

**DRAFT ENVIRONMENTAL ASSESSMENT**

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

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U.S. Department of Energy  
Office of Nuclear Energy





1 **TABLE OF CONTENTS**  
2

3	1.0	PURPOSE AND NEED FOR AGENCY ACTION .....	1
4	1.1	Background .....	1
5	1.2	Purpose and Need .....	2
6	1.3	The National Environmental Policy Act and Related Procedures .....	2
7	1.4	Relationship to Other National Environmental Policy Act Documents .....	3
8	2.0	DESCRIPTION OF THE PROPOSED ACTION AND ALTERNATIVES .....	5
9	2.1	Enrichment Alternative .....	5
10	2.1.1	Uranium Shipments and Involved Facilities .....	5
11	2.1.2	Maximum Annual Amount and Program Duration .....	11
12	2.1.3	Regulations Governing Material Shipments: United States .....	12
13	2.1.4	Regulations Governing Material Shipments: Overseas .....	12
14	2.2	Direct Sale Alternative .....	13
15	2.3	No Action Alternative .....	13
16	2.4	Enrichment Options Considered but Not Analyzed in Detail .....	14
17	2.4.1	Other Enrichment Facilities .....	14
18	2.4.2	Other LEU Product Storage Sites .....	15
19	2.4.3	Other French Ports of Exit and Entry .....	15
20	2.4.4	Other Modes of Transport: Air Transport .....	15
21	2.4.5	Use of Great Lakes Ports .....	15
22	3.0	AFFECTED ENVIRONMENTS .....	17
23	3.1	Affected Facilities .....	17
24	3.1.1	United States Department of Energy and United States Enrichment Corporation, Paducah Gaseous Diffusion Plant, Paducah, Kentucky .....	18
25	3.1.2	United States Department of Energy and United States Enrichment Corporation, Portsmouth American Centrifuge Plant, Portsmouth, Ohio .....	21
26	3.1.3	Louisiana Energy Services National Enrichment Facility, Eunice, New Mexico .....	25
27	3.1.4	AREVA Fuel Fabrication Facility, Richland, Washington .....	27
28	3.1.5	Global Nuclear Fuel Company Fuel Fabrication Facility, Wilmington, North Carolina .....	30
29	3.1.6	Westinghouse Electric Corporation Fuel Fabrication Facility, Columbia, South Carolina .....	33
30	3.2	Uranium Market .....	36
31	4.0	ENVIRONMENTAL IMPACTS .....	41
32	4.1	Existing Analyses and Scope of Impact Assessment .....	41
33	4.2	Enrichment Alternative .....	55
34	4.2.1	Transportation Impacts under the Enrichment Alternative .....	55
35	4.2.2	Low-Enriched Uranium Storage Impacts under the Enrichment Alternative .....	77
36	4.2.3	Impacts on the Uranium Market Under the Enrichment Alternative .....	81

1	4.3	Direct Sale Alternative.....	81
2	4.3.1	Transportation, Enrichment, and Storage Impacts under the Direct Sale	
3		Alternative.....	81
4	4.3.2	Impacts on the Uranium Market under the Direct Sale Alternative .....	81
5	4.4	No Action Alternative.....	83
6	4.4.1	Environmental Impacts under the No Action Alternative .....	83
7	4.4.2	Impacts on the Uranium Market under the No Action Alternative .....	84
8	4.5	Cumulative Impacts .....	84
9	4.5.1	Enrichment Alternative.....	84
10	4.5.2	Direct Sale Alternative.....	90
11	4.5.3	No Action Alternative.....	90
12	5.0	IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES	
13		AND SHORT-TERM USES OF THE ENVIRONMENT VS. LONG-TERM	
14		PRODUCTIVITY .....	91
15	5.1	Irreversible and Irretrievable Commitment of Resources.....	91
16	5.2	The Relationship between Local Short-Term Uses of the Human Environment	
17		and the Maintenance and Enhancement of Long-Term Productivity .....	91
18	6.0	REFERENCES .....	93
19	APPENDIX A:	SECRETARY OF ENERGY’S MARCH 2008 POLICY STATEMENT ...	A-1
20	APPENDIX B:	TRANSMITTAL LETTERS AND DISTRIBUTION LISTS .....	B-1
21	APPENDIX C:	OTHER NEPA DOCUMENTS CONSIDERED.....	C-1
22			
23	<b>LIST OF TABLES</b>		
24			
25	Table 2-1.	Excess Inventory, LEU Product, and DU Tails Characteristics .....	10
26	Table 4-1.	Summary of Impacts from National Enrichment Facility Construction,	
27		Operation, and Decommissioning.....	44
28	Table 4-2.	Summary of Impacts from American Centrifuge Plant Construction,	
29		Operation, and Decommissioning.....	47
30	Table 4-3.	Summary of Expected Impacts from Operation of the Paducah and the	
31		Portsmouth Conversion Facilities .....	52
32	Table 4-4.	Transportation Distances and Population Densities .....	57
33	Table 4-5.	Characteristics of Uranium Cylinders.....	60
34	Table 4-6.	Number of Cylinders and Truck, Rail, and Barge Shipments under the	
35		Proposed Action.....	60
36	Table 4-7.	Radionuclide Inventory of Uranium Cylinders.....	60
37	Table 4-8a.	Total Transportation Impacts from Truck Shipments of Uranium Hexafluoride	
38		under the Proposed Action.....	62
39	Table 4-8b.	Transportation Impacts from Truck Shipments of 2,000 MTU of Uranium	
40		Hexafluoride in a Given Year under the Proposed Action .....	63
41	Table 4-8c.	Transportation Impacts from Truck Shipments of 4,000 MTU of Uranium	
42		Hexafluoride in a Given Year under the Proposed Action .....	64

1	Table 4-9.	Maximum Individual Impacts from Truck Shipments.....	65
2	Table 4-10a.	Total Transportation Impacts from Rail Shipments of Uranium Hexafluoride	
3		under the Proposed Action.....	67
4	Table 4-10b.	Transportation Impacts from Rail Shipments of 2,000 MTU of Uranium	
5		Hexafluoride in a Given Year under the Proposed Action .....	68
6	Table 4-10c.	Transportation Impacts from Rail Shipments of 4,000 MTU of Uranium	
7		Hexafluoride in a Given Year under the Proposed Action .....	69
8	Table 4-11.	Maximum Individual Impacts from Rail Shipments .....	70
9	Table 4-12.	Exposed Populations along Barge and Truck Routes.....	71
10	Table 4-13.	Radiological Consequences for the Population from Severe Transportation	
11		Accidents Involving Depleted Uranium Hexafluoride .....	74
12	Table 4-14.	Radiological Consequences for the Maximally Exposed Individual from	
13		Severe Transportation Accidents Involving Depleted Uranium Hexafluoride.....	74
14	Table 4-15.	Chemical Consequences for the Population from Severe Transportation	
15		Accidents Involving Depleted Uranium Hexafluoride .....	76
16	Table 4-16.	Chemical Consequences for the Maximally Exposed Individual from Severe	
17		Transportation Accidents Involving Depleted Uranium Hexafluoride.....	76
18	Table 4-17.	Occupational Radiation Doses at FFFs in 2006.....	80
19	Table C-1.	Other NEPA Documents Considered.....	C-1
20			

21 **LIST OF FIGURES**

22			
23	Figure 2-1.	Domestic Facility Locations .....	6
24	Figure 2-2.	Excess Inventory Shipments to Domestic Enrichment Facilities .....	7
25	Figure 2-3.	NU Product Shipments .....	7
26	Figure 2-4.	LEU Product Shipments to Five Optional Storage Locations .....	8
27	Figure 2-5.	Excess Inventory Shipments to, and NU Product and/or LEU Product	
28		Shipments from, France .....	8
29	Figure 2-6.	DU Tails Shipments for Storage at Paducah or Portsmouth.....	9
30	Figure 3-1.	Paducah, Kentucky, Locator Map.....	18
31	Figure 3-2.	Piketon, Ohio, Locator Map.....	22
32	Figure 3-3.	Eunice, New Mexico, Locator Map .....	26
33	Figure 3-4.	Richland, Washington, Locator Map .....	28
34	Figure 3-5.	Wilmington, North Carolina, Locator Map .....	31
35	Figure 3-6.	Columbia, South Carolina, Locator Map .....	34
36	Figure 3-7.	Uranium Fuel Cycle.....	37
37	Figure 4-1.	Rail and Truck Routes .....	58
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2  
3  
4  
5  
6  
7  
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**LIST OF ACRONYMS AND ABBREVIATIONS**

1		
2	ACP	American Centrifuge Plant
3	ALARA	as low as reasonably achievable
4	ANSI	American National Standards Institute
5	CaF <sub>2</sub>	calcium fluoride
6	CEQ	Council on Environmental Quality
7	CFR	U.S. Code of Federal Regulations
8	D&D	decontamination and decommissioning
9	dB[A]	A-weighted decibel
10	DCP	dry conversion process
11	DOE	U.S. Department of Energy
12	DOT	U.S. Department of Transportation
13	DU	depleted uranium
14	DUF <sub>6</sub>	depleted uranium hexafluoride
15	EA	environmental assessment
16	EIS	environmental impact statement
17	EPA	U.S. Environmental Protection Agency
18	ERI	Energy Resources International, Inc.
19	ETTP	East Tennessee Technology Park
20	FONSI	Finding of No Significant Impact
21	FFF	fuel fabrication facility
22	g	force of gravity
23	GDP	gaseous diffusion plant
24	GNEP	Global Nuclear Energy Partnership
25	GNF	Global Nuclear Fuel
26	HEU	highly enriched uranium
27	HF	hydrogen fluoride
28	IAEA	International Atomic Energy Agency
29	ISO	International Organization for Standardization
30	LCF	latent cancer fatality
31	LES	Louisiana Energy Services
32	LEU	low-enriched uranium
33	LEUF <sub>6</sub>	low-enriched uranium hexafluoride
34	LLMW	low-level mixed waste
35	LLW	low-level waste
36	μCi/cc	microcuries per cubic centimeter
37	MEI	maximally exposed individual
38	mg/kg	milligrams per kilogram
39	mrem	millirem
40	mSv	millisievert
41	MT	metric ton
42	MTCA	Model Toxics Control Act
43	MTU	metric tons of uranium
44	N/A	not applicable
45	NAAQS	National Ambient Air Quality Standards

Draft Environmental Assessment:  
Disposition of DOE Excess Depleted Uranium, Natural Uranium, and Low-Enriched Uranium

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1	NEF	National Enrichment Facility
2	NEPA	National Environmental Policy Act
3	NRC	U.S. Nuclear Regulatory Commission
4	NU	natural uranium
5	NUF <sub>6</sub>	natural uranium hexafluoride
6	pCi/g	picocuries per gram
7	PEIS	programmatic environmental impact statement
8	PM <sub>2.5</sub>	particulate matter with a diameter of 2.5 microns or less
9	PM <sub>10</sub>	particulate matter with a diameter of 10 microns or less
10	PSF	Physical Sciences Facility
11	RAI	request for additional information
12	ROD	Record of Decision
13	SAR	safety analysis report
14	SNM	special nuclear material
15	SWU	separative work unit
16	Tc	technetium
17	TCE	trichloroethylene
18	U <sub>3</sub> O <sub>8</sub>	triuranium octoxide
19	UDS	Uranium Disposition Services, LLC
20	UF <sub>6</sub>	uranium hexafluoride
21	UO <sub>2</sub>	uranium dioxide
22	UO <sub>2</sub> F <sub>2</sub>	uranyl fluoride
23	USEC	United States Enrichment Corporation
24	VOC	volatile organic compound
25	WEC	Westinghouse Electric Corporation



1 **SUMMARY**

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

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

25 The excess inventory that DOE proposes to disposition is stored as uranium hexafluoride (UF<sub>6</sub>)  
26 at the DOE Portsmouth site in Ohio and the DOE Paducah site in Kentucky. DOE also  
27 anticipates the potential identification of additional amounts of LEU with a <sup>235</sup>U content of less  
28 than 4.95 percent. Under the Enrichment Alternative, the uranium could be transported by truck  
29 or rail to one or more of three enrichment facilities in the United States or to an enrichment  
30 facility in France. Shipments to France could be via any of several east-coast or gulf-coast U.S.  
31 ports; however, this EA assumes, for purposes of analysis, that the uranium would be transported  
32 by barge to New Orleans, Louisiana, then by ship to France. The LEU product could be stored at  
33 up to three U.S. commercial nuclear fuel fabrication facilities (FFFs) in North Carolina, South  
34 Carolina, and Washington State, and/or at DOE's Portsmouth or Paducah sites. When DU is  
35 enriched to NU, it would be stored at enrichment facilities in Kentucky, New Mexico, and/or  
36 Ohio, and/or at DOE's Portsmouth or Paducah sites. The DU that would result from the  
37 enrichment process, called "DU tails", would be stored and managed at the enrichment facility or  
38 be transported to and stored and managed at DOE's Portsmouth or Paducah sites.

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

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

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

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

- 14 • For all truck, rail, and barge transport options, for all domestic and foreign enrichment  
15 facility locations, and for all storage options, transportation of the entire inventory of DU,  
16 NU, and LEU subject to this EA is estimated to result in approximately 3 transportation-  
17 related fatalities over approximately 25 years.<sup>2</sup> For overseas transportation, this includes  
18 impacts from sea transit, U.S. port operations, and overland transport. These  
19 transportation impacts include the radiological and nonradiological impacts from  
20 incident-free transportation and transportation accidents.
- 21 • For enrichment at the National Enrichment Facility (NEF) near Eunice, New Mexico, the  
22 truck or rail transportation impacts would be higher than for enrichment at Paducah,  
23 Kentucky, or Portsmouth, Ohio, because the NU, LEU, or DU feed would be shipped  
24 greater distances, and the DU tails and NU product, could be stored/dispositioned by  
25 NEF, or could be shipped back to Paducah or Portsmouth.
- 26 • The probability of a latent cancer fatality (LCF) for the maximally exposed individual  
27 (MEI) along the truck transportation routes was estimated to range from  $8.3 \times 10^{-8}$  to  
28  $5.3 \times 10^{-7}$ . For the analysis, the MEI was located 30 meters from the highway and was  
29 exposed to all truck shipments. The shipments are assumed to travel at a speed of  
30 24 kilometers (15 miles) per hour, which is representative of speeds in urban areas.
- 31 • The probability of an LCF for the MEI along the rail transportation routes was almost  
32 identical to truck transport, ranging from  $8.2 \times 10^{-8}$  to  $5.2 \times 10^{-7}$ . For the analysis, the  
33 MEI was located 30 meters from the railroad and was exposed to all rail shipments. The  
34 shipments are assumed to travel at a speed of 24 kilometers (15 miles) per hour, which is  
35 representative of speeds in urban areas.

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<sup>2</sup> 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).

- 1       • The transportation-related impacts of transporting the uranium to New Orleans by barge  
2       would be less than the impacts of transporting the uranium there by truck or rail due to  
3       the fewer number of required shipments and the fact that the exposed population would  
4       be smaller for barge transport.
  
- 5       • Severe rail accidents would have higher consequences than truck accidents because each  
6       railcar would carry four cylinders of DU, NU, or LEU (feed), compared with only one for  
7       each truck. For LEU product, each railcar would carry 12 cylinders, compared with 3 for  
8       each truck.
  
- 9       • For a severe truck accident involving one cylinder of depleted uranium hexafluoride  
10       (DUF<sub>6</sub>), the population radiation dose could be as high as 32,000 person-rem in an urban  
11       area if stable atmospheric conditions existed at the time of the accident. Based on this  
12       population radiation dose, it was estimated that there could be 20 LCFs in the exposed  
13       population of about 3 million people. For comparison, in a population of 3 million  
14       people, approximately 700,000 would be expected to die from cancer of all causes. The  
15       radiation dose for the MEI was estimated to be as high as 0.91 rem if stable atmospheric  
16       conditions existed at the time of the accident. The probability of an LCF for this  
17       individual was estimated to be 0.0005. If the severe transportation accident involved NU  
18       feed or product, the radiological consequences would be higher—about 28 LCFs. For the  
19       MEI, the probability of an LCF would be 0.0008. If the severe transportation accident  
20       involved LEU product, the radiological consequences would be about 75 LCFs in the  
21       exposed population, assuming that all three 30B cylinders in a truck shipment were  
22       breached during the severe accident. For the MEI, the probability of an LCF would be  
23       0.002.
  
- 24       • For a severe rail accident involving four cylinders of DUF<sub>6</sub>, the population radiation dose  
25       could be as high as 130,000 person-rem in an urban area if stable atmospheric conditions  
26       existed at the time of the accident. Based on this population radiation dose, it was  
27       estimated that there could be 80 LCFs in the assumed exposed population of about  
28       3 million people. For comparison, in a population of 3 million people, approximately  
29       700,000 would be expected to die from cancer of all causes. The radiation dose for the  
30       MEI was estimated to be as high as 3.7 rem if stable atmospheric conditions existed at the  
31       time of the accident. The probability of an LCF for this individual was estimated to be  
32       0.002. If the severe transportation accident involved NU feed or product, the radiological  
33       consequences would be higher—about 110 LCFs in the exposed population. For the MEI,  
34       the probability of an LCF would be 0.003. If the severe transportation accident involved  
35       LEU product, the radiological consequences would be about 310 LCFs in the exposed  
36       populations, assuming that all twelve 30B cylinders in a rail shipment were breached  
37       during the severe accident. For the MEI, the probability of an LCF would be 0.009.
  
- 38       • Three individuals could suffer irreversible health effects from severe truck accidents and  
39       four individuals could suffer irreversible health effects from severe rail accidents due to  
40       the chemical toxicity associated with UF<sub>6</sub>, hydrogen fluoride (HF), and uranyl fluoride  
41       (UO<sub>2</sub>F<sub>2</sub>). No fatalities are estimated to result from chemical exposure.

- 1       • In a 1999 study, DOE concluded that the consequences of an intentional destructive act  
2 involving the transport of NU would be less than or similar to the consequences of severe  
3 transportation accidents (DOE 1999a). Therefore, the consequences of intentional  
4 destructive acts would be similar to the consequences discussed above for severe truck  
5 and rail accidents involving DU, NU, and LEU.
- 6       • If a severe accident involving stored LEU product were to occur, the accident would  
7 result in an estimated population dose. For example, at the Global Nuclear Fuel (GNF)  
8 FFF, a severe accident was estimated to result in a population dose of 29,000 person-rem.  
9 In the exposed population of 29,000 people around the GNF facility, this radiation dose is  
10 estimated to result in 17 LCFs. The radiation dose for an individual located 2 kilometers  
11 from the facility was estimated to be 5 rem. The probability of an LCF for this person is  
12 estimated to be 0.003. If this accident occurred at other sites, the results would vary  
13 depending on the enrichment of the UF<sub>6</sub>, the exposed population, or atmospheric  
14 conditions.
- 15       • Direct sales or enrichment would be managed by DOE to avoid or minimize adverse  
16 material impacts on the domestic uranium industry and market.

1 **1.0 PURPOSE AND NEED FOR AGENCY ACTION**

3 **1.1 Background**

5 The U.S. Department of Energy (DOE)  
7 owns and manages an inventory of depleted  
9 uranium (DU), natural uranium (NU), and  
11 low-enriched uranium (LEU). This  
13 inventory is currently stored in large  
15 cylinders as depleted uranium hexafluoride  
17 ( $\text{DUF}_6$ ), natural uranium hexafluoride  
19 ( $\text{NUF}_6$ ), and low-enriched uranium  
21 hexafluoride ( $\text{LEUF}_6$ ) at the DOE Paducah  
23 site in western Kentucky (DOE Paducah)  
25 and the DOE Portsmouth site near Piketon  
27 in south-central Ohio (DOE Portsmouth)<sup>3</sup>.  
29 This inventory exceeds DOE's current and  
31 projected energy and defense program  
33 needs.

**Uranium Hexafluoride ( $\text{UF}_6$ )**

Uranium hexafluoride ( $\text{UF}_6$ ) 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  $\text{UF}_6$  is a white, dense, crystalline material that resembles rock salt.  $\text{UF}_6$  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  $\text{UF}_6$  comes into contact with water, such as water vapor in the air, the  $\text{UF}_6$  and water react, forming corrosive hydrogen fluoride (HF) and a uranium-fluoride compound called uranyl fluoride ( $\text{UO}_2\text{F}_2$ ). For this reason,  $\text{UF}_6$  is always handled in leak-tight containers and processing equipment.

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

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

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<sup>3</sup> 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    **1.2    Purpose and Need**

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

9

**Uranium-235: DU, LEU, and HEU**

Uranium exists as three naturally occurring isotopes: uranium-238 (<sup>238</sup>U), uranium-235 (<sup>235</sup>U), and uranium-234 (<sup>234</sup>U). The <sup>235</sup>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 <sup>235</sup>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 <sup>235</sup>U. Through gaseous diffusion or centrifugation enrichment processes, the concentration of <sup>235</sup>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 <sup>235</sup>U less than 20 percent. HEU has a concentration of <sup>235</sup>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 <sup>235</sup>U.

After increasing the concentration of <sup>235</sup>U in a portion of the uranium mixture during the enrichment process, the remaining uranium mixture has a reduced concentration of <sup>235</sup>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 <sup>235</sup>U is less than 0.711 percent, although enrichment normally results in DU having much lower levels of <sup>235</sup>U.

10

11    **1.3    The National Environmental Policy Act and Related Procedures**

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

1 **1.4 Relationship to Other National Environmental Policy Act Documents**

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

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1    **2.0    DESCRIPTION OF THE PROPOSED ACTION AND ALTERNATIVES**

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

13   **2.1    Enrichment Alternative**

14   **2.1.1   Uranium Shipments and Involved Facilities**

15   Under the Enrichment Alternative, DOE would contract to ship and enrich excess NU, DU  
16   (having an assay equal to or greater than 0.35 percent <sup>235</sup>U), and LEU (having an assay greater  
17   than 0.711 percent <sup>235</sup>U but less than 4.95 percent <sup>235</sup>U) as UF<sub>6</sub>.

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

28   U.S. facility enrichment operations (including enrichment technologies; feed material, end  
29   product, and waste product handling; logistics; and facility management) have been described in  
30   detail in applicable DOE and NRC NEPA documents. Those documents describe the enrichment  
31   operations, the enrichment facilities, the waste management activities, and the environmental  
32   impacts that would be applicable to the enrichment activities that would occur under the  
33   Proposed Action. Those descriptions are summarized and incorporated into this EA by reference  
34   (NRC 2005 [LES NEF]; NRC 2006 [USEC ACP]; DOE 1982 [Paducah GDP]). The French  
35   enrichment plant uses a gas diffusion process to enrich uranium into reactor-grade LEU for some  
36   100 nuclear reactors in France and throughout the world.

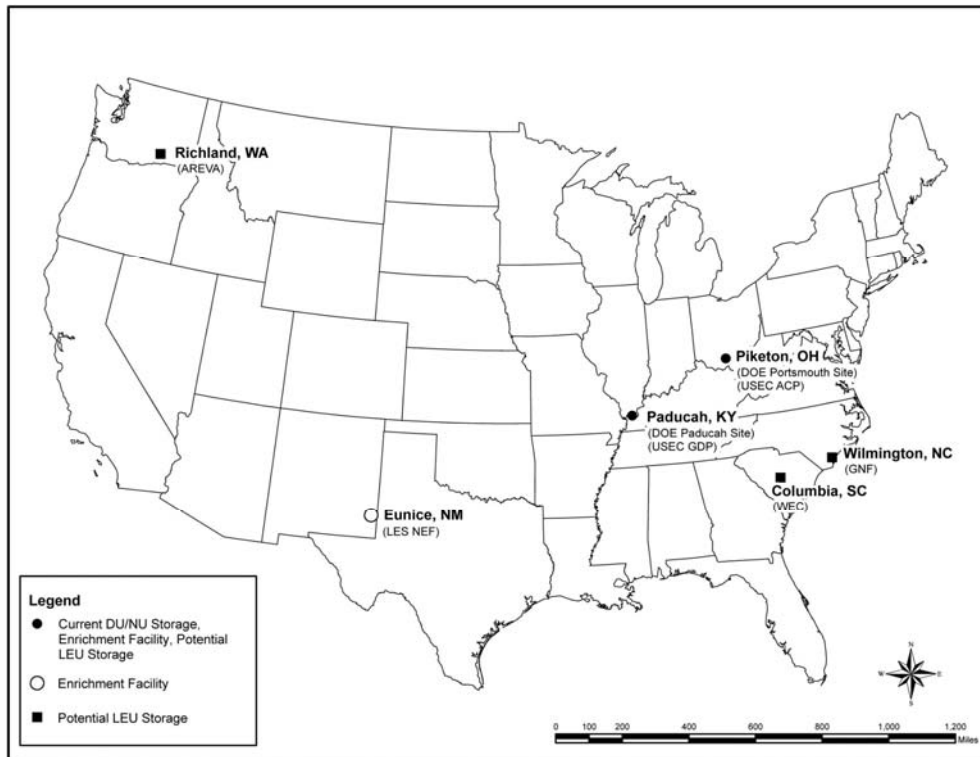
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<sup>4</sup> In this EA, the term “sale” includes direct sales, transfers, or other transactions the Department may undertake to disposition its excess uranium inventory.

