US Exhibit 3

Surplus Plutonium EIS

Office of
Fissile Materials Disposition

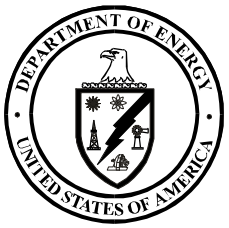
United States Department of Energy

Surplus Plutonium Disposition Final Environmental Impact Statement

Summary

November 1999

For Further Information Contact:
U.S. Department of Energy
Office of Fissile Materials Disposition, P.O. Box 23786, Washington, DC 20026-3786



DOE/EIS-0283

Surplus Plutonium Disposition Final Environmental Impact Statement

Summary

United States Department of Energy
Office of Fissile Materials Disposition

November 1999

Table of Contents

List of Figures

List of Tables

List of Acronyms

ALARA	as low as is reasonably achievable
APSF	Actinide Packaging and Storage Facility
ANL–W	Argonne National Laboratory–West
CANDU	Canadian Deuterium Uranium
CAA	Clean Air Act
CFR	Code of Federal Regulations
D&D	decontamination and decommissioning
DCS	Duke Engineering & Services, COGEMA Inc., and Stone & Webster
DOE	U.S. Department of Energy
DWPF	Defense Waste Processing Facility
EA	environmental assessment
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
FFTF	Fast Flux Test Facility
FMEF	Fuels and Materials Examination Facility
FR	Federal Register
HEU	highly enriched uranium
HLW	high-level waste
HLWVF	high-level-waste vitrification facility
INEEL	Idaho National Engineering and Environmental Laboratory
ITP	In-Tank Precipitation
LANL	Los Alamos National Laboratory
LCF	latent cancer fatality
LEU	low-enriched uranium
LLNL	Lawrence Livermore National Laboratory
LLW	low-level waste
LWR	light water reactor
MEI	maximally exposed individual
MOX	mixed oxide
NAAQS	National Ambient Air Quality Standards
NAS	National Academy of Sciences
NEPA	National Environmental Policy Act
NESHAPs	National Emissions Standards for Hazardous Air Pollutants
NOI	Notice of Intent
NRC	U.S. Nuclear Regulatory Commission
NWPA	Nuclear Waste Policy Act
ORNL	Oak Ridge National Laboratory
ORR	Oak Ridge Reservation
PEIS	programmatic environmental impact statement
R&D	research and development
RCRA	Resource Conservation and Recovery Act
RFETS	Rocky Flats Environmental Technology Site
RFP	Request for Proposals
ROD	Record of Decision
ROI	region of influence
SCSHPO	South Carolina State Historic Preservation Officer
SDWA	Safe Drinking Water Act
SPD EIS	*Surplus Plutonium Disposition Environmental Impact Statement*
SRS	Savannah River Site
SST/SGT	safe, secure trailer/SafeGuards Transport
TRU	transuranic
WIPP	Waste Isolation Pilot Plant

Chemicals and Units of Measure

cm	centimeter
g	gram
gal	gallon
in	inch
kg	kilogram
km	kilometer
l	liter
lb	pound
m^3	cubic meter
mi	mile
mrem	millirem
MWh	megawatt-hour
rem	roentgen equivalent man
t	metric ton
ton	short ton
UO_2	uranium dioxide
yd^3	cubic yard
yr	year
°C	degrees Celsius (Centigrade)

Metric Conversion Chart

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

Metric Prefixes

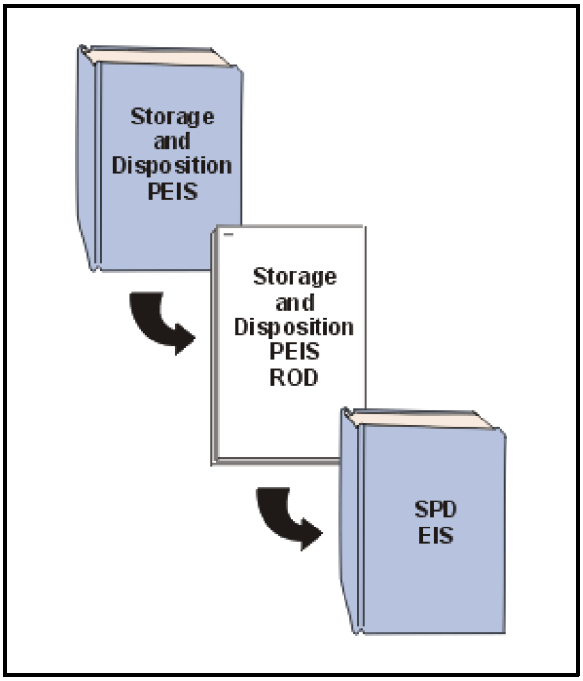
Prefix	Symbol	Multiplication Factor
exa-	E	1 000 000 000 000 000 000 = 10^{18}
peta-	P	1 000 000 000 000 000 = 10^{15}
tera-	T	1 000 000 000 000 = 10^{12}
giga-	G	1 000 000 000 = 10^{9}
mega-	M	1 000 000 = 10^{6}
kilo-	k	1 000 = 10^{3}
hecto-	h	100 = 10^{2}
deka-	da	10 = 10^{1}
deci-	d	0.1 = 10^{-1}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

