEC FFF site environment and safety analyses.

Table C-1. Other NEPA Documents Considered (continued)

Description of the Proposed Action	ROD	Comments
Environmental Assessment for the Renewal of NRC License No. SNM-1097 for General Electric Company Nuclear Energy Production Facility, Wilmington, North Carolina **(May 1997)** Current Licensee: GNF-Americas, LLC		
The proposed action in this 1997 EA is the renewal of NRC Materials License SNM-1097. This would allow GE to continue producing uranium dioxide (UO_2) powder, pellets, and fuel rods, and continue support operations such as scrap recovery, waste disposal, laboratory analyses, and manufacturing technology development. In addition, GE would begin operation of a new dry conversion process (DCP) for converting UF_6 to UO_2, which would eventually replace the current ammonium diuranate process. An interim period of 1 year was estimated where both processes would be concurrently operated, allowing the DCP to gradually come up to production capacity. Renewal of the GE materials license SNM-1097 would result in continued release of radioactive and nonradioactive effluents. However, the impact to human health and the environment from these releases has been determined to be insignificant, and GE has committed to effluent monitoring, environmental monitoring, and as low as reasonably achievable (ALARA) programs to ensure continued minimal impact. The small adverse impacts are outweighed by the positive impacts from continued operation of the facility, mainly from economic benefits to the surrounding community.	N/A	This EA incorporates the description of the GNF FFF site environment and safety analyses.
Environmental Assessment for the Renewal of NRC License No. SNM-1227 for Siemens Power Corporation, Richland, Washington **(June 1995)** Current Licensee: AREVA NP Inc. Note: A new EA to support a license renewal is currently being prepared		
The proposed action in this 1995 EA is the renewal of the SPC License SNM-1227 for 10 years with expansion of the DCP. With this renewal, SPC would expand the capacity of the DCP to convert UF_6 to UO_2 and would continue to manufacture fuel assemblies for light-water reactors.	N/A	This EA incorporates the description of the AREVA FFF site environment and safety analyses.
Environmental Assessment for Construction and Operation of a Physical Sciences Facility (PSF) at the Pacific Northwest National Laboratory, Richland, Washington (January 2007)		
The proposed action was construction and operation of a large research complex on DOE property located about 1.6 kilometers (1 mile) from the AREVA FFF.	N/A	This EA reviewed and incorporated the cumulative impacts cited in this EA.

ROD = Record of Decision.
N/A = not applicable.