1 If DOE contracts for the enrichment of DU to NU, DOE would contract for the storage of the  
2 resultant NU at the enrichment facility performing the enrichment operations, or for the transport  
3 of the NU to DOE Paducah and/or DOE Portsmouth. If DOE contracts for the enrichment of DU,  
4 NU, or LEU to obtain LEU with up to 4.95 percent  $^{235}\text{U}$  content, DOE would contract to  
5 transport the LEU product to, and store it at, one or more of five domestic sites. Three of these  
6 sites are commercial nuclear fuel fabrication facilities (FFFs) operated by AREVA in Richland,  
7 Washington (AREVA FFF); by Westinghouse Electric Corporation (WEC) near Columbia,  
8 South Carolina (WEC FFF); and by Global Nuclear Fuel (GNF) near Wilmington, North  
9 Carolina (GNF FFF). DOE considers on-site storage at these FFFs to be desirable because they  
10 require LEU as process feedstock and already store quantities of LEU on-site. In total, up to  
11 670 metric tons of uranium (MTU) could be stored at the FFFs. DOE also could contract to ship  
12 the LEU product to DOE Paducah and/or DOE Portsmouth and store or sell it. Both DOE sites  
13 have the required infrastructure and security, as well as extensive experience in the safe  
14 management, storage, and logistics of uranium cylinders. If other sites are proposed in the future  
15 for storage, additional NEPA analysis would be prepared, as appropriate.

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

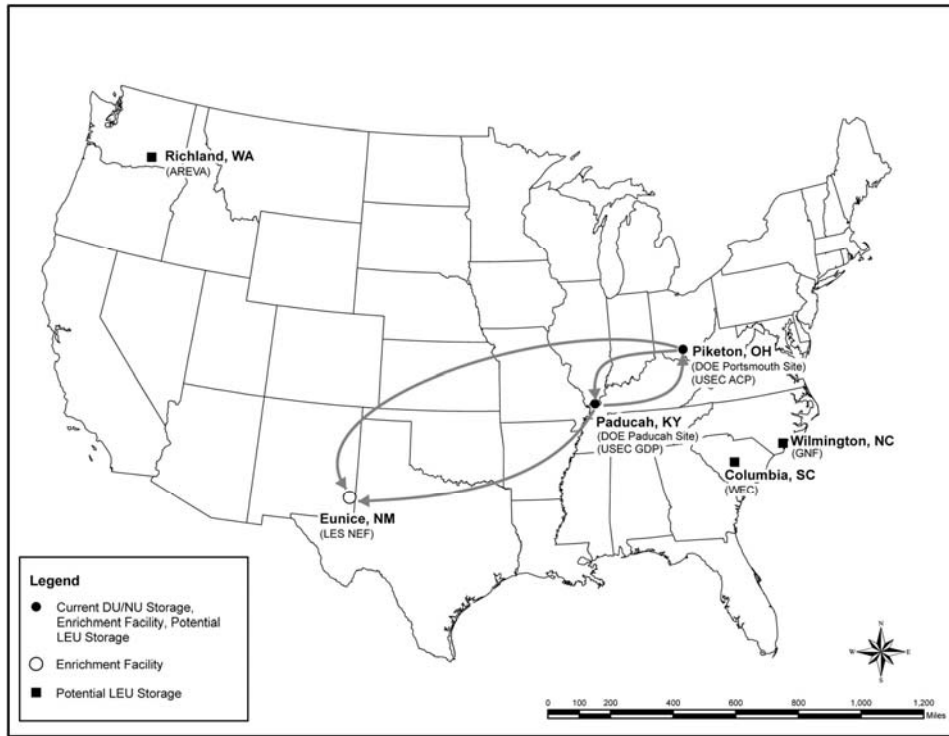
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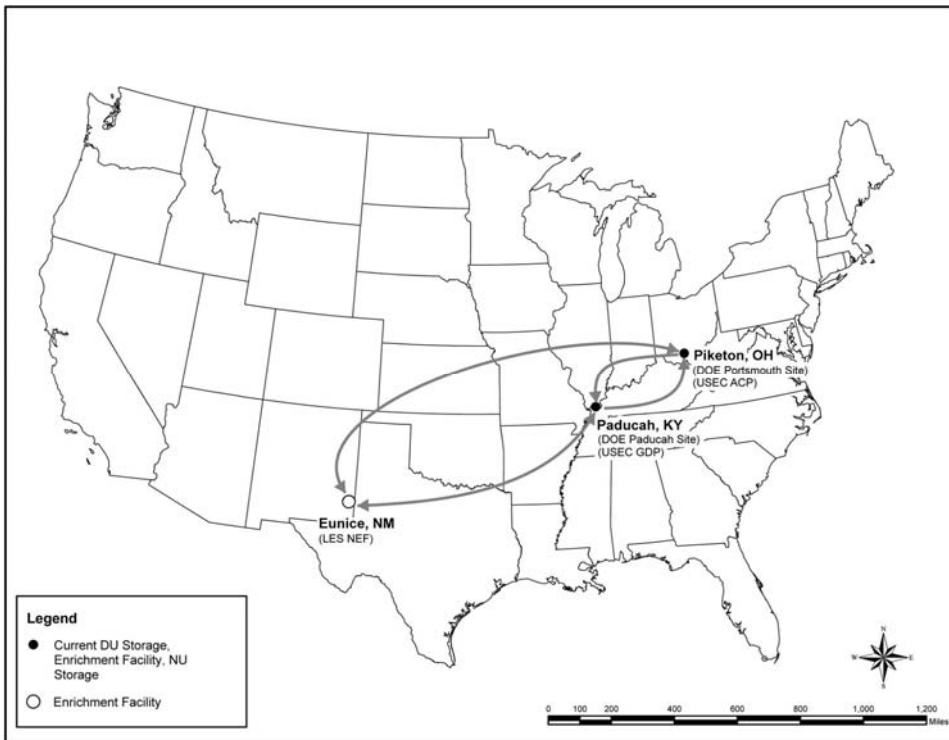
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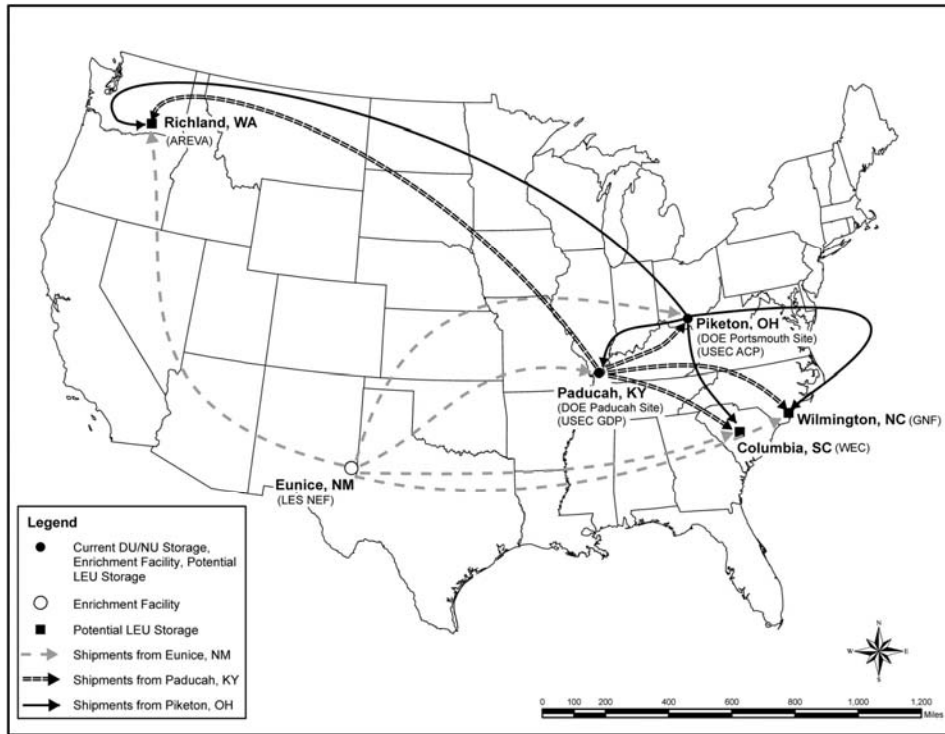
**Figure 2-1. Domestic Facility Locations**



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



4 **Figure 2-3. NU Product Shipments**



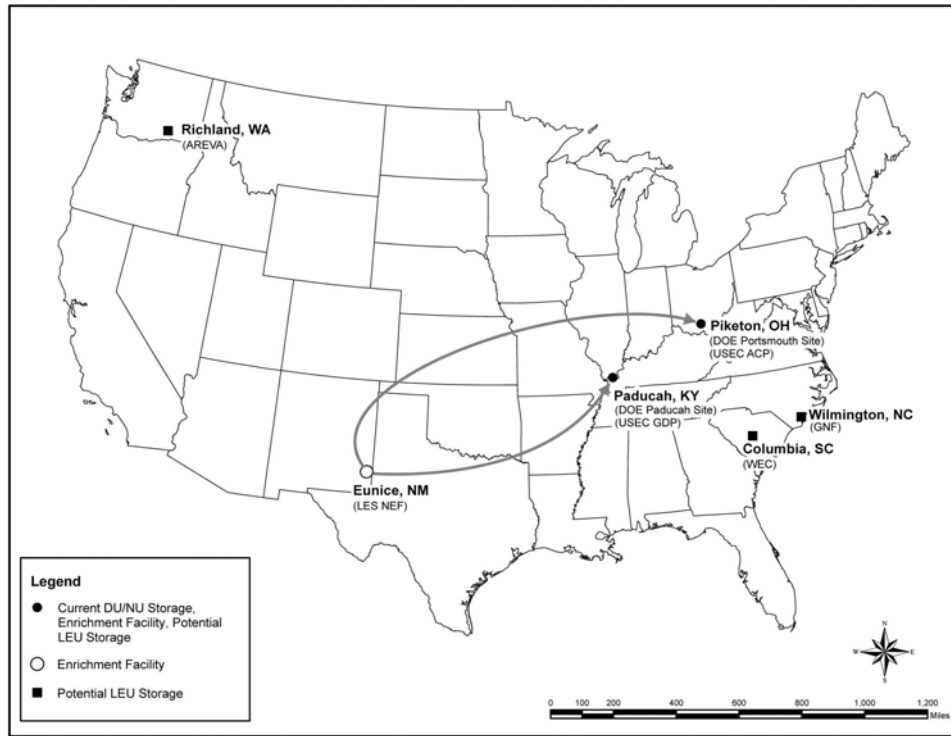
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**Figure 2-4. LEU Product Shipments to Five Optional Storage Locations**



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



1  
2 **Figure 2-6. DU Tails Shipments for Storage at Paducah or Portsmouth**

3  
4 Enriching the excess inventory to either NU or LEU product would result in the production of  
5 “DU tails”. In this EA, it is assumed that the DU tails would have a 0.20 percent  $^{235}\text{U}$  content.  
6 The DU tails are an end product that results from uranium enrichment; they have a lower  $^{235}\text{U}$   
7 content than the DU that would serve as feed for enrichment operations. As part of the Proposed  
8 Action, DOE would contract with the enrichment facility to store and/or dispose of the DU tails  
9 or, in the case of domestic enrichment facilities, to ship the DU tails from the domestic  
10 enrichment facilities to DOE Paducah and/or DOE Portsmouth for storage, pending final  
11 disposition consistent with the DOE decisions announced in the *Record of Decision for*  
12 *Construction and Operation of a Depleted Uranium Hexafluoride Conversion Facility at the*  
13 *Paducah, KY, Site (69 FR 44654)*; and *Record of Decision for Construction and Operation of a*  
14 *Depleted Uranium Hexafluoride Conversion Facility at the Portsmouth, OH, Site (69 FR 44649)*.  
15 DOE assumes DU tails from enrichment in France would not be returned to the United States but  
16 would be disposed of in France in accordance with French policies and regulations. DOE may  
17 contract with the enricher to store, convert, and dispose of the tails.

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

1 **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 <sup>a</sup>	296
LEU product	4,919	3,195
DU tails	89,972 <sup>b</sup>	10,931
NU product	22,213	3,445
DU tails	53,083 <sup>c</sup>	6,450

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

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

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

1 that analyzing only New Orleans as a marine terminal port is sufficient for the purposes of this  
2 EA. If other marine terminal ports were proposed, DOE would evaluate the need for additional  
3 NEPA analysis.

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

### 7 **2.1.2 Maximum Annual Amount and Program Duration**

8 Under the Enrichment Alternative,  
9 enrichment of excess inventory would be  
10 managed consistent with applicable law  
11 and in a manner tailored to avoid or  
12 minimize adverse impacts to the uranium  
13 market and industry. In accordance with  
14 the Secretarial Policy Statement, to the  
15 extent practicable, the Department will  
16 manage its uranium inventories in a

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.

17 manner that is consistent with and supportive of the maintenance of a strong domestic nuclear  
18 industry. Consistent with this principle, the Department believes that, as a general matter, the  
19 introduction into the domestic market of uranium from Departmental inventories in amounts that  
20 do not exceed 10 percent of the total annual fuel requirements of all licensed nuclear power  
21 plants—that is, approximately 2,000 MT NU equivalent based on current requirements—should  
22 not have an adverse material impact on the market or uranium industry. The Department  
23 anticipates, however, that it may introduce into the domestic market, in any given year, less than  
24 that amount, or, in some years for certain special purposes (such as the provision of initial core  
25 loads for new reactors), more than that amount. The increase in demand would arise because  
26 loading the core of a new reactor requires approximately three times as much LEU fuel as the  
27 amount subsequently required during reloading. DOE has conservatively assumed that such  
28 events could double the amount of uranium introduced into the market in a given year (i.e.,  
29 4,000 MT rather than 2,000 MT). These annual amounts would include uranium introduced into  
30 the domestic uranium market from all Departmental inventories, including LEU generated via  
31 the down-blending of highly enriched uranium (HEU) in the ongoing National Nuclear Security  
32 Administration (NNSA) HEU disposition program (61 FR 40619).

33 The specific annual amounts would be determined on an ongoing basis; the amounts would  
34 depend upon market analyses for particular sales. Because precise annual enrichment or sale  
35 quantities would be uncertain and would change from year to year, for purposes of assessing  
36 environmental impacts in this EA, DOE assumes that the Proposed Action could result in the  
37 annual enrichment and/or sale of excess inventory sufficient to introduce into the domestic  
38 market in a given year up to approximately 2,000 MT NU equivalent. This EA also analyzes the  
39 impacts of introducing approximately 4,000 MT NU equivalent in the event the Department  
40 determines, in a given year, that circumstances warrant the introduction of the greater amount  
41 into the market. Such circumstances might arise, for example, as new reactors are scheduled to  
42 begin operating, thereby increasing the short-term demand for uranium. This increase in demand

1 would arise because loading the core of a new reactor requires approximately three times as  
2 much LEU fuel as would be required later during re-loading. For the purposes of this EA, DOE  
3 has conservatively assumed that such events could lead to a doubling of the amount of uranium  
4 introduced into the market in a given year (i.e., 4,000 MT NU, rather than 2,000 MT NU).  
5 Because these annual amounts could also include, for example, LEU entering the domestic  
6 market via the NNSA HEU disposition program, it is likely that the amount of excess inventory  
7 enriched and/or sold under the Proposed Action would be somewhat less than the amount  
8 sufficient to introduce approximately 2,000 MT NU equivalent or 4,000 MT NU equivalent,  
9 respectively, into the domestic market.

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

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

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

### 20 **2.1.3 Regulations Governing Material Shipments: United States**

21 Within the United States, uranium would be shipped in accordance with U.S. Department of  
22 Transportation (DOT) and NRC regulations governing the transport of radioactive materials—in  
23 particular, 49 CFR Part 173, subpart I, “Class 7 (Radioactive) Materials.” Among other things,  
24 49 CFR 173.420 requires that each UF<sub>6</sub> cylinder be designed, fabricated, inspected, tested, and  
25 marked in accordance with the version of American National Standards Institute (ANSI) N14.1,  
26 *Uranium Hexafluoride - Packaging for Transport* that was in effect at the time the cylinder was  
27 manufactured. Cylinders not meeting these requirements are referred to as “nonconforming”  
28 because they are overfilled, over-pressurized, or structurally substandard. Any UF<sub>6</sub> currently  
29 stored in a nonconforming cylinder would not be transported without prior preparation, such as  
30 obtaining a DOT exemption, placing the nonconforming cylinder in an over-pack, or transferring  
31 the material to a conforming cylinder.

### 32 **2.1.4 Regulations Governing Material Shipments: Overseas**

33 Uranium would be shipped to and from France in accordance with applicable DOT regulations,  
34 applicable French regulations, International Atomic Energy Agency (IAEA) *Safety Standards*  
35 *Regulations for the Safe Transport of Radioactive Material* (IAEA 2005), IAEA *Interim*  
36 *Guidance on the Safe Transport of Uranium Hexafluoride* (IAEA 1991), and the provisions of  
37 the International Organization for Standardization (ISO) document ISO 7195 (ISO 1993). As  
38 with domestic shipments, any UF<sub>6</sub> currently stored in a cylinder that did not conform to all  
39 applicable regulations would not be transported without prior preparation sufficient to make the



1 cylinder conform to all applicable regulatory requirements. With regard to international  
2 shipments, it is noteworthy that in 2004, the NRC issued a final rule, effective October 2004, that  
3 amended its regulations on packaging and transporting radioactive material. This rule made NRC  
4 regulations compatible with the latest version of the IAEA standards and codified other  
5 applicable requirements.<sup>5</sup>

## 6 **2.2 Direct Sale Alternative**

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

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

## 25 **2.3 No Action Alternative**

26 In 1999, DOE prepared and issued a programmatic environmental impact statement (PEIS) that  
27 assessed the potential impacts of alternative DOE management strategies for DUF<sub>6</sub> stored at  
28 three DOE sites: Paducah, Portsmouth, and the East Tennessee Technology Park (ETTP) at Oak  
29 Ridge, Tennessee (DOE 1999b). The PEIS considered the environmental impacts, benefits, costs,  
30 and institutional and programmatic needs associated with the management and use of  
31 approximately 700,000 MT tons of DUF<sub>6</sub>. The alternatives analyzed in the PEIS included no  
32 action, long-term storage as UF<sub>6</sub>, long-term storage as uranium oxide, use as uranium oxide, use  
33 as uranium metal, and disposal. In its Record of Decision (ROD) (64 FR 43358), DOE stated the  
34 following:

35       “DOE has decided to promptly convert the depleted UF<sub>6</sub> inventory to depleted  
36 uranium oxide, depleted uranium metal, or a combination of both. The depleted  
37 uranium oxide will be used as much as possible and the remaining depleted  
38 uranium oxide will be stored for potential future uses or disposal, as necessary.”

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

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

2 “The DOE has now decided to transfer up to 1,700 of the approximately 4,700  
3 cylinders containing DUF<sub>6</sub> from the East Tennessee Technology Park (ETTP) in  
4 Oak Ridge, Tennessee, to its storage facilities at DOE’s enrichment facility at  
5 Portsmouth, Ohio...”

6 Subsequently, in 2004 DOE issued two site-specific EISs (DOE 2004a, 2004b) and associated  
7 RODs (69 FR 44654; 69 FR 44649) for construction and operation of two DUF<sub>6</sub> conversion  
8 facilities, one at the DOE Paducah site (DOE 2004a) and one at the DOE Portsmouth site (DOE  
9 2004b). These two new facilities are nearing completion, and operations are projected to begin in  
10 2010.

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

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

## 26 **2.4 Enrichment Options Considered but Not Analyzed in Detail**

### 27 **2.4.1 Other Enrichment Facilities**

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

1    **2.4.2 Other LEU Product Storage Sites**

2    DOE considered storing LEU product at the AREVA nuclear FFF in Lynchburg, Virginia. This  
3    site was eliminated from further analysis because this facility uses uranium feed in the form of  
4    uranium oxide, not UF<sub>6</sub>.

5    **2.4.3 Other French Ports of Exit and Entry**

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

10   **2.4.4 Other Modes of Transport: Air Transport**

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

15   **2.4.5 Use of Great Lakes Ports**

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

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1    **3.0    AFFECTED ENVIRONMENTS**

2    This chapter describes two classes of environment—geographic and economic—that are  
3    potentially affected by DOE’s Proposed Action. The affected geographic environment comprises  
4    the six sites where the excess uranium is now stored, where enrichment could occur, and where  
5    LEU and DU tails could be stored<sup>6</sup>. The economic environment is the existing uranium market.

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

10   **3.1    Affected Facilities**

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

- 13       • *DOE Paducah/USEC Paducah GDP*: current storage, proposed enrichment site, and  
14       proposed NU, LEU, and DU tails storage;
- 15       • *DOE Portsmouth/USEC ACP*: current storage, proposed enrichment site, and proposed  
16       NU, LEU, and DU tails storage;
- 17       • *Louisiana Energy Services (LES) National Enrichment Facility (NEF), Eunice, New*  
18       *Mexico*: proposed enrichment site, and proposed temporary storage for NU;
- 19       • *AREVA Fuel Fabrication Facility (AREVA FFF), Richland, Washington*: proposed LEU  
20       storage;
- 21       • *GNF Fuel Fabrication Facility (GNF FFF), Wilmington, North Carolina*: proposed LEU  
22       storage; and
- 23       • *WEC Fuel Fabrication Facility (WEC FFF), Columbia, South Carolina*: proposed LEU  
24       storage.

25   Each of these six geographic locations either currently hosts a DOE site or has been licensed by  
26   NRC to host an existing or under-construction uranium enrichment facility, DUF<sub>6</sub> conversion  
27   facility, or nuclear FFF. Therefore, each of these affected environments has been previously and  
28   extensively described and categorized in a DOE or NRC EA, EIS, or other agency document.  
29   These existing documents provide detailed site maps and descriptions of the environments that  
30   would be affected by agency actions. Sections 3.1.1 through 3.1.6 of this EA provide site locator  
31   maps, summary site descriptions, and summaries of those aspects of the environment that may  
32   affect, or be affected by, DOE’s Proposed Action based on the descriptions in these existing

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<sup>6</sup> 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.