Summary

S.1 INTRODUCTION

In December 1996, the U.S. Department of Energy (DOE) published the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (*Storage and Disposition PEIS*) (DOE 1996a). That PEIS analyzes the potential environmental consequences of alternative strategies for the long-term storage of weapons-usable plutonium and highly enriched uranium (HEU) and the disposition of weapons-usable plutonium that has been or may be declared surplus to national security needs.[1] The Record of Decision (ROD) for the *Storage and Disposition PEIS*, issued on January 14, 1997 (DOE 1997a), outlines DOE's decision to pursue an approach to plutonium disposition that would make surplus weapons-usable plutonium inaccessible and unattractive for weapons use. DOE's disposition strategy, consistent with the Preferred Alternative analyzed in the *Storage and Disposition PEIS*, allows for both the immobilization of some (and potentially all) of the surplus plutonium and use of some of the surplus plutonium as mixed oxide (MOX) fuel in existing domestic, commercial reactors. The disposition of surplus plutonium would also involve disposal of both the immobilized plutonium and the MOX fuel (as spent nuclear fuel) in a potential geologic repository.[2,3]

On May 22, 1997, DOE published a Notice of Intent (NOI) in the Federal Register (FR) (DOE 1997b) announcing its decision to prepare an environmental impact statement (EIS) that would tier from the analysis and decisions reached in connection with the *Storage and Disposition PEIS*. This EIS, the *Surplus Plutonium Disposition Environmental Impact Statement* (SPD EIS), addresses the extent to which each of the two plutonium disposition approaches (immobilization and MOX) would be implemented and analyzes candidate sites for plutonium disposition facilities and activities (i.e., lead assembly fabrication and postirradiation examination),[4] as well as alternative technologies for immobilization. In July 1998, DOE issued the SPD Draft EIS. That draft included a description of the potential environmental impacts of using from three to eight commercial nuclear reactors to irradiate MOX fuel. The potential impacts were based on a generic reactor analysis. In March 1999, DOE awarded a contract for



[1] DOE addresses the disposition of surplus HEU in a separate environmental impact statement, the *Disposition of Surplus Highly Enriched Uranium Final Environmental Impact Statement* (DOE 1996b) issued in June 1996, with the ROD (DOE 1996c) issued in August 1996.

[2] The U.S. Nuclear Regulatory Commission (NRC) has reviewed DOE's plans to place immobilized material into the potential geologic repository and has agreed that with adequate canister and package design features, the immobilized plutonium waste forms can be acceptable for disposal in the repository (Paperiello 1999).

[3] Sidebars are used throughout the Summary of the SPD Final EIS to indicate where changes were made since the Summary of the SPD Draft EIS and the *Supplement* were issued. Section S.2 discusses these changes.

[4] The SPD EIS also analyzes a No Action Alternative, i.e., the possibility of disposition not occurring and, instead, continued storage of surplus plutonium in accordance with the *Storage and Disposition PEIS* ROD.

MOX fuel fabrication and irradiation services.[5] After this award, DOE issued a *Supplement to the SPD Draft EIS (Supplement)* (April 1999) that describes the potential environmental impacts of using MOX fuel at three proposed reactor sites and provides updated information on the proposed disposition program. These updates and site-specific analyses have been incorporated in the SPD Final EIS.

The SPD EIS analyzes a nominal 50 metric tons (t) (55 tons) of surplus weapons-usable plutonium, which is primarily in the form of pits (the core element of a nuclear weapon's fission component), metals, and oxides.[6] In addition to 38.2 t (42 tons) of weapons-grade plutonium already declared by the President as excess to national security needs, the material analyzed includes weapons-grade plutonium that may be declared surplus in the future, as well as weapons-usable, reactor-grade plutonium that is surplus to the programmatic and national defense needs of DOE.

As depicted in Figure S–1, there are seven locations of surplus plutonium within the DOE complex: the Hanford Site (Hanford) near Richland, Washington; Idaho National Engineering and Environmental Laboratory (INEEL) near Idaho Falls, Idaho; Lawrence Livermore National Laboratory (LLNL) in Livermore, California;[7] Los Alamos National Laboratory (LANL) near Los Alamos, New Mexico; the Pantex Plant (Pantex) near Amarillo, Texas; the Rocky Flats Environmental Technology Site (RFETS) near Golden, Colorado; and the Savannah River Site (SRS) near Aiken, South Carolina.