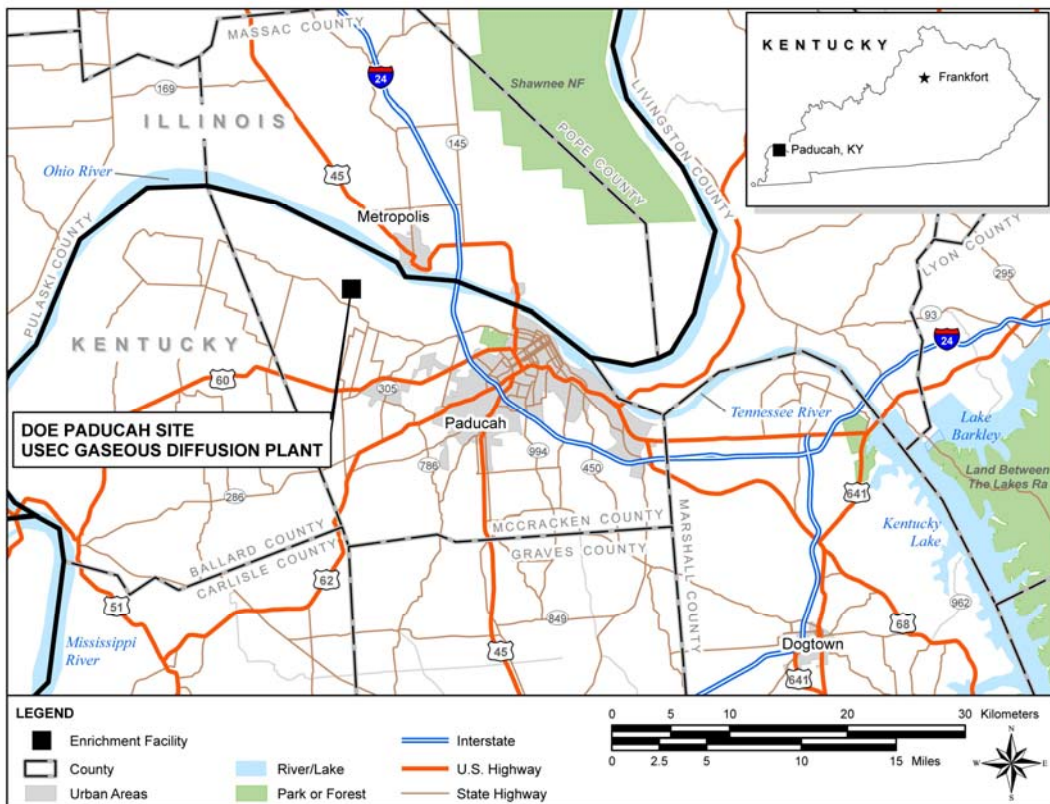
1 documents. More detailed descriptions of resource areas that would not be affected by DOE's  
2 Proposed Action (including, for example, ecological resources, endangered species, wetlands,  
3 noise, construction-related impacts) are also found in these existing documents.

4 **3.1.1 United States Department of Energy and United States Enrichment Corporation,**  
5 **Paducah Gaseous Diffusion Plant, Paducah, Kentucky**

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

- 9
- 10 • *Final Environmental Impact Statement for Construction and Operation of a Depleted*  
11 *Uranium Hexafluoride Conversion Facility at the Paducah, Kentucky, Site* (DOE 2004a).  
12 DOE/EIS-0359. June 2004.  
<http://web.ead.anl.gov/uranium/documents/paddeis/index.cfm>.
  - 13 • *Paducah Annual Site Environmental Report for Calendar Year 2005* (DOE 2007a).  
14 PRS-ENM-0002. August 2007. <http://www.prs-llc.net/aser/2005.html>.

15  
16



**Figure 3-1. Paducah, Kentucky, Locator Map**

- 1       • *Final Environmental Impact Assessment of the Paducah Gaseous Diffusion Plant Site*  
2       (DOE 1982). DOE/EA-0155. August 1982.  
3       [http://www.osti.gov/bridge/product.biblio.jsp?osti\\_id=6727682](http://www.osti.gov/bridge/product.biblio.jsp?osti_id=6727682).
  
- 4       • *Final Programmatic Environmental Impact Statement for Alternative Strategies for the*  
5       *Long-term Management and Use of Depleted Uranium Hexafluoride* (DOE 1999b).  
6       DOE/EIS-0269. April 1999.  
7       <http://web.ead.anl.gov/uranium/documents/nepacomp/peis/index.cfm>.

## 8       ***Site Description***

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

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

23       In 2002, DOE awarded a contract to Uranium Disposition Services, LLC (UDS) to design, build,  
24       and operate DUF<sub>6</sub> conversion plants at the DOE Paducah and Portsmouth sites. The contract  
25       includes cylinder surveillance and maintenance, which began June 2005. The Paducah  
26       conversion plant is currently under construction; it has a projected January 2010 completion date  
27       and June 2010 start-up date.<sup>7</sup>

28       At the end of 2003, the Paducah site managed an inventory of approximately 38,000 cylinders  
29       containing approximately 454,000 MT of UF<sub>6</sub> (mostly DUF<sub>6</sub>) stored in outdoor facilities,  
30       commonly referred to as cylinder storage yards. Additional cylinders are added to the DOE  
31       inventory periodically as a result of formal agreements with the USEC. The site has 13 storage  
32       yards used to store DOE-generated DUF<sub>6</sub> cylinders; an additional 4 yards are used to store  
33       USEC-generated cylinders that are now managed by DOE. Over several years, most of the  
34       storage yards that previously had gravel bases have been reconstructed with concrete bases to  
35       better control water infiltration and runoff.

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<sup>7</sup> Personal communication: telephone conversation, May 27, 2008; William Fallon, Battelle; and Barry Tilden, UDS.

1    ***Radiation Environment***

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

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

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

26   In 2001, the measured external radiation doses for Paducah cylinder yard workers was  
27   254 mrem, well below the maximum dose limit of 5,000 mrem per year set for radiation workers  
28   (10 CFR Part 835).

29   ***Seismic Environment***

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

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<sup>8</sup> 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).



1 The seismic hazards at the Paducah site have been studied extensively. A safety analysis report  
2 (SAR) for this site, completed in March 1997, provided comprehensive analyses and discussions  
3 of seismic hazards at the site (Lockheed Martin Energy Systems 1997a). The analyses considered  
4 the possibility of large-magnitude earthquakes similar to the New Madrid earthquakes of 1811–  
5 1812. The analyses performed by DOE were independently reviewed by the U.S. Geological  
6 Survey. This independent review indicated that the seismic sources, recurrence rates, maximum  
7 magnitudes, and attenuation functions used in the SAR analyses were representative of a wide  
8 range of professional opinion and were suitable for obtaining probabilistically based seismic  
9 hazard estimates. Because of the proximity of the site to the New Madrid seismic zone, special  
10 deterministic analyses were also performed to estimate the ground motions at the site in the case  
11 of recurrence of an earthquake of the same magnitude as the 1811–1812 New Madrid  
12 earthquakes. The results of the deterministic analyses were similar to the probabilistic seismic  
13 hazard results for the probabilities associated with the recurrence of the New Madrid earthquake  
14 of 1811–1812. The results indicated that continued storage of DUF<sub>6</sub> cylinders at the Paducah site  
15 is safe.

### 16 ***Groundwater***

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

### 25 ***Air Quality***

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

### 29 ***Waste Management***

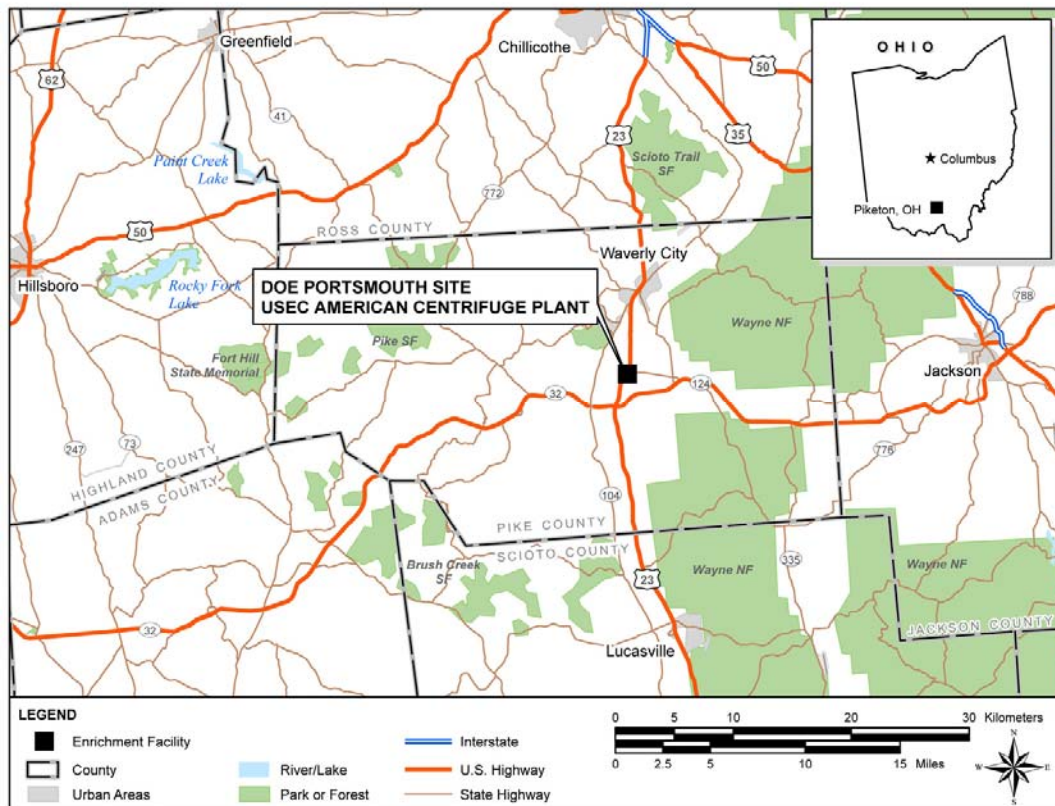
30 The Paducah site generates wastewater, nonhazardous waste, nonradioactive hazardous waste,  
31 low-level waste (LLW), and low-level mixed waste (LLMW). Wastewater is discharged through  
32 permitted outfalls; nonhazardous solid waste is disposed of at an on-site landfill; and  
33 nonradioactive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

### 35 **3.1.2 United States Department of Energy and United States Enrichment Corporation,** 36 **Portsmouth American Centrifuge Plant, Portsmouth, Ohio**

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

- 1 • *Final Environmental Impact Statement for the Proposed American Centrifuge Plant in*  
2 *Piketon, Ohio* (NRC 2006). NUREG-1834, Vol.1. April 2006.
- 3 • *Environmental Assessment of the USEC Inc. American Centrifuge Lead Cascade Facility*  
4 *at Piketon, Ohio* (NRC 2004). January 2004.
- 5 • *Final Environmental Impact Statement for Construction and Operation of a Depleted*  
6 *Uranium Hexafluoride Conversion Facility at the Portsmouth, Ohio, Site* (DOE 2004b).  
7 DOE/EIS-0360. June 2004.  
8 <http://web.ead.anl.gov/uranium/documents/portdeis/index.cfm>.
- 9 • *Portsmouth Annual Site Environmental Report for 2005* (DOE 2007b). August 2007.  
10 <http://www.lpports.com/05%20Annual%20Environmental%20Report.htm>.
- 11 • *Final Programmatic Environmental Impact Statement for Alternative Strategies for the*  
12 *Long-term Management and Use of Depleted Uranium Hexafluoride* (DOE 1999b).  
13 DOE/EIS-0269. April 1999.  
14 <http://web.ead.anl.gov/uranium/documents/nepacomp/peis/index.cfm>.

15



**Figure 3-2. Piketon, Ohio, Locator Map**

1 ***Site Description***

2 The NRC issued a construction and operating license to USEC for the ACP in April 2007. The  
3 license, which is valid for 30 years, includes authorization to enrich uranium up to an assay level  
4 of 10 percent <sup>235</sup>U.

5 The DOE Portsmouth site is located in Pike County, Ohio, approximately 35 kilometers  
6 (22 miles) north of the Ohio River and 5 kilometers (3 miles) southeast of the town of Piketon.  
7 The two largest cities in the vicinity are Chillicothe, located 42 kilometers (26 miles) north of the  
8 site, and Portsmouth, 35 kilometers (22 miles) south. The Portsmouth site includes the  
9 Portsmouth GDP, which was previously operated by DOE and later by USEC. Uranium  
10 enrichment operations were discontinued in May 2001.

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

20 The ACP is being constructed by USEC within the confines of the Portsmouth site. It will be  
21 situated on approximately 81 hectares (200 acres) of the southwest quadrant of the controlled  
22 access area. In addition to this space, two UF<sub>6</sub> cylinder storage yards (the existing X-745G-2 and  
23 proposed X-745H), occupying a total of 11 hectares (27 acres), will be located in the northeast  
24 part of the DOE reservation just north of the Perimeter Road. The ACP will consist of  
25 refurbished existing buildings and land formerly used for the Portsmouth GDP as well as newly  
26 constructed facilities in that same area.

27 In 2002, DOE awarded a contract to UDS to design, build, and operate DUF<sub>6</sub> conversion plants  
28 at the DOE Paducah and Portsmouth sites. The contract includes cylinder surveillance and  
29 maintenance, which began June 27, 2005. Construction of the Portsmouth conversion plant is  
30 complete, the facility is preparing for its operational readiness review, and start-up is projected  
31 for March 2010.<sup>9</sup>

32 The Portsmouth site houses over 20,000 DUF<sub>6</sub> cylinders. The cylinders are located in two  
33 storage yards that have concrete bases. The cylinders are stacked two high. All 10- and 14-ton  
34 (9- and 13-tonne) cylinders stored in these yards have been or are being inspected and  
35 repositioned. They have been placed on new concrete saddles with sufficient room between  
36 cylinders and cylinder rows to permit adequate visual inspection of cylinders.

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<sup>9</sup> Personal communication: telephone conversation, May 27, 2008; William Fallon, Battelle; and Barry Tilden, UDS.

1    ***Radiation Environment***

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

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

13   The Portsmouth site environmental report for 2005 (DOE 2007b) reported that the maximum  
14   dose a member of the public could receive from radiation released by DOE Portsmouth in 2005  
15   was 1.67 mrem, based on a maximum dose of 0.012 mrem from airborne radionuclides,  
16   0.025 mrem from radionuclides released to the Scioto River, 1.1 mrem from direct radiation  
17   from DU cylinder storage yards, and 0.53 mrem based on exposure to radionuclides detected at  
18   off-site monitoring locations in 2005. This dose (1.67 mrem) was well below the 100-mrem-per-  
19   year limit set by DOE for the dose to a member of the public from radionuclides from all  
20   potential pathways. The dose to a member of the public from airborne radionuclides released by  
21   DOE Portsmouth (0.012 mrem) was approximately 1,000 times less than the 10-mrem-per-year  
22   standard set by EPA. Operation of the Portsmouth conversion facility would add a very small  
23   increment to the current public dose. The MEI dose from operation of the conversion facility was  
24   modeled to be less than  $3.0 \times 10^{-5}$  mrem per year (DOE 2004b).

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

28   ***Seismic Environment***

29   The Portsmouth site is within 96 kilometers (60 miles) of the Bryant Station-Hickman Creek  
30   Fault. No correlation has been made between this fault and historical seismicity. The seismic  
31   hazards at the Portsmouth site were analyzed and documented in a March 1997 SAR (Lockheed  
32   Martin Energy Systems, Inc. 1997b). The results presented in the SAR indicate that continued  
33   storage of DUF<sub>6</sub> cylinders at the Portsmouth site is safe.

34   ***Groundwater***

35   On-site groundwater at and around the Portsmouth site is monitored for radioactive and  
36   nonradioactive constituents at more than 400 wells. On site, five areas of groundwater  
37   contamination have been identified that contain contaminants. The main contaminants are  
38   volatile organic compounds (VOCs) (mostly TCE) and radionuclides (e.g., uranium, and <sup>99</sup>Tc).  
39   Data from annual groundwater monitoring (DOE 2007b) showed that no contaminants exceeded

1 their primary drinking water standards at off-site locations near the Portsmouth site. TCE was  
2 detected in three on-site monitoring wells in concentrations exceeding the drinking water  
3 standard. However, TCE has not been detected in an off-site well adjacent to Portsmouth above  
4 the drinking water standard. DOE is addressing the groundwater contamination through a variety  
5 of groundwater remediation and containment systems, including phytoremediation, pump-and-  
6 treat systems, and barrier walls.

### 7 *Air Quality*

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

### 11 *Waste Management*

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

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

### 36 **3.1.3 Louisiana Energy Services National Enrichment Facility, Eunice, New Mexico**

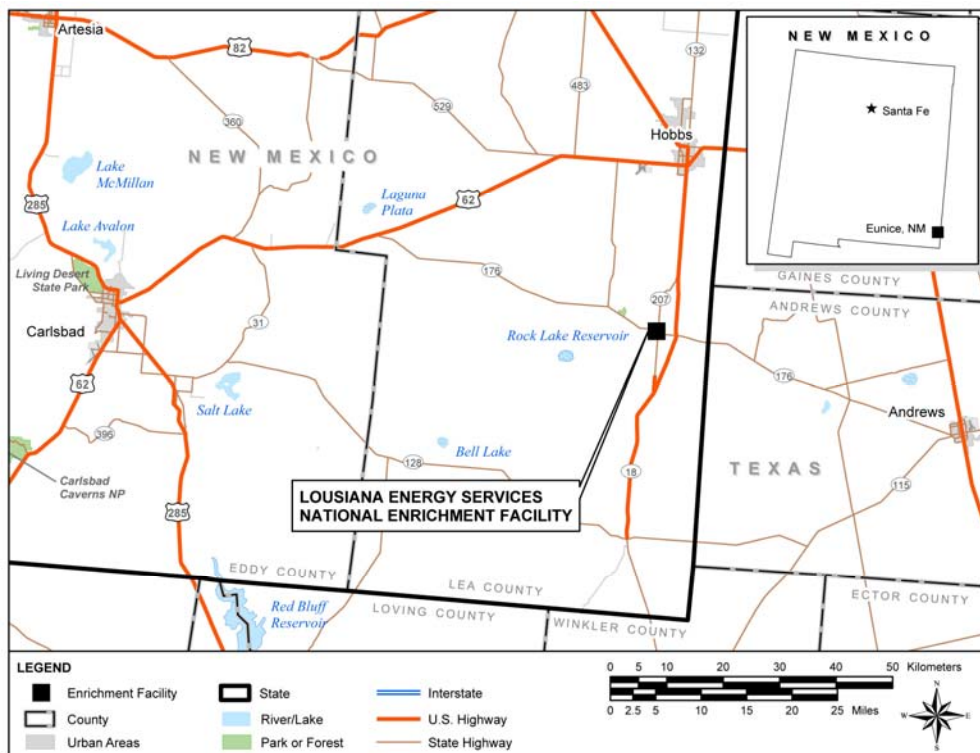
37 Figure 3-3 shows the location of the NEF near Eunice in Lea County, New Mexico. The affected  
38 environment as summarized below is described in detail in the following document, which is  
39 incorporated into this EA by reference:

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

### 3 **Site Description**

4 The NEF site covers about 220 hectares (543 acres) located 8 kilometers (5 miles) east of the city  
5 of Eunice, New Mexico. Lea County currently owns the property; however, on December 8,  
6 2004, LES began a lease for 30 years, after which LES would purchase the land from Lea  
7 County. Before NEF construction began, the entire site was undeveloped with the exception of  
8 an underground carbon dioxide pipeline and a gravel road. The site was previously used for  
9 cattle grazing. There is no permanent surface water on the site, and appreciable groundwater  
10 reserves are deeper than 340 meters (1,115 feet). The nearest permanent resident is  
11 4.3 kilometers (2.6 miles) west of the proposed site near the junction of New Mexico  
12 Highway 234 and New Mexico Highway 18.

13 New Mexico Highway 234 is a two-lane highway located on the southern border of the proposed  
14 NEF site. It has 3.6-meter (12-foot) wide driving lanes, 2.4-meter (8-foot) wide shoulders, and a  
15 61-meter (200-foot) right-of-way easement on either side. The highway provides direct access to  
16 the site. The northern side of the site is bordered by a railroad spur.



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

1    ***Radiation Environment***

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

3    ***Seismic Environment***

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

10   ***Air Quality***

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

12   ***Waste Management***

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

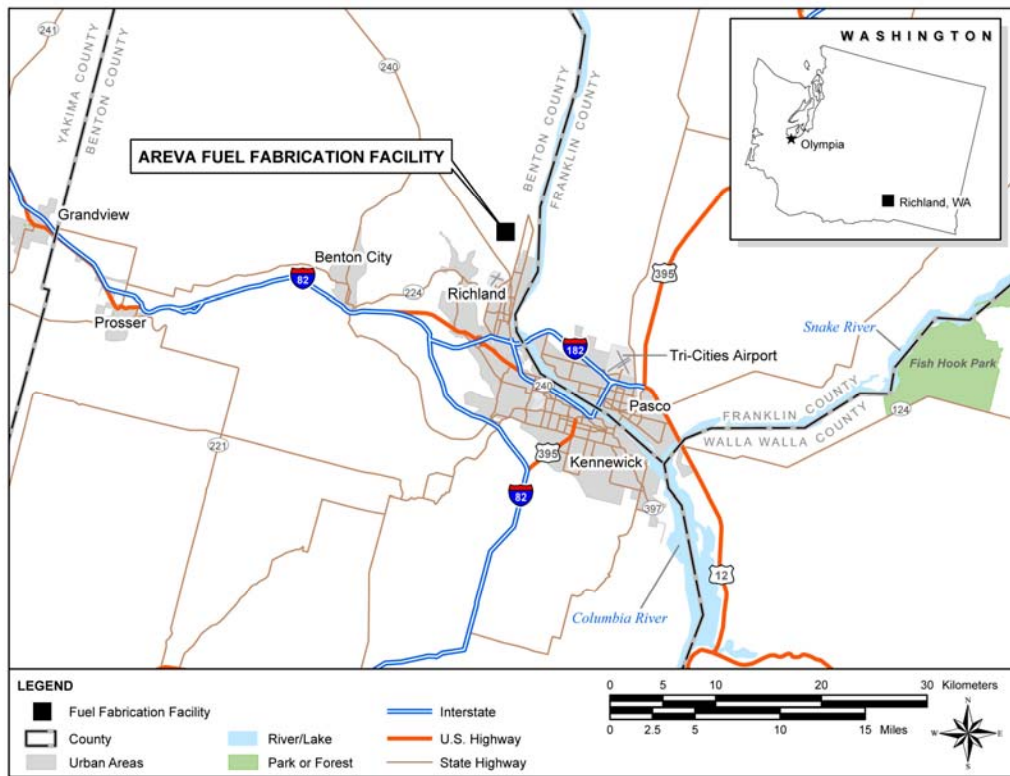
17   **3.1.4 AREVA Fuel Fabrication Facility, Richland, Washington**

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

- 22       • *Environmental Assessment for Renewal of Special Nuclear Material License SNM-1227,*  
23       *Docket 70-1257* (NRC 1995). Siemens Power Corporation Richland, Washington. (June)
- 24       • *Supplement to Applicant's Environmental Report* (AREVA 2006). E06-04-004. October  
25       2006.

26   ***Site Description***

27   The AREVA FFF is located at 2101 Horn Rapids Road, just within the northern limits of the  
28   City of Richland in Benton County, Washington. The fenced exclusion area of approximately  
29   20 hectares (50 acres) lies within 130 hectares (320 acres) of land owned by AREVA within the  
30   Horn Rapids Industrial Park. Stevens Drive, the primary route south into Richland, is  
31   approximately 1,200 meters (4,000 feet) to the east.



1  
2 **Figure 3-4. Richland, Washington, Locator Map**

3  
4 The facility contains numerous buildings plus various outside facilities/structures (tank farms,  
5 storage pads, etc.). The buildings and structures are confined within a secured fenced area and  
6 include the major special nuclear material (SNM)-processing production facilities, a number of  
7 SNM-handling production support facilities (product storage warehouses, waste treatment  
8 facilities, etc.), and a large number of non-SNM-handling production and administrative support  
9 facilities (materials warehouses, craft shops, office buildings, etc.). There is a UF<sub>6</sub> cylinder  
10 storage facility for the receipt, handling, and storage of full, empty, and heel quantity UF<sub>6</sub>  
11 cylinders, including weighing and assaying of cylinder contents. There is also a UF<sub>6</sub> cylinder  
12 recertification facility.

13 There are no public facilities (schools, hospitals, parks) in the immediate vicinity of the plant  
14 site. The nearest schools, Washington State University at Tri-Cities and the Hanford High  
15 School, are approximately 3 kilometers (2 miles) southeast of the plant, and the northernmost  
16 portion of Leslie Groves Park along the Columbia River is about 5 kilometers (3 miles) southeast  
17 of the site. The West Richland Public Golf Course is approximately 5.6 kilometers (3.5 miles)  
18 southwest of the plant. The nearest hospital, Kadlec Hospital, is located approximately  
19 8 kilometers (5 miles) south of the plant in Richland.

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



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

#### 6 ***Radiation Environment***

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

#### 15 ***Seismic Environment***

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

#### 21 ***Groundwater***

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

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

1    ***Air Quality***

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

4    ***Waste Management***

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

9    **3.1.5 Global Nuclear Fuel Company Fuel Fabrication Facility, Wilmington, North**  
10    **Carolina**

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

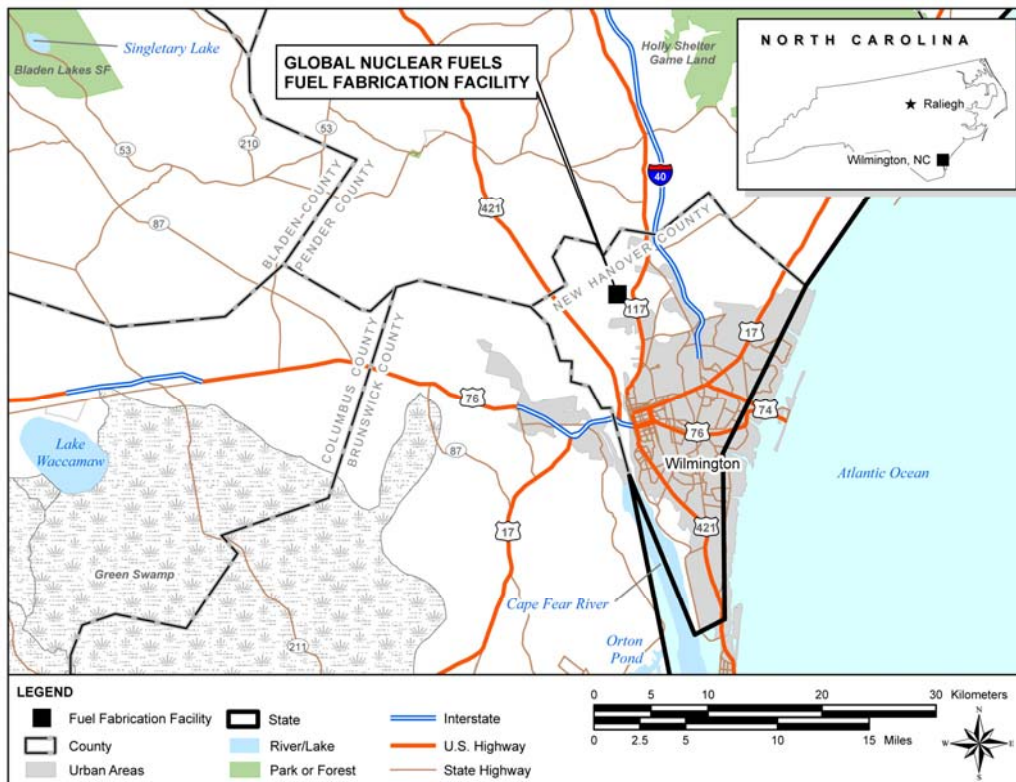
- 14       • *Environmental Assessment for the Renewal of Special Nuclear Material License SNM-*  
15       *1097, General Electric Company, Nuclear Energy Production Facility, Wilmington, NC*  
16       *(NRC 1997). (May).*
- 17       • *GNF–Americas Wilmington Environmental Report Supplement (GNF 2007). For the*  
18       *period 1995-2005. March 30, 2007.*

19    ***Site Description***

20    The GNF FFF is situated on a 673-hectare (1,664-acre) tract of land located next to NC Highway  
21    133 (formerly designated Highway 117) and is approximately 10 kilometers (6 miles) north of  
22    the City of Wilmington in New Hanover County. New Hanover County is situated in the coastal  
23    plains section of southeastern North Carolina with the Atlantic Ocean to the east, Cape Fear  
24    River to the west, and Pender County to the north. Due to the curving coastline in this area, the  
25    ocean lies approximately 16 kilometers (10 miles) east and 42 kilometers (26 miles) south of the  
26    GNF FFF Wilmington site.

27    The surrounding terrain is typical for coastal Carolina. It has an average elevation of less than  
28    12 meters (40 feet) above mean sea level and is characterized by gently rolling land, with rivers  
29    and creeks and adjoining swamps and/or marshlands. Approximately 74 hectares (182 acres) of  
30    the southwest portion of the GNF FFF Wilmington property are classified as swamp forest.

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



1  
2 **Figure 3-5. Wilmington, North Carolina, Locator Map**

3  
4 The major portion of the site is bordered on the east by NC Highway 133, on the southwest  
5 perimeter by the Northeast Cape Fear River; and on the north, and for most of the south property  
6 line, by undeveloped forestlands. Approximately 10 hectares (24 acres) are east of NC Highway  
7 133 and contain an employee recreation area, a future railroad right-of-way, three potable water  
8 supply wells, and temporary truck parking. The south property line for approximately 900 meters  
9 (3,000 feet) is bordered by a new highway (Wilmington Bypass I-140). Due to road construction  
10 and the new Bypass I-140, US Highway 117 is now designated NC Highway 133.

11 ***Radiation Environment***

12 The gamma radiation exposure levels measured at the site boundary are at background levels.  
13 Gross alpha ambient airborne concentrations are measured routinely at the southern fence line  
14 and are typically on the order of  $4 \times 10^{-15}$  microcuries per cubic centimeter ( $\mu\text{Ci}/\text{cc}$ ).

15 Direct inhalation of airborne releases is the most likely intake pathway. The off-site population  
16 dose estimates have been calculated using EPA's COMPLY code. An individual dose of  
17  $8.5 \times 10^{-4}$  mrem was calculated using the nearest population center 3 kilometers (2 miles) south  
18 of the facility and 2005 air stack releases. All releases were assumed to be  $^{234}\text{U}$  (Class Y  
19 insoluble). When direct data were not available, conservative assumptions were made. Thus,  
20 there is a high degree of confidence that dose equivalent values are not underestimated. A  
21 conservative assumption was made to apply the individual dose at this population center to the

1 entire 200,000 persons (2000 census) in the surrounding area. The estimated 0.17 person-rem for  
2 the surrounding population can be compared to the annual average 60,000 person-rem received  
3 by this population due to natural background. Therefore, the average annual dose received by an  
4 individual in the surrounding population from releases at this facility is several orders of  
5 magnitude less than 1 mrem. There are no potential health effects which might be predicted from  
6 such doses.

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

13 The uranium concentration and gross alpha activity concentration of the discharge to the  
14 Northeast Cape Fear River are determined from analysis of the samples collected at the final  
15 process basin outfalls. The final process basin outfall was sampled for gross alpha concentrations  
16 during the 1995-2005 period. The highest average concentration during that period was  
17  $1.23 \times 10^{-7}$   $\mu\text{Ci/cc}$  in 2005. Compared with the 10 CFR 20 Appendix B limit, the 2005 site  
18 discharge was 41 percent of the limit.

### 19 *Seismic Environment*

20 North Carolina lies within an intraplate region of the North American tectonic plate and has  
21 relatively low seismic activity. The Wilmington area has had nine reported earthquakes since  
22 1800. The 1884 and 1958 Wilmington area earthquakes rated 5 on the Modified Mercalli scale.  
23 The site is located in Zone 1 of the 1973 Uniform Building Code. The code requirements  
24 indicate that structures in Zone 1 must withstand intensities of 5 and 6 on the Modified Mercalli  
25 scale without receiving earthquake damage. Earthquakes produced by small faults along the  
26 Atlantic seaboard have the potential to cause damage, even if the faults do not reach the surface.  
27 The earthquake causing the most damage in North Carolina had an epicenter near Charleston,  
28 South Carolina, approximately 250 kilometers (155 miles) southwest of Wilmington. This  
29 earthquake, a 7.2 on the Richter scale, occurred in 1886 and caused chimneys and plaster to  
30 crack.

### 31 *Groundwater*

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

1 ***Air Quality***

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

3 ***Waste Management***

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

15 **3.1.6 Westinghouse Electric Corporation Fuel Fabrication Facility, Columbia, South**  
16 **Carolina**

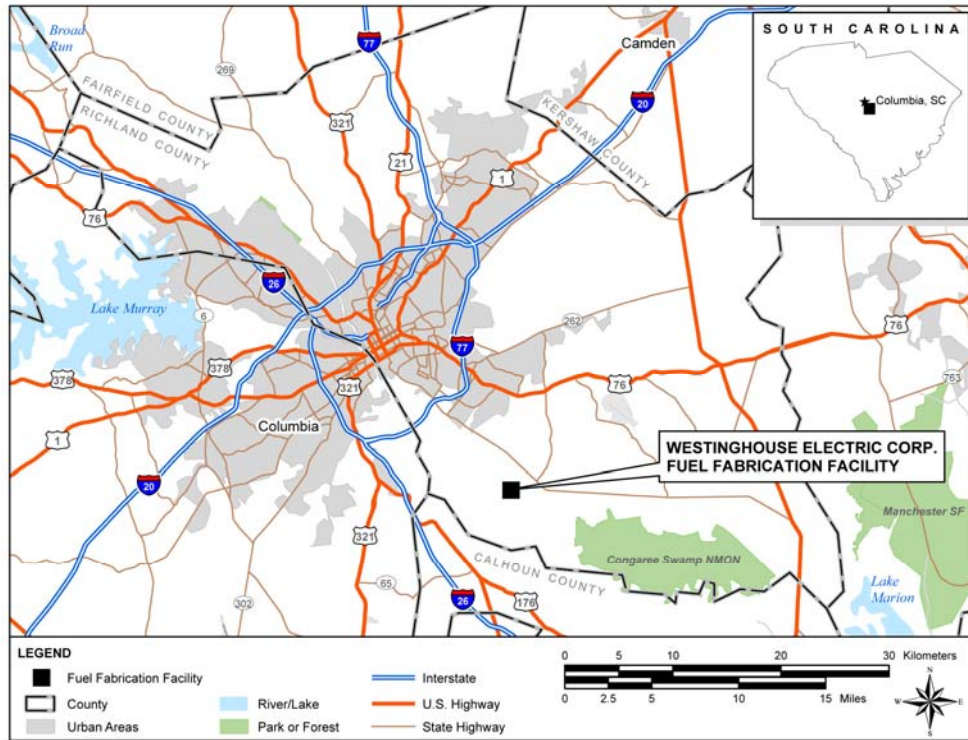
17 Figure 3-6 illustrates the location of the WEC FFF near Columbia, South Carolina. The affected  
18 environment as summarized below is described in detail in the following document, which is  
19 incorporated into this EA by reference:

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

23 ***Site Description***

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

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



1  
2 **Figure 3-6. Columbia, South Carolina, Locator Map**

3  
4 The land around the WEC FFF site is used for a variety of purposes. Two schools are located  
5 within an 8-kilometer [5-mile] radius of WEC FFF. South Carolina Electric and Gas is  
6 constructing a new commercial electrical substation on approximately 2.8 hectares [7 acres]  
7 along the northwest border of WEC FFF property on land purchased from WEC. The new  
8 facility should improve reliability of electrical service to the WEC FFF and other customers in  
9 the vicinity and will not routinely be staffed with personnel. The land sale and right-of-way  
10 issuance was completed in 2005. Two public parks are near the WEC FFF site: Bluff Road Park  
11 is located approximately 5.6 kilometers (3.5 miles) to the north, and Hopkins Park is  
12 approximately 4 kilometers (2.5 miles) to the east. Located approximately 8 kilometers (5 miles)  
13 southeast of WEC FFF is the Congaree National Park. Other facilities in the vicinity include the  
14 Richland County Detention Center located 8 kilometers (5 miles) to the north. Two major  
15 military installations are located near WEC FFF: Fort Jackson Military Reservation  
16 approximately 11 kilometers (7 miles) north, and McEntire Joint National Guard Station  
17 approximately 9.7 kilometers (6 miles) northeast. Columbia and the surrounding area contain a  
18 well-developed and maintained system of interstate, regional, and local highways that provide  
19 easy year-round access. Three interstate highways serve Columbia. The WEC FFF site can be  
20 accessed by state highway SC 48. Although CSX Transportation Inc. operates two rail lines close  
21 to the WEC FFF site, there are no rail lines or spurs on the property.

1    ***Radiation Environment***

2    Radiological doses to the public from the WEC FFF operations are primarily from air emissions.  
3    Over 99 percent of the off-site dose originates from the airborne pathway. Typical cumulative  
4    WEC FFF stack emissions would result in a total effective dose of less than 0.4 mrem to a  
5    hypothetical exposed individual living at the site boundary. For the 6-year period from 2000 to  
6    2005, this annual dose ranged between 0.30 mrem and 0.38 mrem. This is approximately  
7    4 percent of the 10-mrem annual dose limit from air emissions cited in 10 CFR 20.1101. In  
8    contrast, the annual radiological total effective dose from liquid effluents is only  $3 \times 10^{-4}$  mrem.  
9    The annual total effective dose from the combined effluent releases for the nearest actual resident  
10   to the licensed operations is approximately  $3 \times 10^{-2}$  mrem. This is approximately 0.03 percent of  
11   the 100-mrem annual dose limit from all pathways imposed by 10 CFR 20.1301.

12   ***Seismic Environment***

13   The WEC FFF site is not located near an active tectonic margin. The nearest major seismic  
14   source is the Charleston seismic zone, located approximately 145 kilometers (90 miles) southeast  
15   of the WEC FFF site. Seismicity in the area is characterized by small-magnitude background  
16   earthquakes and very infrequent moderate-to-large intra-continental earthquakes. The  
17   U.S. Geological Survey reports that 69 earthquakes have occurred within a 200-kilometer  
18   (120-mile) radius of the WEC FFF site since 1973, ranging in magnitude from 1.1 to 4.9 on the  
19   Richter scale. The largest of these recent earthquakes occurred in 1974 and was located  
20   144 kilometers (89.5 miles) from the WEC FFF site. However, an earthquake of magnitude 7.2  
21   on the Richter scale occurred near Charleston, South Carolina, in 1886, killing 60 people and  
22   causing major damage in the area. The site has a 10-percent probability of exceeding a peak-  
23   ground acceleration of approximately 0.1 g (the force of gravity) and a 2-percent chance of  
24   exceeding a peak-ground acceleration of approximately 0.3 g in a 50-year period.

25   ***Groundwater***

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

31   ***Air Quality***

32   Air pollutant concentration levels in Richland County are lower than the established National  
33   Ambient Air Quality Standards (NAAQS) for all pollutants except ozone. Portions of Lexington  
34   and Richland Counties, including the area around WEC FFF, have exceeded the NAAQS ozone  
35   standard. The EPA has deferred designating this area as nonattainment because the counties have  
36   successfully participated in the Early Action Compact. Pending final EPA action, the state

1 considers Richland County, especially southern Richland County where the WEC FFF is located,  
2 to be an attainment area for ozone.<sup>10</sup>

### 3 **3.2 Uranium Market**

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

#### 8 *Sources and Production*

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

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

18 Figure 3-7 illustrates the uranium fuel cycle.

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

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

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

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



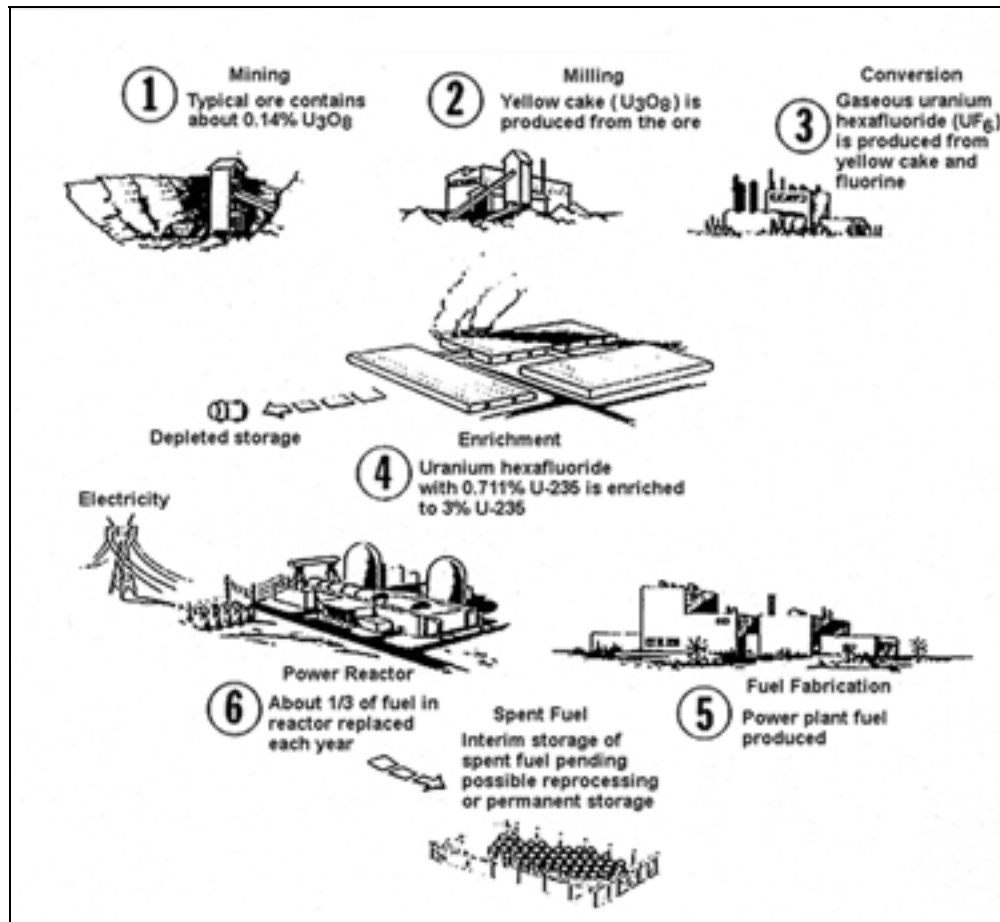


Figure 3-7 Uranium Fuel Cycle

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11

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.

12  
13  
14  
15  
16  
17  
18  
19

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)  $U_3O_8$ .

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

### 11 ***Demand Factors***

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

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

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

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

### 34 ***Uranium Sales Contracts***

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

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

### 9 ***The Spot Market***

10 A spot market contract usually consists of just one delivery and is typically priced at or near the  
11 published spot market price at the time of contract award. When a contract is priced at spot, it is  
12 usually the value quoted by one of the several market information services, such as Ux  
13 Consulting, TradeTech, or Nukem, at the end of the month prior to the delivery date. Spot market  
14 delivery quantities vary from 23,000 kilograms (50,000 pounds) to a few hundred thousand  
15 pounds U<sub>3</sub>O<sub>8</sub>. Over the last few years, about 15 percent of the western world's uranium  
16 requirements have been procured in the spot market—that is, for delivery within 12 months of  
17 contract award.

### 18 ***The Long-term Market***

19 Historically, some 85 percent of all uranium has been sold under long-term, multi-year contracts  
20 with deliveries starting 1 to 3 years after contract award. Long-term contract terms range from  
21 2 to 10 years or more, with the first delivery occurring within 24 months of contract award.  
22 Commercial terms are specified in the contract for each individual (usually annual) delivery,  
23 although those terms may vary from delivery to delivery over the duration of the contract. Long-  
24 term contracts may include a clause that allows the buyer to vary the size of each delivery within  
25 prescribed limits. For example, delivery quantities may vary from the prescribed annual volume  
26 by plus or minus 15 percent.

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

### 31 ***The U.S.-Russian HEU Agreement***

32 The Energy Policy Act of 1992, Public Law 102-486, amended the Atomic Energy Act of 1954  
33 by establishing USEC as a wholly-owned government corporation to take over the operation of  
34 DOE's uranium enrichment enterprise. Subchapter A of Title III of Public Law 104-134, the  
35 USEC Privatization Act, in Section 3103, authorized USEC's Board of Directors, with approval  
36 of the Secretary of the Treasury, to transfer the interest of the United States in USEC to the  
37 private sector in a manner that provides for the long-term viability of USEC, provides for the  
38 continuation by USEC of the operation of DOE's GDPs, provides for the protection of the public  
39 interest in maintaining a reliable and economical domestic source of uranium mining, enrichment

1 and conversion services, and, to the extent not inconsistent with such purposes, secures the  
2 maximum proceeds to the United States.

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

9 In 1994, the USEC, as agent for the U.S. government, and Russia signed an agreement whereby  
10 USEC would purchase the enrichment component of the LEU upon delivery to the United States.  
11 In 1999, Cameco and two other western companies, AREVA and RWE Nukem (now part of  
12 EnergySolutions), concluded an agreement with Russia whereby they have the option to  
13 purchase the majority of the natural feed component of LEU. This agreement is officially called  
14 the UF<sub>6</sub> Feed Component Implementing Contract. In November 2001, the western companies  
15 agreed to exercise a portion of their options to bring predictability to the program—predictable  
16 supply to the western market and predictable revenue to the Russians.

1 **4.0 ENVIRONMENTAL IMPACTS**

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

5 **4.1 Existing Analyses and Scope of Impact Assessment**

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

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

18 Operations and impacts previously analyzed at these  
19 facilities would be unaffected, either adversely or  
20 beneficially, by the Proposed Action.

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

31 Because the Proposed Action involves no new construction and no on-site or off-site disturbance  
32 of previously undisturbed land, there would be no potential for the Proposed Action to impact  
33 current land use; biotic communities; cultural, historical, or archaeological resources; visual  
34 resources; ambient noise levels; threatened or endangered species or their critical habitats;  
35 wetlands; or floodplains. The existing and projected enrichment facility and FFF operational  
36 work forces previously analyzed would not change as a result of DOE’s Proposed Action. The  
37 impacts to current or projected utility and public safety infrastructures in the communities where  
38 these plants are located would not differ from those impacts previously analyzed. The Proposed  
39 Action would not result in criteria air pollutant emissions beyond those already assessed in  
40 existing NEPA documents. The ambient air quality in the regions where enrichment and storage

**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.

1 activities would occur complies with applicable ambient air quality standards<sup>12</sup>. Health impacts  
2 related to air emissions resulting from transportation activities are addressed in the transportation  
3 impacts section (Section 4.2.1). There would be no environmental justice impacts beyond those  
4 discussed in the existing NEPA documents, which identified no environmental justice impacts  
5 due either to the absence of minority or low-income populations, or to the absence of adverse  
6 impacts to any population.

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

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

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

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

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<sup>12</sup> 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).

<sup>13</sup> 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.

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

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

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

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

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

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

23 "NRC reviewed available environmental review documentation for the PGDP that  
24 was prepared in accordance with the National Environmental Policy Act. Available  
25 NEPA documents include site-wide environmental assessments by both the  
26 Department of Energy and the United States Enrichment Corporation, and an NRC  
27 environmental assessment for approving USEC's compliance plan that was  
28 associated with their initial certificate application. The NRC staff conducted this  
29 review to ensure that environmental effects associated with facility changes in  
30 support of higher assay operations remained appropriately bounded by previous  
31 NEPA analyses. Upon completion of this review, the NRC staff affirmed that *there*  
32 *are no new and significant environmental impacts associated with higher assay*  
33 *operations at the PGDP*. Therefore, consistent with the bases for the 10 CFR  
34 51.22(c)(19) categorical exclusion, the NRC staff finds that issuance of the  
35 Certificate Evaluation Report for higher assay operation at the PGDP will not result  
36 in any significant new environmental impact." (Italicized emphasis added.)

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

Resource Area	Impact Summary
Land Use	<b>Small Impact.</b> 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	<b>Small Impact.</b> 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	<b>Small Impact.</b> 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	<b>Small Impact.</b> Air concentrations of the criteria pollutants predicted for vehicle emissions and emissions of particulate matter of less than 10 microns in diameter (PM <sub>10</sub> ) 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	<b>Small Impact.</b> 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	<b>Small Impact.</b> 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	<b>Small Impact.</b> 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	<b>Small Impact.</b> 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	<b>Small Impact.</b> 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	<b>Small Impact.</b> Noise would come predominantly from traffic. Noise levels during operations would be within the U.S. Department of Housing and Urban Development guidelines.
Transportation	<p><b>Small Impact during Normal Operations; Small to Moderate during Accidents.</b></p> <p>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<sub>6</sub>) 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 <math>3 \times 10^{-2}</math> LCFs due to direct radiation. All rail shipments of feed, product, waste materials, and empty cylinders would result in fewer than <math>8 \times 10^{-2}</math> LCFs to the general population over the life of the proposed NEF due to vehicle emissions and <math>1 \times 10^{-1}</math> LCFs from direct radiation. If a rail accident involving the shipment of DUF<sub>6</sub> 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<sub>6</sub> in an urban area could have temporary adverse chemical impacts on as many as 1,700 people.</p> <p><b>Small Impact during Decommissioning.</b> Small impacts would occur if DUF<sub>6</sub> 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<sub>6</sub> conversion facility.</p>
Public and Occupational Health and Safety	<p><b>Small Impact during Construction and Normal Operations.</b> 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 <math>1.3 \times 10^{-3}</math> mrem due to normal NEF operations.</p> <p><b>Small to Moderate Impact for Accidents.</b> The most severe accident is estimated to be the release of UF<sub>6</sub> 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.</p>

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

Resource Area	Impact Summary
Waste Management	<p><b>Small Impact.</b> 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.</p> <p><b>Small to Moderate Impact for DUF<sub>6</sub> Waste Management.</b> 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<sub>6</sub>: 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<sub>6</sub> byproduct. No final location has yet been determined for a private conversion facility, but the EIS contemplated potential DUF<sub>6</sub> conversion at a non-DOE facility. Alternatively, DOE would process the DUF<sub>6</sub> 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.</p>

Source: NRC 2005.