Under the hybrid alternatives, about 34 percent of the surplus plutonium analyzed in the SPD EIS is not suitable for fabrication into MOX fuel due to the complexity, timing, and cost that would be involved in purifying the material. The *Storage and Disposition PEIS* ROD determined that DOE would immobilize at least 8 t (9 tons) of the current surplus plutonium. Since issuance of the ROD, further consideration has indicated that 17 t (19 tons) of the surplus plutonium is not suitable for use in MOX fuel and should be immobilized. Therefore, fabricating all 50 t (55 tons) of surplus plutonium into MOX fuel is not a reasonable alternative and is not analyzed. The SPD EIS does, however, analyze the immobilization of all the surplus plutonium. (Section S.3 of this Summary provides a discussion on the amounts of materials subject to disposition.) Given the variability in purity of the surplus plutonium to be dispositioned, some of the plutonium currently considered for MOX fuel fabrication may also need to be immobilized. The incremental impacts that would be associated with a small shift in materials throughput are discussed in Chapter 4 of the SPD EIS.

In the *Storage and Disposition PEIS* ROD, DOE retained the option to use some of the surplus plutonium as MOX fuel in Canadian Deuterium Uranium (CANDU) reactors, which would have been undertaken only in the event that a multilateral agreement were negotiated among Russia, Canada, and the United States. Since the SPD Draft EIS was issued, DOE determined that adequate reactor capacity is available in the United States to disposition that portion of the U.S. surplus plutonium suitable for MOX fuel and, therefore, while still reserving the CANDU option, DOE is no longer actively pursuing it. DOE, in cooperation with Canada and Russia, proposes to participate in a test and demonstration program using U.S. and Russian MOX fuel in a

[5] Limited activities may be conducted under this contract including non-site-specific work associated with the development of the initial design for the MOX fuel fabrication facility and plans (paper studies) for outreach, long lead-time procurement, regulatory management, facility quality assurance, safeguards, security, fuel qualifications, and deactivation. Under the contract options, no substantive design work or construction on the proposed MOX facility would begin before a SPD EIS ROD is issued, and any such work would depend on decisions in the ROD.

[6] Some materials are already in a final disposition form (i.e., irradiated fuel) and will not require further action before disposal. These materials, therefore, are not included in the 50 t (55 tons) analyzed in the SPD EIS.

[7] Some of the surplus plutonium originally stored at RFETS was shipped to LLNL, where special handling and disassembly processes occurred. The receipt and disassembly of these materials and future processing work will result in the recovery of approximately 1.7 t (1.9 tons) of surplus plutonium at LLNL.