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

Resource Area	Impact Summary
Land Use	<b>Small Impact.</b> 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	<b>Small Impact.</b> 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	<b>Small Impact.</b> 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	<b>Small to Moderate Impact.</b> 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 fence line. 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	<b>Small Impact.</b> 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	<b>Small Impact.</b> 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	<b>Small Impact.</b> 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	<b>Small to Moderate Impact.</b> 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	<b>Small Impact.</b> 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	<b>Small Impact.</b> 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	<b>Small to Moderate Non-radiological Impacts from Routine Transportation.</b> 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
	<p>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.</p> <p><b>Small Radiological Impacts from Routine Transportation and Transportation Accidents.</b> 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.</p> <p><b>Moderate Non-Radiological Impacts from Transportation Accidents.</b> Transportation accidents involving the release of UF<sub>6</sub>, 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<sub>6</sub> reacts with the moisture in the atmosphere to form HF and uranyl fluoride (UO<sub>2</sub>F<sub>2</sub>), 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<sub>6</sub> 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.</p> <p><b>Small Impact During D&amp;D.</b> 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&amp;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&amp;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.</p>

**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	<p><b>Small Impact.</b> 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.</p> <p>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&amp;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.</p>
Waste Management	<p><b>Small Impact.</b> 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.</p> <p>The ACP would generate approximately 41,105 cylinders of DUF<sub>6</sub>, containing approximately 512,730 MT (535,200 tons) of material. Production of DUF<sub>6</sub> for the 10 percent enrichment scenario would be less than this amount. All of this DUF<sub>6</sub> 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.</p>

1 Source: NRC 2006.

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

3 In two EISs analyzing construction and operation of proposed UF<sub>6</sub> conversion facilities at DOE  
4 Paducah (DOE 2004a), and DOE Portsmouth (DOE 2004b), DOE found that environmental  
5 impacts associated with the proposed action alternatives would include (1) impacts to local air,  
6 water, soil, ecological, and cultural resources during conversion facility construction; (2) impacts  
7 to workers from facility construction and operations; (3) impacts from small amounts of DU and  
8 other hazardous compounds released to the environment through normal conversion plant air  
9 effluents; (4) impacts from the shipment of cylinders, conversion products, and waste products;  
10 and (5) impacts from potential accidents involving the release of radioactive material or  
11 hazardous chemicals. However, most of the identified impacts were associated with the  
12 construction (now complete at Portsmouth and nearly complete at Paducah) rather than the future  
13 operation of the new conversion facilities. As discussed in Section 2.3, the No Action Alternative  
14 for this EA relative to DU is the status quo; that is, DOE would implement the currently planned  
15 operation of these two new facilities rather than implementing either of the Proposed Action  
16 alternatives described in Sections 2.1 and 2.2. Consequently, the operational impacts DOE  
17 assessed in its two DU conversion facility EISs (DOE 2004a, 2004b) are tantamount to the  
18 impacts of the No Action Alternative for DU assessed in this EA. In addition, the two DU  
19 conversion facility EISs evaluated continued storage of NU and LEU cylinders as part of their no  
20 action alternatives, which is comparable to the No Action Alternative in this EA and is also  
21 comparable to the storage of NU and LEU cylinders after enrichment at Portsmouth and Paducah  
22 in the Proposed Action of this EA. Therefore, DOE anticipates no new or previously  
23 unrecognized or unanalyzed impacts. Table 4-3 summarizes the generally minor operational  
24 impacts for DU conversion assessed in the two conversion facility EISs.<sup>15</sup>

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

28 ***Conclusion***

29 In the context of impacts at enrichment facilities, DU feed is similar chemically and physically to  
30 NU feed. DU feed would have slightly lower radiological hazard than NU feed because of  
31 decreased <sup>234</sup>U and <sup>235</sup>U. Given equal amounts of DU or NU feed, there would also be a slightly  
32 lesser amount of DU tails with an assay of 0.20 percent than DU tails with an assay of  
33 0.35 percent. In addition, DU tails with an assay of 0.20 percent would have a slightly lower  
34 radiological hazard than DU tails with an assay of 0.35 percent because of the decreased <sup>234</sup>U.  
35 Enrichment activities would also take place within the NRC-licensed capacities at the enrichment  
36 facilities. Therefore, DOE has determined that the impacts of enriching DU tails would be  
37 similar to or slightly less than the impacts of enriching NU.

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<sup>15</sup> 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 <sub>6</sub> 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 fatality would be estimated under both transportation modes. If HF were neutralized to calcium fluoride (CaF <sub>2</sub> ), 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 <sub>2.5</sub> ) would be well within standards. The background level of annual average PM <sub>2.5</sub> 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 <sub>2</sub> . 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	<p>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.</p> <ul style="list-style-type: none"> <li>▪ 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.</li> <li>▪ The sites are located in attainment regions. However, the background annual-average PM<sub>2.5</sub> concentration is near (for Paducah) or exceeds (for Portsmouth) the regulatory standard. Cumulative impacts would not affect attainment status.</li> <li>▪ 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.</li> <li>▪ Cumulative ecological impacts on habitats and biotic communities, including wetlands, would be negligible to minor.</li> <li>▪ Cumulative land use impacts are anticipated to be negligible to minor.</li> <li>▪ 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.</li> <li>▪ Socioeconomic impacts under all alternatives considered are anticipated to be generally positive, often temporary, and relatively small.</li> </ul>

Sources: DOE 2004a, 2004b.

PM<sub>2.5</sub> = particulate matter with a diameter of 2.5 microns or less; PM<sub>10</sub> = particulate matter with a diameter of 10 microns or less.

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1 In the context of impacts at conversion facilities, DU tails with an assay of 0.20 percent would  
2 have a slightly lower radiological hazard than DU tails with an assay of 0.35 percent, again  
3 because of decreased <sup>234</sup>U. In addition, given equal amounts of feed, there would also be a  
4 slightly lesser amount of DU tails with an assay of 0.20 percent than DU tails with an assay of  
5 0.35 percent. Therefore, DOE has determined that the impacts of converting DU tails with an  
6 assay of 0.20 percent would be similar to or slightly less than the impacts of converting DU tails  
7 with an assay of 0.35 percent. At the Portsmouth conversion facility, the number of DU cylinders  
8 could increase slightly, from 20,931 to 21,086 (0.7 percent), as a result of the Proposed Action in  
9 this draft EA. At the Paducah conversion facility, the number of DU cylinders could also  
10 increase slightly, from 41,013 to 41,168 (0.4 percent), as a result of the Proposed Action in this  
11 draft EA. The impacts from these incremental changes would be minor.

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

## 23 **4.2 Enrichment Alternative**

### 24 **4.2.1 Transportation Impacts under the Enrichment Alternative**

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

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

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

12 Radiological dose during normal, incident-free transportation of radioactive materials result from  
13 exposure to the external radiation field that surrounds the shipping containers. The dose is a  
14 function of the number of people exposed, their proximity to the containers, their length of time  
15 of exposure, and the intensity of the radiation field surrounding the containers. The radiation  
16 dose rate at 1 meter from UF<sub>6</sub> containers ranges from about 0.2 to 1 mrem per hour (NRC 2005,  
17 NRC 2006). In this analysis, the radiation dose rate was estimated to be 1 mrem per hour at a  
18 distance of 1 meter (3 feet) from the cylinders used to ship the UF<sub>6</sub>.

19 Radiological impacts were determined for crew workers and the general population during  
20 normal, incident-free transportation. For truck shipments, the crew were drivers of the shipment  
21 vehicles. For rail shipments, the crew were workers in close proximity to the shipping containers  
22 during railcar inspection or classification. The general population was the individuals within  
23 800 meters (2,600 feet) of the road or railway (off-link), sharing the road or railway (on-link),  
24 and at stops. Collective doses for the crew and general population were calculated using the  
25 RADTRAN 5 computer code (Neuhauser and Kanipe 2000; Neuhauser et al. 2000). Individual  
26 radiation doses were also estimated for people along the route at a distance of 30 meters  
27 (100 feet) from the highway or railroad. Nonradiological incident-free impacts were also  
28 determined for exhaust and fugitive dust emissions from highway and rail traffic.

29 Human health impacts could also result from transportation accidents in which no radioactive  
30 material would be released (i.e., traffic fatalities), and from transportation accidents in which  
31 radioactive material could be released from a cylinder. For transportation accidents involving a  
32 release of radioactive material, DOE estimated radiological accident risks (probability of  
33 occurrence × consequence) expressed as the number of latent cancer fatalities (LCFs) summed  
34 over a complete spectrum of accidents. Impacts were evaluated for the population within  
35 80 kilometers (50 miles) of the road or railway using the RADTRAN 5 computer code. DOE  
36 assumed that people would be exposed through inhalation, direct external dose from radioactive  
37 material that has deposited on the ground after being dispersed from the accident site (referred to  
38 as groundshine), and direct external dose from the passing cloud of dispersed radioactive  
39 material (referred to as cloudshine). In addition to transportation accident risks, the radiological  
40 and toxicological consequences of severe transportation accidents involving UF<sub>6</sub> releases were  
41 also evaluated.

Draft Environmental Assessment:  
Disposition of DOE Excess Depleted Uranium, Natural Uranium, and Low-Enriched Uranium

**Table 4-4. Transportation Distances and Population Densities**

Origin	Destination	Distance (km)				Population Density (people/km <sup>2</sup> )		
		Rural	Suburban	Urban	Total	Rural	Suburban	Urban
<b>Truck Routes</b>								
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
<b>Rail Routes</b>								
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
<b>Barge Routes</b>								
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

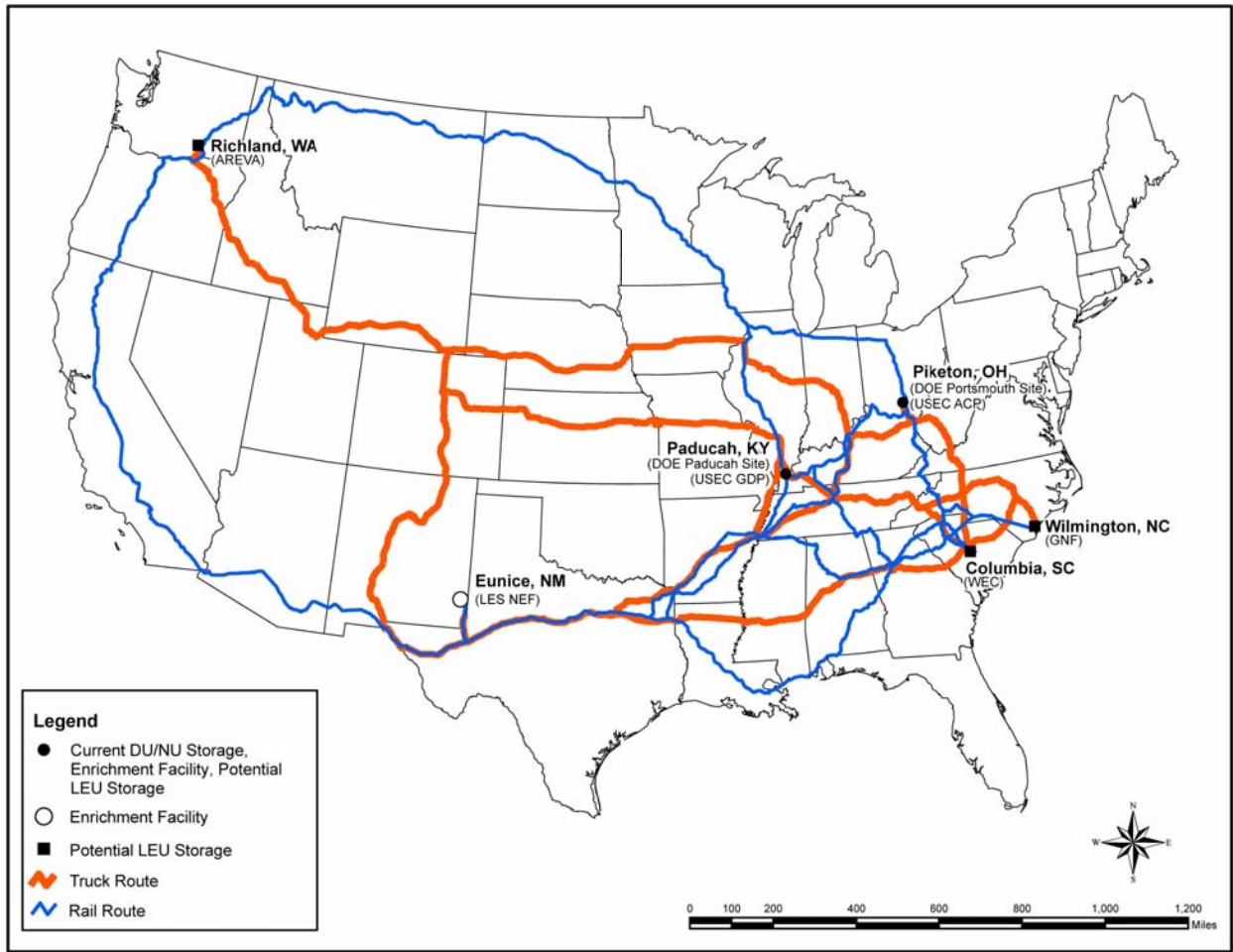


Figure 4-1. Rail and Truck Routes

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3 The total impacts of transportation are the sum of the radiological and nonradiological incident-  
4 free and accident impacts. For incident-free transportation, the impacts are (1) the radiological  
5 impacts from exposure to low levels of radiation from the UF<sub>6</sub> cylinders, and (2) the  
6 nonradiological impacts from truck or train exhaust (vehicle emissions). For accidents, the  
7 impacts are (1) the radiological risks associated with the UF<sub>6</sub> being shipped, and  
8 (2) nonradiological traffic fatalities. The toxicological accident risks associated with the UF<sub>6</sub>  
9 being shipped were not included with the estimate of accident risk because these risks were  
10 previously shown to be small relative to radiological accident risks and nonradiological traffic  
11 fatalities (Biwer et al. 2001).

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

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

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

11 The number of cylinders of NU feed, DU feed, and 1,100 MTU of LEU feed represent the actual  
12 number of cylinders in DOE's inventory. DU tails are typically stored in 48Y or 48G cylinders.  
13 The 48G cylinder is slightly smaller than the 48Y cylinder. Therefore, the number of DU tails  
14 cylinders was estimated using the 48G cylinder. An additional 900 MTU of LEU feed was also  
15 analyzed. This additional 900 MTU of LEU feed was assumed to have an enrichment of  
16 1.7 percent. LEU with enrichment greater than 1.0 percent but less than 4.5 percent is typically  
17 shipped in 48X or 48Y cylinders. The 48X cylinder is slightly smaller than the 48Y cylinder.  
18 Therefore, the number of LEU feed cylinders was estimated using the 48X cylinder. NU is  
19 typically shipped in 48X or 48Y cylinders. The 48X cylinder is slightly smaller than the 48Y  
20 cylinder. Therefore, the number of NU product cylinders was estimated using the 48X cylinder.  
21 LEU enriched to 4.95 percent is typically shipped in 30B cylinders. Therefore, the 30B cylinder  
22 was used to estimate the number of LEU product cylinders.

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

28 The radionuclide content of UF<sub>6</sub> is due to the naturally occurring isotopes of uranium (<sup>234</sup>U, <sup>235</sup>U,  
29 and <sup>238</sup>U) and their short-lived radioactive progeny. Table 4-7 lists the radionuclide inventories  
30 of <sup>234</sup>U, <sup>235</sup>U, and <sup>238</sup>U contained in the cylinders.

31 The numbers of cylinders that would be necessary to ship and store the feed, product, and tails  
32 are listed in Table 4-6. For 48X, 48Y, or 48G cylinders, one cylinder was assumed to be shipped  
33 on a truck. For 30B cylinders, three cylinders were assumed to be shipped on a truck. For rail  
34 shipments, four 48X, 48Y, or 48G cylinders or twelve 30B cylinders were assumed to be shipped  
35 on a railcar. For barge shipments, sixty-five 48X, 48Y, 48G, or 30B cylinders were assumed to  
36 be shipped on a barge based on the number of cylinders shipped in the barge illustrated in  
37 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 <sup>3</sup> )	108.9	142.7	139.0	26.0
Weight limit (MT UF <sub>6</sub> )	9.539	12.501	12.174	2.277
Weight limit (MTU)	6.45	8.45	8.23	1.54
Maximum enrichment (weight percent <sup>235</sup> U)	4.5	4.5	1.0	5.0

Source: USEC 2006.

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**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 <sup>a</sup>	10,931	10,931	2,733	169
NU product	3,445	3,445	862	53
DU tails <sup>b</sup>	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.

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**Table 4-7. Radionuclide Inventory of Uranium Cylinders**

Material	<sup>234</sup> U Inventory (Ci)	<sup>235</sup> U Inventory (Ci)	<sup>238</sup> U Inventory (Ci)
NU feed or product <sup>a</sup>	2.8	0.13	2.8
DU feed <sup>b</sup>	1.1	0.064	2.8
LEU feed <sup>c</sup>	7.4	0.31	2.8
LEU product <sup>d</sup>	4.4	0.16	0.49
DU tails <sup>e</sup>	0.50	0.037	2.8

a. NU feed or product assumed to be 0.711 weight percent <sup>235</sup>U.

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

c. LEU feed assumed to be 1.7 weight percent <sup>235</sup>U.

d. LEU product assumed to be 4.95 weight percent <sup>235</sup>U.

e. DU tails assumed to be 0.20 weight percent <sup>235</sup>U.

7



1    4.2.1.1    *Impacts from Truck Shipments*

2    For truck shipments of UF<sub>6</sub>, radiation doses were evaluated for workers and members of the  
3    public. Workers included the drivers of the trucks carrying the UF<sub>6</sub>, workers involved in loading  
4    and unloading the UF<sub>6</sub> cylinders, and workers who inspected UF<sub>6</sub> shipments. For members of the  
5    public, radiation doses were estimated for people along the route, people sharing the route (in  
6    traffic), and people at stops. The number of health effects from vehicle emissions, the number of  
7    traffic fatalities, and the radiological accident risks were also estimated. The radiological and  
8    toxicological impacts of severe transportation accidents are discussed in Section 4.2.1.5.

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

15   The impacts from truck shipments of UF<sub>6</sub> are listed in Tables 4-8a, 4-8b, and 4-8c. Impacts are  
16   quantified in terms of total fatalities, which are the sum of radiation-related LCFs, vehicle  
17   emission health effects, and traffic fatalities. For enrichment of NU, DU, and LEU feed to LEU  
18   product, the estimated number of total fatalities ranged from 0.22 to 2.5, depending on where the  
19   enrichment of the NU, DU, and LEU feed occurred and where the LEU product and DU tails  
20   were shipped. The estimated number of fatalities from enriching the equivalent of 2,000 MTU of  
21   NU in a given year ranged from 0.0087 to 0.092, and the estimated number of fatalities from  
22   enriching the equivalent of 4,000 MTU of NU in a given year ranged from 0.018 to 0.21. For  
23   perspective, over the period 2002 to 2006, about 43,000 people were killed each year in motor  
24   vehicle accidents in the United States (DOT 2007).

25   For enrichment of DU feed to NU product, the estimated number of total fatalities ranged from  
26   0.18 to 1.9, depending on where the enrichment of the DU feed occurred and where the NU  
27   product and DU tails were shipped. The estimated number of fatalities from enriching the  
28   equivalent of 2,000 MTU of NU in a given year ranged from 0.016 to 0.18, and the estimated  
29   number of fatalities from enriching the equivalent of 4,000 MTU of NU in a given year ranged  
30   from 0.030 to 0.32.

31   For enrichment of DU feed to NU product followed by subsequent enrichment of NU product to  
32   LEU product, enrichment at more than one enrichment facility could occur. The estimated  
33   number of total fatalities ranged from 0.19 to 2.7, depending on where the enrichment of the DU  
34   feed to NU product occurred, where the enrichment of the NU product to LEU product occurred,  
35   where DU tails were shipped, and where the LEU product was shipped. The estimated number of  
36   fatalities from enriching the equivalent of 2,000 MTU of NU in a given year ranged from 0.017  
37   to 0.25, and the estimated number of fatalities from enriching the equivalent of 4,000 MTU of  
38   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
<b>Enrichment to LEU at the Paducah GDP</b>						
NU, DU, LEU feed	$1.7 \times 10^{-2}$	$8.3 \times 10^{-2}$	$2.3 \times 10^{-2}$	$8.7 \times 10^{-2}$	$9.9 \times 10^{-2}$	$3.1 \times 10^{-1}$
LEU product (on-site storage)	--	$5.2 \times 10^{-3}$	--	--	--	$5.2 \times 10^{-3}$
LEU product if shipped to FFFs <sup>a</sup>	$4.0 \times 10^{-3}$ to $1.0 \times 10^{-2}$	$1.2 \times 10^{-2}$ to $2.5 \times 10^{-2}$	$3.7 \times 10^{-3}$ to $7.5 \times 10^{-3}$	$4.9 \times 10^{-2}$ to $1.2 \times 10^{-1}$	$1.4 \times 10^{-2}$ to $5.2 \times 10^{-2}$	$8.3 \times 10^{-2}$ to $2.1 \times 10^{-1}$
Total	$1.7 \times 10^{-2}$ to $2.7 \times 10^{-2}$	$8.9 \times 10^{-2}$ to $1.1 \times 10^{-1}$	$2.3 \times 10^{-2}$ to $3.0 \times 10^{-2}$	$8.7 \times 10^{-2}$ to $2.1 \times 10^{-1}$	$9.9 \times 10^{-2}$ to $1.5 \times 10^{-1}$	$3.1 \times 10^{-1}$ to $5.2 \times 10^{-1}$
<b>Enrichment of DU to NU at the Paducah GDP</b>						
DU feed	$1.3 \times 10^{-2}$	$6.7 \times 10^{-2}$	$1.8 \times 10^{-2}$	$6.3 \times 10^{-2}$	$7.9 \times 10^{-2}$	$2.4 \times 10^{-1}$
NU product (on-site storage)	--	$8.0 \times 10^{-3}$	--	--	--	$8.0 \times 10^{-3}$
Total	$1.3 \times 10^{-2}$	$7.5 \times 10^{-2}$	$1.8 \times 10^{-2}$	$6.3 \times 10^{-2}$	$7.9 \times 10^{-2}$	$2.5 \times 10^{-1}$
<b>Enrichment to LEU at the ACP (Portsmouth)</b>						
NU, DU, LEU feed	$1.1 \times 10^{-2}$	$6.5 \times 10^{-2}$	$1.5 \times 10^{-2}$	$5.7 \times 10^{-2}$	$6.5 \times 10^{-2}$	$2.1 \times 10^{-1}$
LEU product (on-site storage)	--	$5.2 \times 10^{-3}$	--	--	--	$5.2 \times 10^{-3}$
LEU product if shipped to FFFs <sup>a</sup>	$3.4 \times 10^{-3}$ to $1.2 \times 10^{-2}$	$1.3 \times 10^{-2}$ to $2.8 \times 10^{-2}$	$4.2 \times 10^{-3}$ to $8.3 \times 10^{-3}$	$6.3 \times 10^{-2}$ to $1.2 \times 10^{-1}$	$1.1 \times 10^{-2}$ to $5.9 \times 10^{-2}$	$9.4 \times 10^{-2}$ to $2.3 \times 10^{-1}$
Total	$1.1 \times 10^{-2}$ to $2.3 \times 10^{-2}$	$7.1 \times 10^{-2}$ to $9.3 \times 10^{-2}$	$1.5 \times 10^{-2}$ to $2.3 \times 10^{-2}$	$5.7 \times 10^{-2}$ to $1.8 \times 10^{-1}$	$6.5 \times 10^{-2}$ to $1.2 \times 10^{-1}$	$2.2 \times 10^{-1}$ to $4.4 \times 10^{-1}$
<b>Enrichment of DU to NU at the ACP (Portsmouth)</b>						
DU feed	$9.0 \times 10^{-3}$	$5.3 \times 10^{-2}$	$1.2 \times 10^{-2}$	$4.2 \times 10^{-2}$	$5.3 \times 10^{-2}$	$1.7 \times 10^{-1}$
NU product (on-site storage)	--	$8.0 \times 10^{-3}$	--	--	--	$8.0 \times 10^{-3}$
Total	$9.0 \times 10^{-3}$	$6.1 \times 10^{-2}$	$1.2 \times 10^{-2}$	$4.2 \times 10^{-2}$	$5.3 \times 10^{-2}$	$1.8 \times 10^{-1}$
<b>Enrichment to LEU at the NEF</b>						
NU, DU, LEU feed	$6.6 \times 10^{-2}$	$2.2 \times 10^{-1}$	$9.3 \times 10^{-2}$	$4.2 \times 10^{-1}$	$4.1 \times 10^{-1}$	1.2
LEU product <sup>a</sup>	$6.1 \times 10^{-3}$ to $1.0 \times 10^{-2}$	$1.6 \times 10^{-2}$ to $2.4 \times 10^{-2}$	$5.2 \times 10^{-3}$ to $8.1 \times 10^{-3}$	$8.0 \times 10^{-2}$ to $1.4 \times 10^{-1}$	$2.7 \times 10^{-2}$ to $5.1 \times 10^{-2}$	$1.4 \times 10^{-1}$ to $2.3 \times 10^{-1}$
DU tails (to Portsmouth or Paducah)	$4.0 \times 10^{-2}$ to $6.3 \times 10^{-2}$	$1.6 \times 10^{-1}$ to $2.0 \times 10^{-1}$	$5.3 \times 10^{-2}$ to $9.1 \times 10^{-2}$	$1.8 \times 10^{-1}$ to $3.1 \times 10^{-1}$	$2.8 \times 10^{-1}$ to $3.7 \times 10^{-1}$	$7.1 \times 10^{-1}$ to 1.0
Total	$1.1 \times 10^{-1}$ to $1.4 \times 10^{-1}$	$3.9 \times 10^{-1}$ to $4.4 \times 10^{-1}$	$1.5 \times 10^{-1}$ to $1.9 \times 10^{-1}$	$6.7 \times 10^{-1}$ to $8.7 \times 10^{-1}$	$7.2 \times 10^{-1}$ to $8.3 \times 10^{-1}$	2.0 to 2.5
<b>Enrichment to NU at the NEF</b>						
DU feed	$5.3 \times 10^{-2}$	$1.8 \times 10^{-1}$	$7.5 \times 10^{-2}$	$3.0 \times 10^{-1}$	$3.3 \times 10^{-1}$	$9.4 \times 10^{-1}$
NU product <sup>a</sup>	$1.3 \times 10^{-2}$ to $2.0 \times 10^{-2}$	$4.9 \times 10^{-2}$ to $6.2 \times 10^{-2}$	$1.7 \times 10^{-2}$ to $2.9 \times 10^{-2}$	$9.6 \times 10^{-2}$ to $1.7 \times 10^{-1}$	$8.9 \times 10^{-2}$ to $1.2 \times 10^{-1}$	$2.6 \times 10^{-1}$ to $4.0 \times 10^{-1}$
DU tails (to Portsmouth or Paducah)	$2.4 \times 10^{-2}$ to $3.7 \times 10^{-2}$	$9.2 \times 10^{-2}$ to $1.2 \times 10^{-1}$	$3.2 \times 10^{-2}$ to $5.4 \times 10^{-2}$	$1.0 \times 10^{-1}$ to $1.8 \times 10^{-1}$	$1.7 \times 10^{-1}$ to $2.2 \times 10^{-1}$	$4.2 \times 10^{-1}$ to $6.1 \times 10^{-1}$
Total	$8.9 \times 10^{-2}$ to $1.1 \times 10^{-1}$	$3.2 \times 10^{-1}$ to $3.5 \times 10^{-1}$	$1.2 \times 10^{-1}$ to $1.6 \times 10^{-1}$	$5.0 \times 10^{-1}$ to $6.5 \times 10^{-1}$	$5.9 \times 10^{-1}$ to $6.7 \times 10^{-1}$	1.6 to 1.9
<b>Enrichment of DU to NU Followed By Subsequent Enrichment of NU to LEU</b>						
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

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

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

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

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

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

11 Table 4-9 lists the impacts for the MEI along the transportation route. This individual was  
12 assumed to be located 30 meters (100 feet) from the route and to be exposed to all shipments of  
13 UF<sub>6</sub> (i.e., NU feed, NU product, DU feed, DU tails, LEU feed, and LEU product). The shipments  
14 were assumed to travel at a speed of 24 kilometers (15 miles) per hour, which is representative of  
15 speeds in urban areas. The probability of an LCF for the MEI along the transportation route was  
16 estimated to range from  $8.3 \times 10^{-8}$  to  $5.3 \times 10^{-7}$ .

**Table 4-9. Maximum Individual Impacts from Truck Shipments<sup>a</sup>**

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

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<sub>6</sub>. The shipments were assumed to travel at a speed of 24 kilometers per hour.

17

18 **4.2.1.2 Impacts from Rail Shipments**

19 Rail shipments were assumed to be made using general freight; dedicated trains have not  
20 historically been used for UF<sub>6</sub> shipments. For rail shipments of UF<sub>6</sub>, radiation doses were  
21 estimated for workers and members of the public. Workers included workers involved with the  
22 classification of railcars at stops and workers involved in loading and unloading the UF<sub>6</sub>  
23 cylinders. For members of the public, radiation doses were estimated for people along the route  
24 and people sharing the route (in other trains). The number of health effects from vehicle  
25 emissions, the number of traffic fatalities, and the radiological accident risks were also estimated.  
26 The radiological and toxicological impacts of severe transportation accidents are discussed in  
27 Section 4.2.1.5.

28 Transportation impacts were estimated for enrichment of NU, DU, and LEU feed to LEU  
29 product, for enrichment of DU feed to NU product, and for enrichment of DU feed to NU

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

5 The impacts from rail shipments of UF<sub>6</sub> are listed in Tables 4-10a, 4-10b, and 4-10c. Impacts are  
6 quantified in terms of total fatalities, which are the sum of radiation-related LCFs, vehicle  
7 emission health effects, and traffic fatalities. For enrichment of NU, DU, and LEU feed to LEU  
8 product, the estimated number of total fatalities ranged from 0.20 to 2.4, depending on where the  
9 enrichment of the NU, DU, and LEU feed occurred and where the LEU product and DU tails  
10 were shipped. The estimated number of fatalities from enriching the equivalent of 2,000 MTU of  
11 NU in a given year ranged from 0.0080 to 0.096, and the estimated number of fatalities from  
12 enriching the equivalent of 4,000 MTU of NU in a given year ranged from 0.017 to 0.20. For  
13 perspective, over the period 2002 to 2006, about 900 people were killed each year in railroad  
14 accidents and incidents in the United States (DOT 2007).

15 For enrichment of DU feed to NU product, the estimated number of total fatalities ranged from  
16 0.16 to 1.8, depending on where the enrichment of the DU feed occurred and where the NU  
17 product and DU tails were shipped. The estimated number of fatalities from enriching the  
18 equivalent of 2,000 MTU of NU in a given year ranged from 0.015 to 0.17, and the estimated  
19 number of fatalities from enriching the equivalent of 4,000 MTU of NU in a given year ranged  
20 from 0.027 to 0.30.

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

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

34 For enrichment at the NEF, transportation impacts were slightly higher because the NU, DU, or  
35 LEU feed would be shipped from DOE Paducah or DOE Portsmouth to Eunice, New Mexico,  
36 and the DU tails would be dispositioned by the enrichment facility or shipped back to DOE  
37 Paducah or DOE Portsmouth. In addition, NU product could be shipped back to Paducah or  
38 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
<b>Enrichment to LEU at the Paducah GDP</b>						
NU, DU, LEU feed	$2.1 \times 10^{-3}$	$3.5 \times 10^{-2}$	$1.3 \times 10^{-2}$	$1.1 \times 10^{-1}$	$1.3 \times 10^{-1}$	$2.8 \times 10^{-1}$
LEU product (on-site storage)	--	$5.3 \times 10^{-3}$	--	--	--	$5.3 \times 10^{-3}$
LEU product if shipped to FFFs <sup>a</sup>	$1.2 \times 10^{-3}$ to $1.1 \times 10^{-3}$	$6.1 \times 10^{-3}$ to $7.1 \times 10^{-3}$	$3.0 \times 10^{-3}$ to $3.1 \times 10^{-3}$	$7.7 \times 10^{-2}$ to $8.2 \times 10^{-2}$	$2.5 \times 10^{-2}$ to $7.8 \times 10^{-2}$	$1.1 \times 10^{-1}$ to $1.7 \times 10^{-1}$
Total	$2.1 \times 10^{-3}$ to $3.2 \times 10^{-3}$	$4.0 \times 10^{-2}$ to $4.2 \times 10^{-2}$	$1.3 \times 10^{-2}$ to $1.6 \times 10^{-2}$	$1.1 \times 10^{-1}$ to $1.9 \times 10^{-1}$	$1.3 \times 10^{-1}$ to $2.0 \times 10^{-1}$	$2.9 \times 10^{-1}$ to $4.5 \times 10^{-1}$
<b>Enrichment of DU to NU at the Paducah GDP</b>						
DU feed	$1.6 \times 10^{-3}$	$2.8 \times 10^{-2}$	$1.0 \times 10^{-2}$	$7.6 \times 10^{-2}$	$1.0 \times 10^{-1}$	$2.2 \times 10^{-1}$
NU product (on-site storage)	--	$8.0 \times 10^{-3}$	--	--	--	$8.0 \times 10^{-3}$
Total	$1.6 \times 10^{-3}$	$3.6 \times 10^{-2}$	$1.0 \times 10^{-2}$	$7.6 \times 10^{-2}$	$1.0 \times 10^{-1}$	$2.2 \times 10^{-1}$
<b>Enrichment to LEU at the ACP (Portsmouth)</b>						
NU, DU, LEU feed	$1.3 \times 10^{-3}$	$3.4 \times 10^{-2}$	$8.2 \times 10^{-3}$	$7.0 \times 10^{-2}$	$8.3 \times 10^{-2}$	$2.0 \times 10^{-1}$
LEU product (on-site storage)	--	$5.3 \times 10^{-3}$	--	--	--	$5.3 \times 10^{-3}$
LEU product if shipped to FFFs <sup>a</sup>	$6.5 \times 10^{-4}$ to $1.5 \times 10^{-3}$	$6.0 \times 10^{-3}$ to $7.2 \times 10^{-3}$	$1.3 \times 10^{-3}$ to $4.9 \times 10^{-3}$	$2.9 \times 10^{-2}$ to $1.5 \times 10^{-1}$	$2.0 \times 10^{-2}$ to $8.1 \times 10^{-2}$	$5.7 \times 10^{-2}$ to $2.4 \times 10^{-1}$
Total	$1.3 \times 10^{-3}$ to $2.8 \times 10^{-3}$	$3.9 \times 10^{-2}$ to $4.1 \times 10^{-2}$	$8.2 \times 10^{-3}$ to $1.3 \times 10^{-2}$	$7.0 \times 10^{-2}$ to $2.2 \times 10^{-1}$	$8.3 \times 10^{-2}$ to $1.6 \times 10^{-1}$	$2.0 \times 10^{-1}$ to $4.4 \times 10^{-1}$
<b>Enrichment of DU to NU at the ACP (Portsmouth)</b>						
DU feed	$1.1 \times 10^{-3}$	$2.7 \times 10^{-2}$	$6.7 \times 10^{-3}$	$5.1 \times 10^{-2}$	$6.8 \times 10^{-2}$	$1.5 \times 10^{-1}$
NU product (on-site storage)	--	$8.0 \times 10^{-3}$	--	--	--	$8.0 \times 10^{-3}$
Total	$1.1 \times 10^{-3}$	$3.5 \times 10^{-2}$	$6.7 \times 10^{-3}$	$5.1 \times 10^{-2}$	$6.8 \times 10^{-2}$	$1.6 \times 10^{-1}$
<b>Enrichment to LEU at the NEF</b>						
NU, DU, LEU feed	$1.0 \times 10^{-2}$	$4.3 \times 10^{-2}$	$5.2 \times 10^{-2}$	$4.0 \times 10^{-1}$	$6.2 \times 10^{-1}$	1.1
LEU product <sup>a</sup>	$1.1 \times 10^{-3}$ to $1.7 \times 10^{-3}$	$6.4 \times 10^{-3}$ to $7.1 \times 10^{-3}$	$2.9 \times 10^{-3}$ to $6.7 \times 10^{-3}$	$7.7 \times 10^{-2}$ to $2.2 \times 10^{-1}$	$4.0 \times 10^{-2}$ to $7.8 \times 10^{-2}$	$1.3 \times 10^{-1}$ to $3.1 \times 10^{-1}$
DU tails (to Portsmouth or Paducah)	$6.3 \times 10^{-3}$ to $9.6 \times 10^{-3}$	$3.4 \times 10^{-2}$ to $3.6 \times 10^{-2}$	$3.0 \times 10^{-2}$ to $5.1 \times 10^{-2}$	$1.7 \times 10^{-1}$ to $3.0 \times 10^{-1}$	$4.1 \times 10^{-1}$ to $5.7 \times 10^{-1}$	$6.5 \times 10^{-1}$ to $9.7 \times 10^{-1}$
Total	$1.8 \times 10^{-2}$ to $2.1 \times 10^{-2}$	$8.4 \times 10^{-2}$ to $8.7 \times 10^{-2}$	$8.5 \times 10^{-2}$ to $1.1 \times 10^{-1}$	$6.4 \times 10^{-1}$ to $9.2 \times 10^{-1}$	1.1 to 1.3	1.9 to 2.4
<b>Enrichment of DU to NU at the NEF</b>						
DU feed	$8.2 \times 10^{-3}$	$3.5 \times 10^{-2}$	$4.2 \times 10^{-2}$	$2.9 \times 10^{-1}$	$5.0 \times 10^{-1}$	$8.8 \times 10^{-1}$
NU product <sup>a</sup>	$2.0 \times 10^{-3}$ to $3.0 \times 10^{-3}$	$1.1 \times 10^{-2}$ to $1.1 \times 10^{-2}$	$9.5 \times 10^{-3}$ to $1.6 \times 10^{-2}$	$9.1 \times 10^{-2}$ to $1.6 \times 10^{-1}$	$1.3 \times 10^{-1}$ to $1.8 \times 10^{-1}$	$2.4 \times 10^{-1}$ to $3.8 \times 10^{-1}$
DU tails (to Portsmouth or Paducah)	$3.7 \times 10^{-3}$ to $5.7 \times 10^{-3}$	$2.0 \times 10^{-2}$ to $2.1 \times 10^{-2}$	$1.8 \times 10^{-2}$ to $3.0 \times 10^{-2}$	$9.8 \times 10^{-2}$ to $1.8 \times 10^{-1}$	$2.4 \times 10^{-1}$ to $3.4 \times 10^{-1}$	$3.8 \times 10^{-1}$ to $5.7 \times 10^{-1}$
Total	$1.4 \times 10^{-2}$ to $1.7 \times 10^{-2}$	$6.6 \times 10^{-2}$ to $6.8 \times 10^{-2}$	$6.9 \times 10^{-2}$ to $8.8 \times 10^{-2}$	$4.8 \times 10^{-1}$ to $6.3 \times 10^{-1}$	$8.7 \times 10^{-1}$ to 1.0	1.5 to 1.8
<b>Enrichment of DU to NU Followed By Subsequent Enrichment of NU to LEU</b>						
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
<b>Enrichment to LEU at the Paducah GDP</b>						
NU, DU, LEU feed	$8.2 \times 10^{-5}$	$1.4 \times 10^{-3}$	$5.0 \times 10^{-4}$	$4.2 \times 10^{-3}$	$5.1 \times 10^{-3}$	$1.1 \times 10^{-2}$
LEU product (on-site storage)	--	$2.1 \times 10^{-4}$	--	--	--	$2.1 \times 10^{-4}$
LEU product if shipped to FFFs <sup>a</sup>	$4.8 \times 10^{-5}$ to $4.6 \times 10^{-5}$	$2.5 \times 10^{-4}$ to $2.8 \times 10^{-4}$	$1.2 \times 10^{-4}$ to $1.2 \times 10^{-4}$	$3.1 \times 10^{-3}$ to $3.3 \times 10^{-3}$	$1.0 \times 10^{-3}$ to $3.1 \times 10^{-3}$	$4.5 \times 10^{-3}$ to $6.8 \times 10^{-3}$
Total	$8.2 \times 10^{-5}$ to $1.3 \times 10^{-4}$	$1.6 \times 10^{-3}$ to $1.7 \times 10^{-3}$	$5.0 \times 10^{-4}$ to $6.2 \times 10^{-4}$	$4.2 \times 10^{-3}$ to $7.5 \times 10^{-3}$	$5.1 \times 10^{-3}$ to $8.2 \times 10^{-3}$	$1.1 \times 10^{-2}$ to $1.8 \times 10^{-2}$
<b>Enrichment of DU to NU at the Paducah GDP</b>						
DU feed	$1.5 \times 10^{-4}$	$2.6 \times 10^{-3}$	$9.1 \times 10^{-4}$	$6.9 \times 10^{-3}$	$9.2 \times 10^{-3}$	$2.0 \times 10^{-2}$
NU product (on-site storage)	--	$7.3 \times 10^{-4}$	--	--	--	$7.3 \times 10^{-4}$
Total	$1.5 \times 10^{-4}$	$3.3 \times 10^{-3}$	$9.1 \times 10^{-4}$	$6.9 \times 10^{-3}$	$9.2 \times 10^{-3}$	$2.0 \times 10^{-2}$
<b>Enrichment to LEU at the ACP (Portsmouth)</b>						
NU, DU, LEU feed	$5.4 \times 10^{-5}$	$1.3 \times 10^{-3}$	$3.3 \times 10^{-4}$	$2.8 \times 10^{-3}$	$3.3 \times 10^{-3}$	$7.8 \times 10^{-3}$
LEU product (on-site storage)	--	$2.1 \times 10^{-4}$	--	--	--	$2.1 \times 10^{-4}$
LEU product if shipped to FFFs <sup>a</sup>	$2.6 \times 10^{-5}$ to $6.0 \times 10^{-5}$	$2.4 \times 10^{-4}$ to $2.9 \times 10^{-4}$	$5.4 \times 10^{-5}$ to $2.0 \times 10^{-4}$	$1.2 \times 10^{-3}$ to $5.9 \times 10^{-3}$	$8.0 \times 10^{-4}$ to $3.2 \times 10^{-3}$	$2.3 \times 10^{-3}$ to $9.7 \times 10^{-3}$
Total	$5.4 \times 10^{-5}$ to $1.1 \times 10^{-4}$	$1.6 \times 10^{-3}$ to $1.6 \times 10^{-3}$	$3.3 \times 10^{-4}$ to $5.3 \times 10^{-4}$	$2.8 \times 10^{-3}$ to $8.7 \times 10^{-3}$	$3.3 \times 10^{-3}$ to $6.6 \times 10^{-3}$	$8.0 \times 10^{-3}$ to $1.8 \times 10^{-2}$
<b>Enrichment of DU to NU at the ACP (Portsmouth)</b>						
DU feed	$1.0 \times 10^{-4}$	$2.5 \times 10^{-3}$	$6.1 \times 10^{-4}$	$4.6 \times 10^{-3}$	$6.2 \times 10^{-3}$	$1.4 \times 10^{-2}$
NU product (on-site storage)	--	$7.3 \times 10^{-4}$	--	--	--	$7.3 \times 10^{-4}$
Total	$1.0 \times 10^{-4}$	$3.2 \times 10^{-3}$	$6.1 \times 10^{-4}$	$4.6 \times 10^{-3}$	$6.2 \times 10^{-3}$	$1.5 \times 10^{-2}$
<b>Enrichment to LEU at the NEF</b>						
NU, DU, LEU feed	$4.1 \times 10^{-4}$	$1.7 \times 10^{-3}$	$2.1 \times 10^{-3}$	$1.6 \times 10^{-2}$	$2.5 \times 10^{-2}$	$4.5 \times 10^{-2}$
LEU product <sup>a</sup>	$4.6 \times 10^{-5}$ to $6.8 \times 10^{-5}$	$2.6 \times 10^{-4}$ to $2.8 \times 10^{-4}$	$1.2 \times 10^{-4}$ to $2.7 \times 10^{-4}$	$3.1 \times 10^{-3}$ to $8.6 \times 10^{-3}$	$1.6 \times 10^{-3}$ to $3.1 \times 10^{-3}$	$5.1 \times 10^{-3}$ to $1.2 \times 10^{-2}$
DU tails (to Portsmouth or Paducah)	$2.5 \times 10^{-4}$ to $3.8 \times 10^{-4}$	$1.4 \times 10^{-3}$ to $1.5 \times 10^{-3}$	$1.2 \times 10^{-3}$ to $2.0 \times 10^{-3}$	$6.6 \times 10^{-3}$ to $1.2 \times 10^{-2}$	$1.6 \times 10^{-2}$ to $2.3 \times 10^{-2}$	$2.6 \times 10^{-2}$ to $3.9 \times 10^{-2}$
Total	$7.0 \times 10^{-4}$ to $8.6 \times 10^{-4}$	$3.4 \times 10^{-3}$ to $3.5 \times 10^{-3}$	$3.4 \times 10^{-3}$ to $4.4 \times 10^{-3}$	$2.6 \times 10^{-2}$ to $3.7 \times 10^{-2}$	$4.3 \times 10^{-2}$ to $5.1 \times 10^{-2}$	$7.6 \times 10^{-2}$ to $9.6 \times 10^{-2}$
<b>Enrichment of DU to NU at the NEF</b>						
DU feed	$7.4 \times 10^{-4}$	$3.2 \times 10^{-3}$	$3.8 \times 10^{-3}$	$2.6 \times 10^{-2}$	$4.6 \times 10^{-2}$	$8.0 \times 10^{-2}$
NU product <sup>a</sup>	$1.8 \times 10^{-4}$ to $2.8 \times 10^{-4}$	$9.8 \times 10^{-4}$ to $1.0 \times 10^{-3}$	$8.6 \times 10^{-4}$ to $1.5 \times 10^{-3}$	$8.3 \times 10^{-3}$ to $1.5 \times 10^{-2}$	$1.2 \times 10^{-2}$ to $1.6 \times 10^{-2}$	$2.2 \times 10^{-2}$ to $3.4 \times 10^{-2}$
DU tails (to Portsmouth or Paducah)	$3.4 \times 10^{-4}$ to $5.2 \times 10^{-4}$	$1.8 \times 10^{-3}$ to $1.9 \times 10^{-3}$	$1.6 \times 10^{-3}$ to $2.7 \times 10^{-3}$	$8.9 \times 10^{-3}$ to $1.6 \times 10^{-2}$	$2.2 \times 10^{-2}$ to $3.1 \times 10^{-2}$	$3.5 \times 10^{-2}$ to $5.2 \times 10^{-2}$
Total	$1.3 \times 10^{-3}$ to $1.5 \times 10^{-3}$	$6.0 \times 10^{-3}$ to $6.2 \times 10^{-3}$	$6.3 \times 10^{-3}$ to $8.0 \times 10^{-3}$	$4.4 \times 10^{-2}$ to $5.7 \times 10^{-2}$	$7.9 \times 10^{-2}$ to $9.3 \times 10^{-2}$	$1.4 \times 10^{-1}$ to $1.7 \times 10^{-1}$
<b>Enrichment of DU to NU Followed By Subsequent Enrichment of NU to LEU</b>						
Total	$1.0 \times 10^{-4}$ to $2.1 \times 10^{-3}$	$4.2 \times 10^{-3}$ to $9.7 \times 10^{-3}$	$6.1 \times 10^{-4}$ to $1.1 \times 10^{-2}$	$4.6 \times 10^{-3}$ to $8.8 \times 10^{-2}$	$6.2 \times 10^{-3}$ to $1.2 \times 10^{-1}$	$1.6 \times 10^{-2}$ to $2.3 \times 10^{-1}$

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

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

1 Table 4-11 lists the impacts for the MEI along the transportation route. This individual was  
 2 assumed to be located 30 meters (100 feet) from the route and to be exposed to all shipments of  
 3 UF<sub>6</sub> (i.e., NU feed, NU product, DU feed, DU tails, LEU feed, and LEU product). The shipments  
 4 were assumed to travel at a speed of 24 kilometers (15 miles) per hour, which is representative of  
 5 speeds in urban areas. The probability of an LCF for the MEI along the transportation route was  
 6 estimated to range from  $8.2 \times 10^{-8}$  to  $5.2 \times 10^{-7}$ .