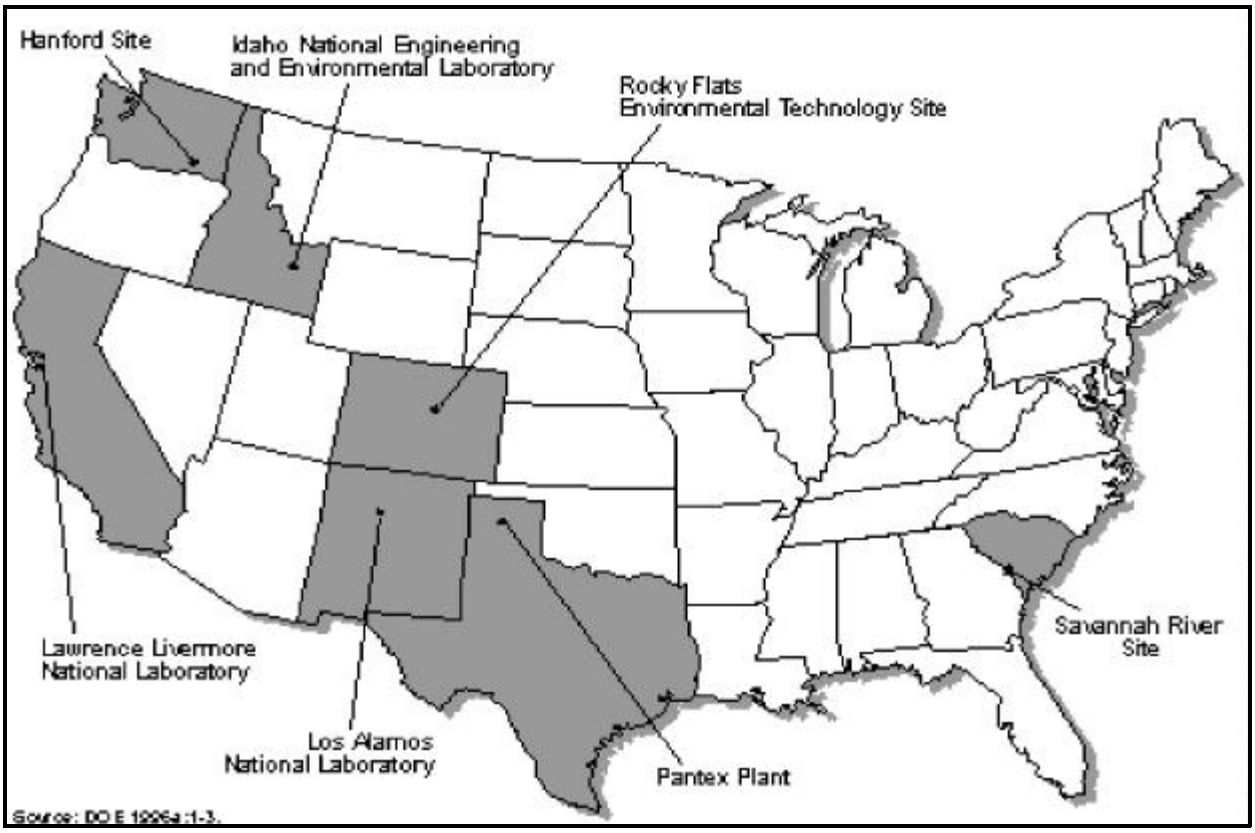


Figure S–1. Locations of Surplus Plutonium

Canadian test reactor.[8] If Russia and Canada agree to disposition Russian surplus plutonium in CANDU reactors in order to augment Russia's disposition capability, shipments of the Russian MOX fuel would take place directly between Russia and Canada.

Purpose of and Need for the Proposed Action

The purpose of and need for the proposed action is to reduce the threat of nuclear weapons proliferation worldwide by conducting disposition of surplus plutonium in the United States in an environmentally safe and timely manner. Comprehensive disposition actions are needed to ensure that surplus plutonium is converted to proliferation-resistant forms. In September 1993, President Clinton issued the *Nonproliferation and Export Control Policy* (White House 1993) in response to the growing threat of nuclear proliferation. Further, in January 1994, President Clinton and Russia's President Yeltsin issued a *Joint Statement Between the United States and Russia on Non-Proliferation of Weapons of Mass Destruction and the Means of Their Delivery* (White House 1994). In accordance with these policies, the focus of the U.S. nonproliferation efforts includes ensuring the safe, secure, long-term storage and disposition of surplus weapons-usable fissile plutonium. Following publication of the SPD Draft EIS, the United States and Russia signed a 5-year agreement to provide the scientific and technical basis for decisions concerning how surplus plutonium will be managed and a statement of principles with the intention of removing approximately 50 t (55 tons) of plutonium from each country's

[8] A separate environmental review, the *Environmental Assessment for the Parallex Project Fuel Manufacture and Shipment* (DOE 1999a; Finding of No Significant Impact [FONSI], August 13, 1999), analyzes the fabrication and proposed shipment of MOX fuel for research and development activities involving the use of limited amounts of U.S. MOX fuel in a Canadian test reactor. The FONSI was announced in a press release on September 2, 1999, and made available to the public.

stockpile (see Appendix A). The disposition activities proposed in the SPD EIS will enhance U.S. credibility and flexibility in negotiations on bilateral and multilateral reductions of surplus weapons-usable fissile materials inventories. [Text deleted.] The United States will retain the option to begin certain disposition activities, whenever appropriate, in order to encourage the Russians and set an international example.

The SPD EIS addresses both the immobilization and MOX approaches to surplus plutonium disposition, which include the siting, construction, operation, and ultimate decontamination and decommissioning (D&D) of three types of facilities at one or two of four candidate DOE sites:

- A facility for disassembling pits (a weapons component) and converting the recovered plutonium, as well as plutonium metal from other sources, into plutonium dioxide suitable for disposition. This facility, the pit disassembly and conversion facility, is referred to in this document as the *pit conversion facility*. Candidate sites for this facility are Hanford, INEEL, Pantex, and SRS.

- A facility for immobilizing surplus plutonium for eventual disposal in a geologic repository pursuant to the Nuclear Waste Policy Act (NWPA), the plutonium conversion and immobilization facility, is referred to as the *immobilization facility*. This facility would include a collocated capability for converting nonpit plutonium materials into plutonium dioxide suitable for immobilization. The immobilization facility would be located at either Hanford or SRS. DOE identified SRS as the preferred site for an immobilization facility in the NOI to prepare the SPD EIS, which was issued in May 1997. Technologies for immobilization are also discussed in the SPD EIS.

- A facility for fabricating plutonium dioxide into MOX fuel, the MOX fuel fabrication facility, is referred to as the *MOX facility*. Candidate sites for this facility are Hanford, INEEL, Pantex, and SRS. Also included in the SPD EIS is a separate analysis of MOX lead assembly[9] activities at five candidate DOE sites: Argonne National Laboratory–West (ANL–W) at INEEL; Hanford; LLNL; LANL; and SRS. DOE would fabricate a limited number of MOX fuel assemblies, referred to as lead assemblies, for testing in a reactor before commencement of fuel irradiation under the proposed MOX fuel program. Postirradiation examination activities at two sites, ANL–W and Oak Ridge National Laboratory (ORNL) in Oak Ridge, Tennessee, are also analyzed in the SPD EIS.

The SPD EIS also analyzes a No Action Alternative, as required by the National Environmental Policy Act (NEPA). In the No Action Alternative, surplus weapons-usable plutonium in storage at various DOE sites would remain at those locations. The vast majority of pits would continue to be stored at Pantex, and the remaining plutonium in various forms would continue to be stored at Hanford, INEEL, LLNL, LANL, RFETS, and SRS.[10]

Issues Identified During the Scoping Period

In mid-1997, DOE conducted a public scoping process to solicit comments on its NOI concerning the disposition of surplus plutonium. The following summary describes the major issues identified during the scoping process.

Issues Already Intended for Inclusion in the SPD EIS. Many comments received during the scoping process concern issues that were already intended to be included in the SPD EIS. For example, many commentors expressed concern over the potential environmental impacts of the various technologies at the candidate sites and requested that an in-depth analysis be conducted to determine the potential impacts. A concern was also

[9] A MOX lead assembly is a prototype reactor fuel assembly that contains MOX fuel.

[10] Should the No Action Alternative be chosen, the ROD pursuant to the SPD EIS would also address the movement of the remaining surplus nonpit plutonium from RFETS in support of its planned closure in 2006.

expressed that making can-in-canister the preferred immobilization technology without an evaluation of alternative technologies circumvents the NEPA process. Other commentors recommended that the SPD EIS include a detailed accounting of the wastes that will be generated and the location of their ultimate disposal. A number of commentors were concerned that existing legal agreements with State governments and other agencies (e.g., triparty agreements) would be overlooked and possibly ignored. Other commentors addressed the quantity of plutonium to be immobilized or fabricated into MOX fuel. DOE is addressing all of these issues in the SPD EIS.

Additional Issues That Need to Be Addressed in the SPD EIS. A few commentors suggested that additional issues be considered in the SPD EIS. [Text deleted.] Some commentors suggested that Pantex be considered as a candidate site for the pit conversion facility under all situations, including the 50-t (55-ton) immobilization option, because most of the surplus pits are currently located there. In response to these comments, DOE added two alternatives to the SPD Draft EIS for the option of immobilizing all 50 t (55 tons) of surplus plutonium. Initially, the alternatives included siting both the pit conversion and immobilization facilities at one site (i.e., Hanford or SRS). The two new alternatives include Pantex as a candidate site for the pit conversion facility.

Issues That Need to Be or Are Already Addressed Elsewhere. Many comments received during the scoping process concern issues that are beyond the scope of the SPD EIS but are being or will be addressed elsewhere. These issues include the relationship of plutonium disposition and tritium production, and use of the Fast Flux Test Facility (FFTF) at Hanford solely for surplus plutonium disposition. The SPD EIS does not address FFTF because the current proposals do not include the use of surplus plutonium as a fuel source for FFTF.[11] A question was raised as to the role of the U.S. Nuclear Regulatory Commission (NRC) licensing requirements in regard to plutonium disposition facilities. Suggestions were made to include NRC processes in the SPD EIS. NRC is a "commenting" agency on the SPD EIS. DOE provided copies of the SPD Draft EIS, *Supplement*, and SPD Final EIS to NRC for review and comment, and DOE is conducting regular meetings with NRC on the MOX approach, including fuel design and qualification.[12] In addition, an NRC license would be sought for the MOX facility. Domestic, commercial reactors operate under NRC licenses, and their proposed use of MOX fuel would be subject to review by NRC.

Some questions and concerns were also raised about the MOX fuel fabrication and reactor irradiation services procurement (see Section S.2 for a discussion of the procurement process and associated NEPA activities). Many commentors suggested that DOE, in either the SPD EIS or other program studies, analyze the total cost of each alternative, including facility construction and modification, operations, and D&D, as well as all related site infrastructure costs. At the same time the SPD Draft EIS was issued, DOE released a cost study (DOE 1998a) focusing on site-specific costs to support site selection. As a followup to this study, DOE prepared a second report (DOE 1999b) that compiles life-cycle costs for the Preferred Alternative and addresses cost-related public comments.[13] These cost studies will be considered, along with the SPD EIS analyses, in the DOE decisionmaking process. Some commentors suggested that the potential impacts of the disposal of spent nuclear fuel generated by MOX fuel use be included in the SPD EIS. This issue has already been addressed in the *Storage and Disposition PEIS*, and disposal of spent nuclear fuel is addressed in the *Draft Environmental Impact Statement*

[11] DOE announced in a Notice of Intent (NOI), published September 15, 1999 (64 FR 50064), that it will prepare a programmatic EIS to evaluate the environmental effects associated with, among other options, the restart and operation of FFTF to meet the need for a range of research and development activities, medical isotope production, and plutonium 238 production to fuel National Aeronautics and Space Administration spacecraft.