**Table 4-11. Maximum Individual Impacts from Rail Shipments<sup>a</sup>**

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

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<sub>6</sub>. The shipments were assumed to travel at a speed of 24 kilometers per hour.

7

8 **4.2.1.3 Impacts from Overseas Shipments**

9 DOE (1999a) evaluated the impacts of shipping 135,000 MTU of NU as UF<sub>6</sub> from the  
 10 Portsmouth and Paducah GDPs to the Russian Federation. In addition, DOE (1994) evaluated the  
 11 impacts of shipping 15,250 MTU of LEU as UF<sub>6</sub> from the Russian Federation to the Portsmouth  
 12 and Paducah GDPs. The total amount of UF<sub>6</sub> evaluated in the Proposed Action, would be  
 13 99,810 MTU<sup>16</sup>, assuming that the DU tails would not be shipped back to the United States,  
 14 which is the standard industry practice.

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

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<sup>16</sup> 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<sub>6</sub> 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.

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

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

5 Based on the analyses presented in DOE (1999a) and DOE (1994), there would be an estimated  
6 2 fatalities from shipping 99,810 MTU of NU feed, DU feed, and LEU feed to the Tricastin  
7 nuclear complex, and NU or LEU product back to the United States. These impacts were based  
8 on shipping UF<sub>6</sub> to DOE's Portsmouth or Paducah facilities. If the UF<sub>6</sub> were subsequently  
9 shipped to a FFF, it is estimated that the number of fatalities would increase slightly, from about  
10 2.0 fatalities to about 2.2 fatalities. If the UF<sub>6</sub> were shipped directly to an FFF instead of having  
11 an intermediate stop at the Portsmouth or Paducah GDPs, the impacts would likely be less  
12 because the total shipping distance would be less.

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

21

**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

22

#### 23 4.2.1.4 Global Commons

24 Shipments of UF<sub>6</sub> to the Tricastin nuclear complex require that impacts on the global commons  
25 be assessed. In accordance with DOE's implementation guidance for Executive Order 12114  
26 (46 FR 1007), DOE (1994) analyzed impacts on the global commons of shipping 15,250 MTU of  
27 LEU as UF<sub>6</sub> from the Russian Federation to the Portsmouth and Paducah GDPs. DOE (1999a)  
28 also analyzed the impacts on global commons of shipping 135,000 MTU of NU as UF<sub>6</sub> from the  
29 Portsmouth and Paducah GDPs to the Russian Federation. Informal consultation with the  
30 National Marine Fisheries Service indicated that, under normal transport conditions, shipment of  
31 LEU by commercial vessel would be indistinguishable from any other commercial shipment and  
32 that there would be no impact on the marine environment, since marine flora and fauna would  
33 not be exposed to UF<sub>6</sub>.

34 The North Atlantic right whale (*Eubalaena glacialis*) is on the federal endangered species list  
35 and is also protected internationally under the Convention for the Regulation of Whaling. There

1 are currently about 300 right whales in the North Atlantic, with ship strikes accounting for about  
2 50 percent of their known deaths. Calving right whales usually winter in the waters between  
3 Savannah, Georgia, and West Palm Beach, Florida, with an area of high density between  
4 Brunswick, Georgia, and St. Augustine, Florida (DOE 2008a). The Maritime Safety Committee  
5 of the International Maritime Organization adopted a mandatory ship-reporting system that took  
6 effect in 1999. Under this system, ships off the southeastern coast of the United States are  
7 required to report whale sightings in the major shipping lanes from November 15 to April 15, so  
8 as to include the calving season for the right whales in this area, and ships off the northeastern  
9 coast, where the whales have been sighted year-round, are required to report sightings  
10 throughout the year. In addition, the National Marine Fisheries Service has established  
11 regulations to implement speed restrictions of no more than 10 knots applying to all vessels  
12 65 feet (19.8 meters) or greater in overall length in certain locations and at certain times of the  
13 year along the east coast of the U.S. Atlantic seaboard. The purpose of the regulations is to  
14 reduce the likelihood of deaths and serious injuries to endangered North Atlantic right whales  
15 that result from collisions with ships (73 FR 60173).

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

24 It is also extremely unlikely, if not impossible, that the proposed shipments would present any  
25 significant risk from an accident to the marine environment, as discussed in the following  
26 paragraphs. In 1984, the French cargo ship Mont-Louis sank after colliding with a ferry. The  
27 cargo included thirty (30) Type 48Y cylinders of UF<sub>6</sub>. In view of the nature of the cargo,  
28 particularly its value, it was decided to salvage the UF<sub>6</sub> cylinders as quickly as possible and to  
29 recover the material. All 30 containers were recovered. They were all intact except one, which  
30 had a slight leak in the valve.

31 Moreover, there is no significant risk to the marine environment even in the event that one or  
32 more cylinders were lost at sea and not retrieved. The oceans contain significant quantities of  
33 uranium and its daughter products due to naturally occurring processes. As a result, marine  
34 organisms are exposed to relatively high levels of background radiation. The cylinders that  
35 contain the UF<sub>6</sub> are designed, constructed, and tested to withstand a severe collision, so  
36 unretrieved cylinders lost as the result of an accident at sea are likely to remain intact.

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

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

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

#### 18 4.2.1.5 *Consequences of Severe Transportation Accidents*

19 DOE (2004a, 2004b) evaluated the radiological consequences of a severe transportation accident  
20 involving  $DUF_6$ . These accidents are characterized by extreme mechanical and thermal forces,  
21 and accidents of this severity would be expected to be extremely rare (Biwer et al. 2001).  
22 Because DOE postulated a hypothetical accident that could occur at any location, the results are  
23 not route-dependent. DOE evaluated the radiological consequences to people in rural areas  
24 (6 persons per square kilometer [15 persons per square mile]), suburban areas (719 persons per  
25 square kilometer [1,798 persons per square mile]), and urban areas (1,600 persons per square  
26 kilometer [4,000 persons per square mile]). Radiation doses were estimated under neutral  
27 atmospheric conditions (Stability Class D with a wind speed of 14 kilometers [9 miles] per hour)  
28 and stable atmospheric conditions (Stability Class F with a wind speed of 3.5 kilometers  
29 [2.2 miles] per hour).

30 Tables 4-13 and 4-14 list the radiological consequences of these severe transportation accidents  
31 based on the radionuclide inventories presented in Table 4-7. For a severe truck accident  
32 involving one cylinder of  $DUF_6$ , the population radiation dose could be as high as 32,000 person-  
33 rem in an urban area if stable atmospheric conditions existed at the time of the accident. Based  
34 on this population radiation dose, it was estimated that there could be 20 LCFs in the exposed  
35 population of about 3 million people. For comparison, in a population of 3 million people,  
36 approximately 700,000 would be expected to die from cancer of all causes. The radiation dose  
37 for the MEI was estimated to be as high as 0.91 rem if stable atmospheric conditions existed at  
38 the time of the accident. The probability of an LCF for this individual was estimated to be  
39 0.0005.

**Table 4-13. Radiological Consequences for the Population from Severe Transportation Accidents Involving Depleted Uranium Hexafluoride<sup>a</sup>**

Mode	Neutral Atmospheric Conditions			Stable Atmospheric Conditions		
	Rural <sup>b</sup>	Suburban	Urban <sup>c</sup>	Rural <sup>b</sup>	Suburban	Urban <sup>c</sup>
<b>Radiological Dose (person-rem)</b>						
Truck	590	580	1,300	15,000	15,000	32,000
Rail	2,400	2,300	5,200	60,000	58,000	130,000
<b>Radiological Risk (LCF)<sup>d</sup></b>						
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).

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**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 <sup>a</sup>	Dose (rem)	Probability of LCF <sup>a</sup>
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).

4  
5

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

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

1 For a severe rail accident involving four cylinders of DUF<sub>6</sub>, the population radiation dose could  
2 be as high as 130,000 person-rem in an urban area when stable atmospheric conditions exist at  
3 the time of the accident. Based on this population radiation dose, it was estimated that there  
4 could be 80 LCFs in the exposed population of 3 million people. For comparison, in a population  
5 of 3 million people, approximately 700,000 would be expected to die from cancer of all causes.  
6 The radiation dose for the MEI was estimated to be as high as 3.7 rem if stable atmospheric  
7 conditions existed at the time of the accident. The probability of an LCF for this individual was  
8 estimated to be 0.002.

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

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

16 DOE (2004a, 2004b) evaluated the chemical consequences of a transportation accident involving  
17 DUF<sub>6</sub>. If UF<sub>6</sub> is released to the atmosphere, it reacts with water vapor in the air to form HF and  
18 UO<sub>2</sub>F<sub>2</sub>, independent of the enrichment of the UF<sub>6</sub> (i.e., natural, enriched, or depleted). The  
19 products are chemically toxic to humans. HF is extremely corrosive; it can damage the lungs and  
20 cause death if inhaled at high enough concentrations. In addition, uranium is a heavy metal that,  
21 in addition to being radioactive, can have toxic chemical effects (primarily on the kidneys) if it  
22 enters the body by way of ingestion and/or inhalation.

23 Because DOE postulated a hypothetical accident that could occur at any location, the results are  
24 not route-dependent. DOE evaluated chemical impacts to rural areas (6 persons per square  
25 kilometer [15 persons per square mile]), suburban areas (719 persons per square kilometer  
26 [1,798 persons per square mile]), and urban areas (1,600 persons per square kilometer  
27 [4,000 persons per square mile]). Chemical impacts are not dependent on enrichment of the  
28 uranium, only on the amount of uranium in the container. For this reason, if the severe  
29 transportation accident involved NU or enriched uranium, the chemical consequences would be  
30 similar.

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

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

11

**Table 4-15. Chemical Consequences for the Population from Severe Transportation Accidents Involving Depleted Uranium Hexafluoride<sup>a</sup>**

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

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**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 <sup>a</sup>	Adverse Effects	Irreversible Adverse Effects <sup>a</sup>
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.

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1    4.2.1.6    *Intentional Destructive Acts*

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

9    **4.2.2    Low-Enriched Uranium Storage Impacts under the Enrichment Alternative**

10   In the two EISs analyzing construction and operation of proposed UF<sub>6</sub> conversion facilities at  
11   DOE Paducah (DOE 2004a) and DOE Portsmouth (DOE 2004b), DOE evaluated the continued  
12   storage of DU, NU, and LEU cylinders as part of the no action alternatives. At Paducah, a total  
13   of 44,077 cylinders (41,013 DUF<sub>6</sub> cylinders, 2,769 non-DUF<sub>6</sub> cylinders, and 295 empty  
14   cylinders) were evaluated. At Portsmouth, a total of 25,231 cylinders (20,931 DUF<sub>6</sub> cylinders,  
15   3,795 non-DUF<sub>6</sub> cylinders, and 505 empty cylinders) were evaluated. As a result of enrichment  
16   activities analyzed in this EA, if DU feed, NU feed, and LEU feed were enriched to LEU  
17   product, the number of DU cylinders would increase slightly, from 10,776 to 10,931. The  
18   number of LEU cylinders would increase from 296<sup>18</sup> to 3,195, and the number of NU cylinders  
19   would decrease from 2,270<sup>19</sup> to 0. The total number of cylinders would increase from 13,342 to  
20   14,126. These numbers of cylinders are well within the numbers of cylinders evaluated in the  
21   two EISs analyzing construction and operation of proposed UF<sub>6</sub> conversion facilities at DOE  
22   Paducah (DOE 2004a) and DOE Portsmouth (DOE 2004b).

23   If DU feed were enriched to NU product, the number of DU cylinders would decrease from  
24   10,776 to 6,450. The number of NU cylinders would increase from 2,270 to 5,715, and the  
25   number of LEU cylinders would be unchanged. The total number of cylinders would decrease  
26   from 13,342 to 12,461. If DU feed were enriched to NU product followed by subsequent  
27   enrichment of this NU product to LEU product, the number of DU cylinders would decrease  
28   from 10,776 to 8,859. The number of NU feed cylinders would be unchanged, and the number of  
29   LEU cylinders would increase from 296 to 1,849. The total number of cylinders would decrease  
30   from 13,342 to 12,978. These numbers of cylinders are well within the numbers of cylinders  
31   evaluated in the two EISs analyzing construction and operation of proposed UF<sub>6</sub> conversion  
32   facilities at DOE Paducah (DOE 2004a) and DOE Portsmouth (DOE 2004b).

33   In the conversion facility EIS for the Portsmouth site, the average worker individual radiation  
34   dose was estimated to be about 600 mrem per year, which is equivalent to an LCF risk of  
35   0.00036. For a worker engaged in cylinder maintenance activities for 40 years (the duration of

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<sup>18</sup> 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.

<sup>19</sup> 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.

1 the no action alternative evaluated in DOE [2004b]), the risk of an LCF is estimated to be 0.014.  
2 The collective radiation dose for workers conducting cylinder maintenance activities at the  
3 Portsmouth site was estimated to be 460 person-rem over the time period 1999 through 2039. In  
4 the exposed population of workers, this collective radiation dose is estimated to result in  
5 0.28 LCFs.

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

12 Accidents involving cylinders were also evaluated in the conversion facility EIS for the  
13 Portsmouth site. The accident with the highest consequences was a fire resulting in the rupture of  
14 three 48G cylinders containing DUF<sub>6</sub>. The radiation dose for an individual member of the public  
15 from this accident was estimated to be 0.013 rem, which is equivalent to an LCF risk of  
16  $7.8 \times 10^{-6}$ . For the exposed population, the collective radiation dose from this accident was  
17 estimated to be 34 person-rem, which is equivalent to 0.020 LCFs in the exposed population. If  
18 this accident occurred at other sites, the results would vary depending on the enrichment of the  
19 UF<sub>6</sub>, the exposed population, or atmospheric conditions.

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

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

33 In the conversion facility EIS for the Paducah site, the maximum individual radiation dose to a  
34 person near the Paducah site boundary was estimated to be less than 0.1 mrem per year, which is  
35 equivalent to an LCF risk of  $6.0 \times 10^{-8}$ . Over 40 years, this would be equivalent to an LCF risk of  
36  $2.4 \times 10^{-6}$ . The collective radiation dose for people around the Paducah site was estimated to be  
37 0.3 person-rem over the time period 1999 through 2039. In the exposed population, this  
38 collective radiation dose is estimated to result in  $1.8 \times 10^{-4}$  LCFs.

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

1 48G cylinders containing DUF<sub>6</sub>. The radiation dose for an individual member of the public from  
2 this accident was estimated to be 0.015 rem, which is equivalent to an LCF risk of  $9.0 \times 10^{-6}$ . For  
3 the exposed population, the collective radiation dose from this accident was estimated to be  
4 29 person-rem, which is equivalent to 0.017 LCFs in the exposed population. If this accident  
5 occurred at other sites, the results would vary depending on the enrichment of the UF<sub>6</sub>, the  
6 exposed population, or atmospheric conditions.

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

13 In the enrichment facility EIS for the NEF site, the NRC evaluated the radiation doses from  
14 direct gamma exposures for members of the public from storage of UF<sub>6</sub> cylinders at the NEF  
15 (NRC 2005). The radiation dose from storage of UF<sub>6</sub> cylinders for a person located at one of  
16 three nearby businesses was found to be less than 3 mrem per year, which is equivalent to an  
17 LCF probability of  $2 \times 10^{-6}$ . Collective radiation doses from direct gamma exposures were not  
18 estimated.

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

23 In the enrichment facility EIS for the NEF site, cylinder storage accidents were not evaluated.  
24 However, an accident involving the hydraulic rupture of a single 48Y UF<sub>6</sub> cylinder containing  
25 LEU product in the blending and liquid sampling area was evaluated. The radiation dose to an  
26 individual located at the controlled area boundary was estimated to be 0.97 rem, which is  
27 equivalent to an LCF risk of 0.00058. For the exposed population, the collective radiation dose  
28 from this accident was estimated to be 12,000 person-rem, which is equivalent to 7.2 LCFs in the  
29 exposed population. If this accident occurred at other sites, the results would vary depending on  
30 the enrichment of the UF<sub>6</sub>, the exposed population, or atmospheric conditions.

31 In the enrichment facility EIS for the ACP site, the NRC also evaluated the radiation doses from  
32 direct gamma exposures for members of the public from storage of UF<sub>6</sub> cylinders at the ACP  
33 (NRC 2006). At the ACP, the presence of existing storage yards was found to have a minimal  
34 effect, if any, on the exposure rate at the site boundary. Along the northern boundary near an  
35 existing cylinder storage yard, where a member of the public might actually stand, the maximum  
36 amount of radiation exposure above the ambient background amounts over the course of a year  
37 was estimated to be less than 13 mrem for an unshielded receptor spending 100 percent of the  
38 year standing at that location. If a person were actually living at that northern boundary location  
39 near this location (nobody currently resides in that area), that person would receive on the order  
40 of 0.87 mrem per year additional exposure when the effects of shielding and residence time are  
41 included. Collective radiation doses from direct gamma exposures were not estimated.

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

5 Accidents at the ACP were also evaluated in the enrichment facility EIS for the ACP site (NRC  
6 2006), which states that the most significant accident consequences are those associated with the  
7 release of UF<sub>6</sub> caused by a breach of an overpressurized cylinder. Consequences are not  
8 presented for accidents; however, NRC (2006) states that accidents at the proposed ACP would  
9 result in small to moderate impacts to workers, the environment, and the public.

10 Table 4-17 lists the occupational radiation doses reported to the NRC by the FFFs in 2006 (NRC  
11 2007b). These radiation doses include all activities at the FFFs, including cylinder storage  
12 activities. Because DOE's LEU would not differ from other LEU that would be stored at the  
13 FFFs, it is not expected that storage of DOE LEU would appreciably alter these occupational  
14 radiation doses. Direct radiation data for members of the public are not reported for the AREVA  
15 FFF (NRC 1995), WEC FFF (NRC 2007a), and GNF FFF (NRC 1997).

16

**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).

17

18 Accidents at the AREVA FFF, WEC FFF, and GNF FFF were evaluated by the NRC. For the  
19 WEC FFF (NRC 2007a), one accident was identified, but the details of the accident were not  
20 provided and accident consequences were not reported. For the AREVA FFF (NRC 1995), four  
21 accidents were evaluated, but none of the accidents were related to cylinder storage. For the GNF  
22 FFF (NRC 1997), seven accidents were evaluated. One accident was relevant to cylinder storage,  
23 a fire involving a single 30B UF<sub>6</sub> cylinder containing LEU product on a storage pad. This  
24 accident was estimated to result in a population radiation dose of 29,000 person-rem. In the  
25 exposed population, this radiation dose is estimated to result in 17 LCFs. The radiation dose for  
26 an individual located 2 kilometers from the facility was estimated to be 5 rem. The probability of  
27 an LCF for this person is estimated to be 0.003. If this accident occurred at other sites, the results  
28 would vary depending on the enrichment of the UF<sub>6</sub>, the exposed population, or atmospheric  
29 conditions.

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

1    **4.2.3 Impacts on the Uranium Market Under the Enrichment Alternative**

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

6    **4.3 Direct Sale Alternative**

7    **4.3.1 Transportation, Enrichment, and Storage Impacts under the Direct Sale Alternative**

8    Under the Direct Sale Alternative, DOE assumes that purchasers would take delivery, transport  
9    and enrich the excess inventory, and transport and store the LEU product in essentially the same  
10   manner and using essentially the same facilities as would DOE under the Enrichment  
11   Alternative. Tails resulting from the ultimate enrichment of DOE's sold excess inventory would  
12   be disposed of in a manner consistent with existing practices at the enrichment facilities, and DU  
13   tail (waste) disposal practices are analyzed in existing enrichment facility and DUF<sub>6</sub> conversion  
14   facility NEPA documents and NRC licenses. For that reason, DOE assumes that the  
15   transportation, enrichment, and storage impacts of the Direct Sale Alternative would be  
16   essentially identical to those of the Enrichment Alternative.

17   **4.3.2 Impacts on the Uranium Market under the Direct Sale Alternative**

18   DOE is authorized to sell the government's excess uranium under the Atomic Energy Act of  
19   1954, as amended, and consistent with the applicable provisions of the 1996 USEC Privatization  
20   Act, Public Law 104-134 (42 U.S.C. 2297h *et seq.*). Section 3112(d) of the USEC Privatization  
21   Act stipulates that prior to selling NU or LEU from DOE's excess inventory, the Secretary of  
22   Energy must make a determination that the sale will not have an "adverse material impact" on  
23   the domestic mining, conversion, and enrichment industry; DOE will receive not less than the  
24   fair market value for the materials; and the material is not necessary for national security needs.

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

33   For the purposes of its analysis, ERI (2008) assumed that the sale by DOE of approximately  
34   10 percent of the average annual U.S. requirements for uranium concentrates (U<sub>3</sub>O<sub>8</sub>) and  
35   conversion services would represent just under 5 percent of the U.S. requirement for enrichment  
36   services on an average annual basis. The potential effects on long-term prices from the average  
37   annual DOE sale were estimated to be a reduction of 3.5 percent per pound of U<sub>3</sub>O<sub>8</sub>, 2 percent  
38   per kilogram of uranium for conversion services, and 1.4 percent per separative work unit  
39   (SWU) in enrichment services. The estimates by ERI (2008) do not reflect other events that

1 could impact the market prices, nor do they reflect the fact that some of these DOE sales are  
2 already anticipated by market participants. ERI (2008) summarizes that the potential reductions  
3 in prices for conversion services are approximately equal to the change in price in the near term  
4 (generally 12 months or less) or in the long term (greater than 12 months). That is, the potential  
5 price impact from DOE sales was shown to be similar to the impact from routine market  
6 fluctuations for conversion services. The potential price impact from DOE sales for uranium  
7 concentrates was 19 percent of the near-term and 13 percent of the long-term prices compared to  
8 2007. The potential price impact from DOE sales for enrichment services was estimated at  
9 26 percent of the near-term and 30 percent of the long-term prices, also compared to 2007.

10 ERI (2008) discusses three industry activities that will provide a mitigating effect on the market  
11 impacts of any DOE actions. First, the domestic industries of uranium concentrates, conversion  
12 of uranium, and enrichment have already committed to production levels and sales through 2009  
13 with some amount of additional forward sales. DOE sales would not displace those committed  
14 actions. Second, there is a reasonable expectation that the domestic services for uranium  
15 concentrates, conversion, and enrichment will increase. ERI (2008) notes that the domestic  
16 uranium concentrate production may double by 2011, domestic conversion may see a 30 percent  
17 increase over the next 7 years, and domestic enrichment services may double over the next  
18 7 years. Finally, ERI (2008) acknowledges that each of these industries operate on an  
19 international basis so they are not entirely reliant upon, or subject to, fluctuations in the domestic  
20 market. Domestic producers are not the high-cost option and should be able to sell their annual  
21 production in a competitive market. Domestic conversion services are in similar position in a  
22 competitive market. DOE sales of enrichment services are not expected to displace only  
23 domestic enrichment supply. U.S. buyers use multiple international sources as well as domestic.  
24 Nearly 100 percent of competitively priced domestic enrichment is under contract through 2009,  
25 and 50 to 60 percent of domestic enrichment capacity is committed through 2017 (ERI 2008).

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

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

38 Consistent with the Secretarial Policy Statement, DOE will manage its excess uranium inventory  
39 in a manner that meets its national security and energy missions and is supportive of the  
40 maintenance of a strong domestic nuclear industry. In addition, consistent with section 3112(d)  
41 of the USEC Privatization Act, the Department would proceed with a particular sale or transfer  
42 for NU or LEU following a determination by the Secretary that there would be no material

1 adverse impact to the domestic mining, conversion, or enrichment industries. Further, to mitigate  
2 any adverse impacts from the sale or transfer of its DU in accordance with NEPA requirements,  
3 and in furtherance of Departmental policies, DOE would conduct an analysis prior to any sales or  
4 transfers of DU to ensure there would be no adverse material impacts to the domestic uranium  
5 industries.