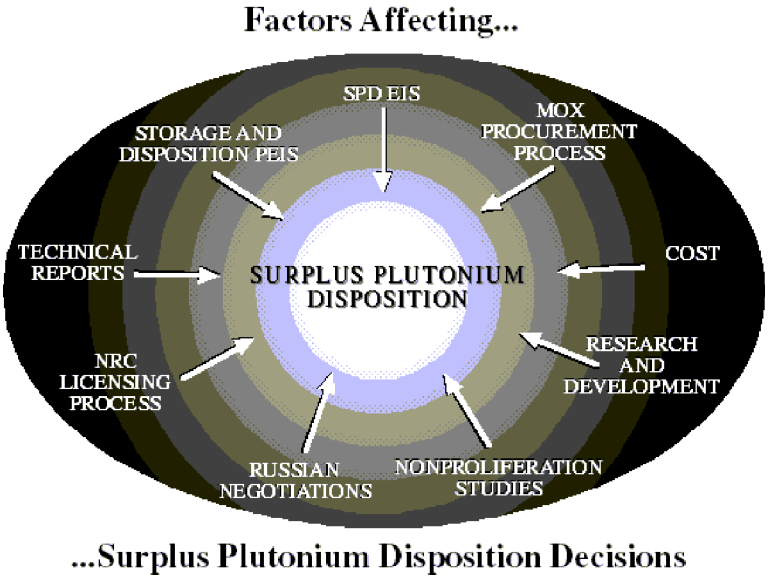
[12] DOE did not receive comments from NRC on the SPD Draft EIS or the *Supplement*.

[13] These two cost reports are available on the Office of Fissile Materials Disposition Web site at http://www.doe-md.com, in the public reading rooms at the candidate sites, and upon request.

for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada (DOE 1999c).[14]

Other. Many of the comments received were expressions of opinion or comments not directly related to issues addressed in the SPD EIS. For example, opposition was expressed by both U.S. and Canadian citizens to using CANDU reactors. Similarly, a number of commentors expressed their support for or opposition to immobilization and MOX technologies. Others expressed support for specific facilities or questioned the viability of site-specific facilities for MOX fuel fabrication, immobilization, or pit conversion. A number of commentors expressed their concern over the market viability of MOX fuel, even though MOX fuel would not be sold on the open market. Some commentors expressed their support for a hybrid disposition approach using both immobilization and MOX fuel fabrication.

Scope of the SPD EIS



Site-specific issues associated with the siting, construction, and operation of the three proposed disposition facilities are analyzed in the SPD EIS. The three facilities would be designed so that they could collectively accomplish disposition of up to 50 t (55 tons) of surplus plutonium over their operating lives, as shown in Table S–1 for the various alternatives under consideration. When the missions of the plutonium disposition facilities are completed, deactivation and stabilization would be performed to reduce the risk of radiological exposure; reduce the need for, and costs associated with, long-term maintenance; and prepare the buildings for potential future use. (Chapter 4 of the SPD EIS provides a discussion on deactivation and stabilization.) At the end of the useful life of the facilities, DOE would evaluate options for D&D or reuse of the facilities. When DOE is ready to propose D&D of these facilities, an appropriate NEPA review will be conducted. (Chapter 4 of the SPD EIS provides a discussion on D&D.) The SPD EIS also analyzes transportation, including the following (see Section S.5 for a more detailed discussion): plutonium from storage locations to the pit conversion facility or the immobilization facility, depending on the material and the alternative; plutonium dioxide from the pit conversion facility to the immobilization or MOX facilities; recovered HEU from the pit conversion facility to Oak Ridge Reservation (ORR); depleted uranium hexafluoride from a representative DOE site to a representative commercial conversion facility; uranium feed

[14] For purposes of the SPD EIS, a potential geologic repository candidate site at Yucca Mountain, Nevada, was assumed to be the final disposal site for all immobilized plutonium and spent fuel. Currently, Yucca Mountain is the only site being characterized as a potential geologic repository. In August 1999, DOE issued a separate EIS, the *Draft Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada* (DOE/EIS-0250D) (DOE 1999c), to analyze the site-specific environmental impacts of construction, operation and monitoring, and eventual closure of a potential geologic repository at Yucca Mountain.

Table S–1. Surplus Plutonium Disposition Facility Alternatives Evaluated in the SPD EIS

Alternative	Pit Disassembly and Conversion	Plutonium Conversion and Immobilization	MOX Fuel Fabrication	Disposition Amounts (Plutonium)
1	**No Action**			
2	Hanford (FMEF)	Hanford (FMEF and HLWVF)	Hanford (New)	17 t Immobilization/ 33 t MOX
3	SRS (New)	SRS (New and DWPF)	SRS (New)	17 t Immobilization/ 33 t MOX
4A	Pantex (New)	Hanford (FMEF and HLWVF)	Hanford (New)	17 t Immobilization/ 33 t MOX
4B	Pantex (New)	Hanford (FMEF and HLWVF)	Hanford (FMEF)	17 t Immobilization/ 33 t MOX
5	Pantex (New)	SRS (New and DWPF)	SRS (New)	17 t Immobilization/ 33 t MOX
6A	Hanford (FMEF)	SRS (New and DWPF)	Hanford (New)	17 t Immobilization/ 33 t MOX
6B	Hanford (FMEF)	SRS (New and DWPF)	Hanford (FMEF)	17 t Immobilization/ 33 t MOX
7	INEEL (FPF)	SRS (New and DWPF)	INEEL (New)	17 t Immobilization/ 33 t MOX
8	INEEL (FPF)	Hanford (FMEF and HLWVF)	INEEL (New)	17 t Immobilization/ 33 t MOX
9	Pantex (New)	SRS (New and DWPF)	Pantex (New)	17 t Immobilization/ 33 t MOX
10	Pantex (New)	Hanford (FMEF and HLWVF)	Pantex (New)	17 t Immobilization/ 33 t MOX
11A	Hanford (FMEF)	Hanford (FMEF and HLWVF)	NA	50 t Immobilization/ 0 t MOX
11B	Pantex (New)	Hanford (FMEF and HLWVF)	NA	50 t Immobilization/ 0 t MOX
12A	SRS (New)	SRS (New and DWPF)	NA	50 t Immobilization/ 0 t MOX
12B	Pantex (New)	SRS (New and DWPF)	NA	50 t Immobilization/ 0 t MOX
[Text deleted.] Alternatives 3B, 5B, 6C, 6D, 7B, 9B, 12B, and 12D have been deleted. Alternative 12C has been renumbered as 12B.[a]				

[a] Section S–4 explains the deletion of these alternatives.

Key: DWPF, Defense Waste Processing Facility; FMEF, Fuels and Materials Examination Facility; FPF, Fuel Processing Facility; HLWVF, high-level-waste vitrification facility (planned); NA, not applicable.

supply (uranium dioxide) from a representative commercial conversion facility to the immobilization and/or MOX fuel fabrication facilities and lead assembly facility; uranium fuel rods from a commercial fuel fabrication facility to the MOX facility and lead assembly facility; plutonium dioxide from LANL to the lead assembly facility; irradiated lead assemblies or rods from a reactor to the postirradiation examination site; spent fuel from the postirradiation examination site to INEEL for storage; MOX fuel to a commercial reactor; and immobilized plutonium to a potential geologic repository.[15] In addition to the various disposition alternatives, a No Action

[15] Shipments of spent fuel to a potential geologic repository are analyzed in the *Draft Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada* (DOE/EIS-0250D) (DOE 1999c).

Alternative is also analyzed. In this alternative, disposition would not occur, and surplus plutonium would remain in long-term storage in accordance with the storage approach identified in the *Storage and Disposition PEIS* ROD.[16] For all alternatives analyzed in the SPD EIS, it is assumed that storage actions described in the *Storage and Disposition PEIS* ROD, as amended, have been accomplished.[17] Because the SPD EIS tiers from the analyses and decisions reached in association with the *Storage and Disposition PEIS*, information relevant to disposition options or candidate sites is incorporated by reference and summarized; it is not repeated here. [Text deleted.]

Lead Assembly Candidate Sites

ANL–W
Hanford
LLNL
LANL
SRS

As part of the assessment of the MOX alternatives, the SPD EIS analyzes the fabrication of up to 10 lead assemblies that may be needed to support the MOX fuel program, although DOE plans to produce only 2. (See Sections 2.18.2 and 4.27 of the SPD EIS for a discussion of how impacts would be lower if only two lead assemblies were fabricated.) Existing DOE facilities at five candidate sites are analyzed, as is the transportation of feed materials to the lead assembly fabrication sites and the fabricated lead assemblies to a domestic, commercial reactor for test irradiation. Postirradiation examination may be required to support NRC licensing activities related to the use of MOX fuel in domestic, commercial reactors. The SPD EIS discusses postirradiation examination at two candidate sites, ANL–W and ORNL. These two sites are currently the only sites that possess the capability to conduct postirradiation examination activities without major modifications to facility and processing capabilities; only minor modifications for receipt of materials would be required. Other potential facilities, either within the DOE complex or in the commercial sector, would require significant modifications to meet expected requirements for postirradiation examination.

The ceramic immobilization, MOX fuel fabrication, and lead assembly processes require the use of uranium dioxide as a feed material, which can be obtained from either natural or depleted uranium. Because DOE has a large inventory of depleted uranium hexafluoride (the equivalent of 385,000 t [424,385 tons] of depleted uranium dioxide), the SPD EIS analyzes using a small amount of that inventory (about 137 t [151 tons] per year) to produce uranium dioxide (White 1997:l).[18, 19] Depleted uranium hexafluoride is currently stored at three DOE sites: the East Tennessee Technology Park in Oak Ridge, Tennessee; the Paducah Gaseous Diffusion Plant near Paducah, Kentucky; and the Portsmouth Gaseous Diffusion Plant (Portsmouth) near Piketon, Ohio. For purposes of analysis in the SPD EIS, Portsmouth is used as a representative site for a source of depleted uranium hexafluoride.[20] Included for evaluation in the SPD EIS are the activities necessary to package the depleted

[16] Should the No Action Alternative be chosen, the ROD pursuant to the SPD EIS would also address the movement of the remaining surplus nonpit plutonium from RFETS in support of its planned closure in 2006.