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

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

#### 21 **4.4 No Action Alternative**

##### 22 **4.4.1 Environmental Impacts under the No Action Alternative**

23 As described in Section 2.3, the No Action Alternative is defined as the status quo. The  
24 environmental impacts that would result under the No Action Alternative assessed in this draft  
25 EA have been assessed and documented in the two EISs that DOE issued in 2004 (DOE 2004a,  
26 2004b) for the two new DU conversion facilities at the Portsmouth and Paducah sites. A text box  
27 on page S-16 of both of these two EISs specifies that the No Action Alternative is storage of  
28 DUF<sub>6</sub> and non-DUF<sub>6</sub> cylinders indefinitely in yards at the Paducah and Portsmouth sites, with  
29 continued cylinder surveillance and maintenance activities. These non-DUF<sub>6</sub> cylinders contain  
30 LEU or NU. The impacts associated with the No Action alternatives evaluated in the two DU  
31 conversion facility EISs are delineated in Summary Table S-6 (DOE 2004a) for the Paducah  
32 conversion facility<sup>20</sup> and Summary Table S-6 (DOE 2004b) for the Portsmouth conversion  
33 facility,<sup>21</sup> and include the impacts of storing DU, NU, and LEU cylinders, although the impacts  
34 are not delineated separately for DU, NU, and LEU cylinders.

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

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<sup>20</sup> Available online at <http://web.ead.anl.gov/uranium/pdf/PAD-Summary.pdf>.

<sup>21</sup> Available online at <http://web.ead.anl.gov/uranium/pdf/PORT-Summary.pdf>.

1 **4.4.2 Impacts on the Uranium Market under the No Action Alternative**

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

8 **4.5 Cumulative Impacts**

9 Cumulative impacts are the impacts that result from the incremental impact of the action when  
10 added to other past, present, and reasonably foreseeable future actions, regardless of what agency  
11 (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result  
12 from individually minor but collectively significant actions taking place over a period of time  
13 (40 CFR § 1508.7). The following sections summarize and generally incorporate by reference,  
14 based on review of existing NEPA documents, relevant cumulative impacts analyses that were  
15 performed as part of those NEPA analyses. These existing NEPA documents address the  
16 enrichment of uranium, conversion of DU tails, fuel fabrication, or the transportation of  
17 radioactive material.

18 **4.5.1 Enrichment Alternative**

19 *4.5.1.1 Facilities*

20 *American Centrifuge Plant*

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

34 *National Enrichment Facility*

35 Cumulative impacts that could occur as a result of construction and operation of the NEF were  
36 extensively analyzed by NRC in Section 4.4 of the NEF EIS (NRC 2005). These analyses  
37 considered all reasonably foreseeable future activities, including construction and operation of  
38 new DU conversion facilities at DOE Paducah and Portsmouth. With the exception of



1 socioeconomics, for all resource areas where NRC identified the potential for cumulative  
2 impacts, NRC determined the cumulative impact would be “small”. For socioeconomics, the  
3 potential cumulative impact was considered to be small to medium and generally positive. If the  
4 DOE chose to enrich NU feed, DU feed, or LEU feed at the NEF, these enrichment services  
5 would be a part of the enrichment services normally provided by the NEF and would not add to  
6 the enrichment capacity or throughput provided at the NEF. Because enriching DOE's uranium  
7 inventory would not increase the enrichment capacity or throughput at NEF, the cumulative  
8 impacts evaluated in NRC 2005 would not be changed by the cumulative impacts expected to  
9 occur at NEF under the Enrichment Alternative assessed in this EA.

## 10 ***Paducah Site***

11 Section S.5.16 of DOE's *Final EIS for Construction and Operation of a Depleted Uranium*  
12 *Hexafluoride Conversion Facility at the Paducah, Kentucky, Site* (DOE 2004a) considered  
13 cumulative impacts in the vicinity of the Paducah site. Actions planned at the Paducah site  
14 included the continuation of uranium enrichment operations by USEC, waste management  
15 activities, waste disposal activities, environmental restoration activities, and DUF<sub>6</sub> management  
16 activities. Actions occurring near the Paducah site that, because of their diffuse nature, could  
17 contribute to existing or future impacts on the site include continued operation of the Tennessee  
18 Valley Authority's Shawnee power plant; the Joppa, Illinois, power plant; and the Honeywell  
19 International uranium conversion plant in Metropolis, Illinois.

- 20 • The cumulative collective radiological exposure to the off-site population would be well  
21 below the maximum DOE dose limit of 100 mrem per year to the off-site MEI and below  
22 the limit of 25 mrem per year specified in 40 CFR 190 for uranium fuel cycle facilities.  
23 Annual individual doses to involved workers would be monitored to maintain exposure  
24 below the regulatory limit of 5 rem per year.
- 25 • Under the EIS's no action alternative cumulative impacts assessment, although less than  
26 1 shipment per year of radioactive wastes is expected from cylinder management  
27 activities, up to 14,400 truck shipments could be associated with existing and planned  
28 actions (no rail shipments are expected). Under the EIS's action alternatives, up to 6,000  
29 rail shipments and 18,600 truck shipments of radioactive material could occur. The  
30 cumulative maximum dose to the MEI along the transportation route near the site  
31 entrance would be less than 1 mrem per year under all alternatives and for all  
32 transportation modes.
- 33 • The Paducah site is located in an attainment region. However, the background annual-  
34 average concentration of particulate matter less than 2.5 microns in diameter (PM<sub>2.5</sub>) is  
35 near the regulatory standard. Cumulative impacts would not affect attainment status.
- 36 • Data from the 2000 annual groundwater monitoring showed that four pollutants exceeded  
37 primary drinking water regulation levels in groundwater at the Paducah site. Good  
38 engineering and construction practices should ensure that indirect cumulative impacts on  
39 groundwater associated with the conversion facility would be minimal.

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

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

## 22 ***AREVA Fuel Fabrication Facility***

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

30 The PSF EA specifically cited the AREVA FFF as a neighboring, potentially affected operation.  
31 The Proposed Action assessed in this EA would likely result in delivery of fewer than 3,195  
32 30B cylinders of LEU product to the AREVA FFF. About 3,200 LEU product cylinders would  
33 be produced during the enrichment of NU feed, DU feed, and LEU feed evaluated in this draft  
34 EA. Based on a 25-year duration of the Proposed Action, about 130 LEU product cylinders  
35 would be shipped annually to the AREVA FFF. Such deliveries are consistent with current

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<sup>22</sup> Available online at [http://gc.energy.gov/NEPA/nepa\\_documents/ea/ea1562/EA\\_1562.pdf](http://gc.energy.gov/NEPA/nepa_documents/ea/ea1562/EA_1562.pdf).

<sup>23</sup> Available online at [http://gc.energy.gov/NEPA/nepa\\_documents/ea/ea1562/FONSI.pdf](http://gc.energy.gov/NEPA/nepa_documents/ea/ea1562/FONSI.pdf).

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

7 ***Westinghouse Electric Corporation Fuel Fabrication Facility***

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

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

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

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<sup>24</sup> 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.

1 ***Global Nuclear Fuel Company Fuel Fabrication Facility***

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

7 "Most of the industrial development in the vicinity of the Wilmington site is on the  
8 northeast side of the Northeast Cape Fear River. No new industrial developments  
9 are known to be planned in the immediate vicinity of the Wilmington site on the  
10 east side of the river. A developer is proposing a new 237-acre (95-hectares)  
11 continuing care retirement community (River Bluffs subdivision) that would be  
12 built on the undeveloped land parcel bounded by the Wilmington site's southern  
13 property line, I-140, and the Northeast Cape Fear River.

14 "There are four on-site planned future actions not related to fuel fabrication  
15 operations that may cumulatively impact the affected areas. These actions include  
16 the ATC II Complex, the Tooling Development Center, the Global Laser  
17 Enrichment Test Loop and Commercial Facility. The ATC II office complex will be  
18 located adjacent to the existing ATC I office building in the southeastern portion of  
19 the Eastern Site Sector, near the south gate Wilmington site entrance. The entire  
20 project will disturb approximately 30 acres (12 hectares) of the Wilmington site. In  
21 preparation for the new office complex, the site has constructed a stormwater  
22 retention pond and has installed a new parking lot and a set of temporary trailers in  
23 front of the existing ATC I building. The temporary trailers will serve as offices  
24 until the new complex is completed. There will be no effluents from these activities  
25 aside from those associated with construction and sanitary waste. The facility will  
26 require an estimated 7,500 gallons (28,400 liters) of potable water, and it is  
27 conservatively assumed that there will be no consumptive losses and that the same  
28 volumes of sanitary wastewater would be generated for treatment in the existing  
29 Wilmington site sanitary WTF, which can accommodate the increase. The Tooling  
30 Development Center will be located in the southwestern portion of the Eastern Site  
31 Sector. It will consist of five new buildings and will disturb approximately 30 acres  
32 (12 hectares) of the Wilmington site.

33 "The facility will require an estimated 5,000 gallons (18,900 liters) of process water  
34 and 11,000 gallons (41,600 liters) of potable water, and it is conservatively assumed  
35 that there will be no consumptive losses and that the same volumes of process and  
36 sanitary wastewaters would be generated for treatment in the existing Wilmington  
37 site final process lagoon facility and sanitary WTF, respectively which can be  
38 accommodated by the treatment facilities. No radioactive material will be used in  
39 the Tooling Development Center buildings, and no air permits will be required.  
40 Approximately 0.75 mile (1.2 kilometers) of new road will be constructed in the  
41 Eastern Site Sector in order to access the Center.

1 “The cumulative impacts of the GLE Test Loop are minimal as discussed in the  
2 SNM-1097 Test Loop license amendment request. The impacts from the  
3 Commercial Facility are expected to be small and will be addressed in a separate  
4 Environmental Report submittal for the GLE Commercial Facility license  
5 application.

6 “The cumulative impacts of the facilities and actions described above are  
7 anticipated to be small.”

8 The Proposed Action assessed in this EA would likely result in delivery of fewer than 3,195  
9 30B cylinders of LEU product to the GNF FFF. About 3,200 LEU product cylinders would be  
10 produced during the enrichment of NU feed, DU feed, and LEU feed evaluated in this draft EA.  
11 Based on a 25-year duration of the Proposed Action, about 130 LEU product cylinders would be  
12 shipped annually to the GNF FFF. Such deliveries are consistent with current GNF FFF  
13 operations. Because the Proposed Action would not impact or expand the GNF FFF operations,  
14 the cumulative impacts described in the RAI would not be changed by the cumulative impacts  
15 expected to occur at the GNF FFF under the Enrichment Alternative assessed in this EA.

#### 16 4.5.1.2 Cumulative Transportation Impacts

17 In Section 8.4.1.5 in DOE (2008c), cumulative impacts of transporting radioactive material were  
18 evaluated for the period 1943 through 2073. Over this time, DOE estimated that there could be  
19 240 LCFs for workers, 210 LCFs for members of the public, and 130 traffic fatalities. In this EA,  
20 less than 1 LCF would be estimated to occur for workers and for members of the public, and  
21 about 1 traffic fatality would be estimated to occur.

#### 22 4.5.1.3 Cumulative Storage Impacts

23 The possession limits for uranium at NRC-licensed FFFs are typically given in terms of  
24 kilograms of <sup>235</sup>U. At an enrichment of 4.95 percent, 1 kilogram of uranium contains  
25 0.0495 kilograms of <sup>235</sup>U. NRC licenses allow for the possession of 75,000 kilograms of <sup>235</sup>U at  
26 the AREVA FFF, 50,000 kilograms of <sup>235</sup>U at the GNF FFF, and 75,000 kilograms of <sup>235</sup>U at the  
27 WEC FFF. DOE would not store <sup>235</sup>U at the FFFs in excess of these amounts without NRC  
28 approval. About 4,900 MT of LEU product would be produced by enriching all the surplus NU,  
29 DU, and LEU feed. This LEU product would contain about 240,000 kilograms of <sup>235</sup>U, or about  
30 9,700 kilograms per year of <sup>235</sup>U over the 25-year time period of the Proposed Action. Therefore,  
31 the enrichment of the surplus NU, DU, and LEU feed would account for only about 13 to  
32 19 percent of the storage capacity at the FFFs on an annual basis.

33 It is also possible that DOE would store up to 670 MTU of LEU containing about  
34 33,200 kilograms of <sup>235</sup>U at the FFFs as an inventory for future DOE use in accordance with  
35 applicable DOE policies and the Secretarial Policy Statement. This would account for 44 to  
36 66 percent of the licensed storage capacity at an FFF. This entire inventory is unlikely to be  
37 stored at a single FFF, and a portion could be stored at the DOE Portsmouth and/or DOE  
38 Paducah facilities.

1 In the two EISs analyzing construction and operation of proposed UF<sub>6</sub> conversion facilities at  
2 DOE Paducah (DOE 2004a) and DOE Portsmouth (DOE 2004b), DOE evaluated the continued  
3 storage of DU, NU, and LEU cylinders as part of the no action alternatives. At the Portsmouth  
4 site, about 210,000 MT of UF<sub>6</sub> (140,000 MTU)<sup>25</sup> was analyzed; at the Paducah site, about  
5 450,000 MT of UF<sub>6</sub> (310,000 MTU) was analyzed. The 4,900 MTU of LEU product that would  
6 be produced under the Proposed Action described in this EA is about 3 percent of the uranium  
7 analyzed at Portsmouth and about 2 percent of the uranium analyzed at Paducah. Furthermore,  
8 the LEU would be the result of enrichment of UF<sub>6</sub> stored at DOE Paducah and DOE Portsmouth  
9 and would not represent a net increase in the uranium managed at the combined facilities.

#### 10 **4.5.2 Direct Sale Alternative**

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

#### 17 **4.5.3 No Action Alternative**

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

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<sup>25</sup> To convert MT of UF<sub>6</sub> to MTU, multiply by 0.67612 (USEC 2006, Table 5).

1 **5.0 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES**  
2 **AND SHORT-TERM USES OF THE ENVIRONMENT VS. LONG-TERM**  
3 **PRODUCTIVITY**

4 **5.1 Irreversible and Irretrievable Commitment of Resources**

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

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

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

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

27 **5.2 The Relationship between Local Short-Term Uses of the Human Environment and**  
28 **the Maintenance and Enhancement of Long-Term Productivity**

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

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19 *the Proposed American Centrifuge Plant in Piketon, Ohio*. NUREG-1834. April. Available  
20 online at <http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1834/>.
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22 *the Proposed National Enrichment Facility in Lea County, New Mexico*. NUREG-1790.  
23 June. Available online at [http://www.nrc.gov/reading-rm/doc-](http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1790/)  
24 [collections/nuregs/staff/sr1790/](http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1790/).
- 25 NRC (U.S. Nuclear Regulatory Commission). 2004. *Environmental Assessment of the USEC Inc.*  
26 *American Centrifuge Lead Cascade Facility at Piketon, Ohio*. January.
- 27 NRC (U.S. Nuclear Regulatory Commission). 2000. *Compliance Evaluation Report: Application*  
28 *Dated October 20, 2000; Higher Assay Upgrade Project*.
- 29 NRC (U.S. Nuclear Regulatory Commission). 1997. *Environmental Assessment for the Renewal*  
30 *of NRC License No. SNM-1097 for General Electric Company Nuclear Energy Production*  
31 *Facility, Wilmington, North Carolina*. May.
- 32 NRC (U.S. Nuclear Regulatory Commission). 1995. *Environmental Assessment for the Renewal*  
33 *of NRC License No. SNM-1227 for Siemens Power Corporation, Richland, Washington*.  
34 June.

- 1 USEC (United States Enrichment Corporation). 2006. *The UF<sub>6</sub> Manual, Good Handling*
- 2 *Practices for Uranium Hexafluoride*. Report No. USEC-651, Revision 9. July.

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1 **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.



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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.

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  
Secretary of Energy

March 11, 2008

Date

1 **APPENDIX B: TRANSMITTAL LETTERS AND DISTRIBUTION LISTS**

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

1 **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](mailto: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,

A handwritten signature in black ink that reads "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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Rajendra K. Sharma  
Senior Environmental Scientist  
NEPA Compliance Officer  
Office of Nuclear Energy

Attachment

cc: Ronald Hagen  
Bill Szymanski



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Draft Environmental Assessment:  
Disposition of DOE Excess Depleted Uranium, Natural Uranium, and Low-Enriched Uranium



**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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U.S. Department of Energy (NE-6)  
Washington, DC 20585  
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NEPA Compliance Officer  
Office of Nuclear Energy

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Bill Szymanski



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Draft Environmental Assessment:  
Disposition of DOE Excess Depleted Uranium, Natural Uranium, and Low-Enriched Uranium



**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,

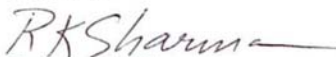
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NEPA Compliance Officer  
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Bill Szymanski



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Draft Environmental Assessment:  
Disposition of DOE Excess Depleted Uranium, Natural Uranium, and Low-Enriched Uranium



**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

Dear Sir/Madam,

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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Draft Environmental Assessment:  
Disposition of DOE Excess Depleted Uranium, Natural Uranium, and Low-Enriched Uranium



**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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**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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Office of Nuclear Energy

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Bill Szymanski



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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,

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](mailto:ronald.hagen@nuclear.energy.gov)

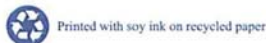
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Senior Environmental Scientist  
NEPA Compliance Officer  
Office of Nuclear Energy

Attachment  
cc: Ronald Hagen  
Bill Szymanski





**Department of Energy**  
Washington, DC 20585

December 23, 2008

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,

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Senior Environmental Scientist  
NEPA Compliance Officer  
Office of Nuclear Energy

Attachment  
cc: Ronald Hagen  
Bill Szymanski



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1 **Distribution List**

2 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  
Department of Administration  
1301 Mail Service Center  
Raleigh, North Carolina 27699-1301

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

State Clearinghouse  
Office of State Budget  
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

1 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

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1 **APPENDIX C: OTHER NEPA DOCUMENTS CONSIDERED**

**Table C-1. Other NEPA Documents Considered**

Description of the Proposed Action	ROD	Comments
<b>EISs for Uranium Enrichment and Conversion Facilities and Programmatic EIS for Managing DUF<sub>6</sub></b>		
<i>Final EIS for the Proposed American Centrifuge Plant in Piketon, Ohio</i> <b>NUREG-1834 (April 2006)</b>		
<a href="http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1834/">http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1834/</a>		
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.
<i>Final EIS for the Proposed National Enrichment Facility in Lea County, New Mexico</i> <b>NUREG-1790 (June 2005)</b>		
<a href="http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1790/">http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1790/</a>		
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 ( <sup>235</sup> 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.

1

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

Description of the Proposed Action	ROD	Comments
<p><b><i>Final EIS for Construction and Operation of a Depleted Uranium Hexafluoride Conversion Facility at the Paducah, Kentucky, Site</i></b> <b>DOE/EIS-0359 (June 2004)</b></p> <p><a href="http://web.ead.anl.gov/uranium/documents/paddeis/index.cfm">http://web.ead.anl.gov/uranium/documents/paddeis/index.cfm</a></p>		
<p>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<sub>6</sub> inventory into DU oxide (primarily U<sub>3</sub>O<sub>8</sub>) and other conversion products. The action includes construction, operation, maintenance, and decontamination and decommissioning (D&amp;D) of the proposed DUF<sub>6</sub> 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<sub>2</sub> and its sale or disposal in the event that the HF product is not sold.</p>	<p>DOE decided to construct and operate the conversion facility in the south-central portion of the Paducah site.</p>	<p>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.</p>
<p><b><i>Final EIS for Construction and Operation of a Depleted Uranium Hexafluoride Conversion Facility at Portsmouth, Ohio, Site</i></b> <b>DOE/EIS-0360 (June 2004)</b></p> <p><a href="http://web.ead.anl.gov/uranium/documents/portdeis/index.cfm">http://web.ead.anl.gov/uranium/documents/portdeis/index.cfm</a></p>		
<p>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<sub>6</sub> inventory into DU oxide (primarily U<sub>3</sub>O<sub>8</sub>) and other conversion products. The action includes construction, operation, maintenance, and D&amp;D of the proposed DUF<sub>6</sub> conversion facility at the Portsmouth site; transportation of DUF<sub>6</sub> cylinders from ETTP to Portsmouth for conversion, and transportation of non-DUF<sub>6</sub> 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<sub>2</sub> and its sale or disposal if the HF product is not sold.</p>	<p>DOE decided to construct and operate the conversion facility in the west-central portion of the Portsmouth site.</p>	<p>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.</p>



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

Description of the Proposed Action	ROD	Comments
<b>DOE EISs (2) Addressing Transportation Impacts</b>		
<b><i>Final Programmatic Environmental Impact Statement for Alternative Strategies for the Long-Term Management and Use of Depleted Uranium Hexafluoride</i></b> <b>DOE/EIS-0269 (April 1999)</b>		
<a href="http://web.ead.anl.gov/uranium/documents/nepacomp/peis/index.cfm">http://web.ead.anl.gov/uranium/documents/nepacomp/peis/index.cfm</a>		
This 1999 PEIS assessed the potential impacts of alternative DOE management strategies for DUF <sub>6</sub> 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 <sub>6</sub> , long-term storage as uranium oxide, use as uranium oxide, use as uranium metal, and disposal.	DOE decided to promptly convert the DUF <sub>6</sub> 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.
<b><i>Final EIS on Disposition of Surplus Highly Enriched Uranium</i></b> <b>DOE/EIS-0240-S (June 1996)</b>		
<a href="http://www.fas.org/nuke/control/fmd/docs/summary.pdf">http://www.fas.org/nuke/control/fmd/docs/summary.pdf</a> ; <a href="http://www.epa.gov/fedrgstr/EPA-IMPACT/1995/October/Day-26/pr-1440.html">http://www.epa.gov/fedrgstr/EPA-IMPACT/1995/October/Day-26/pr-1440.html</a>		
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
<b>DOE EA (1) Addressing Transportation Impacts</b>		
<i>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</i> <b>DOE/EA-0837, January (USEC/EA 94001)</b>		
<a href="http://www.osti.gov/bridge/product.biblio.jsp?osti_id=10144278">http://www.osti.gov/bridge/product.biblio.jsp?osti_id=10144278</a>		
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.
<b>DOE EA (1) Addressing Economic Impacts of Uranium Sales</b>		
<i>DOE Sale of Surplus Natural and Low Enriched Uranium</i> <b>DOE/EA-1172</b>		
<a href="http://www.ne.doe.gov/pdfFiles/finalea.pdf">http://www.ne.doe.gov/pdfFiles/finalea.pdf</a>		
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
<b>NRC EAs for Nuclear Fuel Company License Renewals and DOE EA for Research Facility near the AREVA FFF</b>		
<i>Environmental Assessment for the Renewal of NRC License No. SNM 1107 for Westinghouse Columbia Fuel Fabrication Facility, Columbia, South Carolina (April 2007)</i>		
Current Licensee: Westinghouse Electric Company, LLC		
<p>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.</p> <p>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.</p> <p>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.</p>	<p>N/A</p>	<p>This EA incorporates the description of the WEC FFF site environment and safety analyses.</p>

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

Description of the Proposed Action	ROD	Comments
<p><b><i>Environmental Assessment for the Renewal of NRC License No. SNM-1097 for General Electric Company Nuclear Energy Production Facility, Wilmington, North Carolina (May 1997)</i></b></p> <p>Current Licensee: GNF-Americas, LLC</p>		
<p>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<sub>2</sub>) 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<sub>6</sub> to UO<sub>2</sub>, 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.</p> <p>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.</p>	N/A	This EA incorporates the description of the GNF FFF site environment and safety analyses.
<p><b><i>Environmental Assessment for the Renewal of NRC License No. SNM-1227 for Siemens Power Corporation, Richland, Washington (June 1995)</i></b></p> <p>Current Licensee: AREVA NP Inc. Note: A new EA to support a license renewal is currently being prepared</p>		
<p>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<sub>6</sub> to UO<sub>2</sub> and would continue to manufacture fuel assemblies for light-water reactors.</p>	N/A	This EA incorporates the description of the AREVA FFF site environment and safety analyses.
<p><b><i>Environmental Assessment for Construction and Operation of a Physical Sciences Facility (PSF) at the Pacific Northwest National Laboratory, Richland, Washington (January 2007)</i></b></p>		
<p>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.</p>	N/A	This EA reviewed and incorporated the cumulative impacts cited in this EA.

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