[17] Recent studies indicated that cost savings could be realized from the transfer of nonpit materials from RFETS and Hanford to SRS earlier than specified in the *Storage and Disposition PEIS* ROD. A supplement analysis was prepared and determined that a supplemental PEIS would not be needed; an amended ROD was issued in August 1998 (63 FR43386) and included decisions to accelerate shipment of all nonpit surplus plutonium from RFETS to SRS and the relocation of all Hanford surplus plutonium to SRS, if SRS is selected as the immobilization disposition site.

[18] The contractor chosen by DOE to conduct MOX fuel fabrication has the option of acquiring uranium dioxide from another source.

[19] Potential use of depleted uranium hexafluoride or facilities at the gaseous diffusion plants will be consistent with the *Final Programmatic Environmental Impact Statement for Alternative Strategies for the Long-Term Management and Use of Depleted Uranium Hexafluoride* (DOE/EIS-0269, April 1999; ROD August 1999) and the *Final Plan for Conversion of Depleted Uranium Hexafluoride, As Required by Public Law 105–204* (DOE, July 1999).

[20] The Portsmouth Gaseous Diffusion Plant is used as a representative site because it is the only one of the three DOE sites that is currently capable of transferring the depleted uranium hexafluoride from the 12.7-t (14-ton) tails cylinders in which it is currently stored to the 2.28-t (2.5-ton) feed cylinders that are compatible with the processing equipment at a commercial facility (White 1997:5). However, DOE has no preference as to where the depleted uranium is acquired.

uranium hexafluoride for shipment to a representative commercial conversion facility (for purposes of analysis, the SPD EIS uses the General Electric Company's Nuclear Energy Production Facility in Wilmington, North Carolina) for conversion to uranium dioxide,[21] to transport the depleted uranium hexafluoride from Portsmouth to Wilmington, and to transport the uranium dioxide from Wilmington to the candidate immobilization, MOX fuel fabrication, and lead assembly sites (i.e., ANL–W, Hanford, INEEL, LLNL, LANL, Pantex, and SRS).

DOE's NOI announcing the preparation of the SPD EIS included a table outlining 12 originally proposed disposition alternatives. Each alternative identified the facilities, new or existing, at each candidate site that would be analyzed in the SPD EIS. Since the publication of the NOI, DOE further increased the number of alternatives for SPD EIS analysis to include a new MOX facility at Hanford, in addition to the alternative involving modifying the Fuels and Materials Examination Facility (FMEF). For the option of immobilizing all 50 t (55 tons) of surplus plutonium, DOE also included Pantex as a candidate site for pit disassembly and conversion activities, making a total of four 50-t (55-ton) all-immobilization alternatives in the SPD Draft EIS. Previously, only Hanford and SRS had been considered as sites for pit disassembly and conversion activities for the 50-t (55-ton) all-immobilization case. Eight alternatives using Building 221–F at SRS for the immobilization facility that were analyzed in the SPD Draft EIS have been eliminated from the SPD Final EIS because the amount of space required for the immobilization facility would be significantly larger than originally planned. These eight alternatives are no longer considered reasonable because the construction required for the proposed immobilization facility is now expected to be nearly the same whether the facility is entirely located in a new building or is built in addition to using a portion of Building 221–F at SRS. For clarity, variations of each alternative are presented in the SPD EIS as separate, discrete alternatives. There are now 15 action alternatives presented as 11 sets of alternatives, plus the No Action Alternative (see Table S–1).

As indicated in the ROD for the *Storage and Disposition PEIS*, the SPD EIS analysis provides, in part, the basis for determining a specific immobilization technology. The SPD EIS analyzes in detail the proposed can-in-canister approach and compares the results to the impacts predicted in the *Storage and Disposition PEIS* for the homogenous immobilization approach in new vitrification and ceramic immobilization facilities. In addition, for the can-in-canister approach, the SPD EIS separately analyzes the effects of immobilizing plutonium in either a titanate-based ceramic material or a lanthanide borosilicate glass.

To further define the potential processes to be used for the disposition of surplus plutonium, several research and development (R&D) activities are ongoing. A discussion of these R&D activities is provided in the *Pit Disassembly and Conversion Demonstration Environmental Assessment and Research and Development Activities* (DOE 1998b) (DOE/EA-1207, August 1998; Finding of No Significant Impact [FONSI], August 1998). Several of these R&D activities are likely to continue after the ROD for the SPD EIS is issued.

Preferred Alternatives

DOE's Preferred Alternative for the disposition of surplus weapons-usable plutonium is Alternative 3: to disposition up to 50 t[22] (55 tons) of plutonium at SRS using a hybrid approach that involves both the ceramic can-in-canister immobilization approach and the MOX approach. Approximately 17 t (19 tons) would be immobilized in a ceramic form, placed in cans, and embedded in large canisters containing high-level vitrified waste for ultimate disposal in a potential geologic repository pursuant to the NWPA. Approximately 33 t

[21] Possible existing sites for this conversion include nuclear fuel fabrication facilities in Missouri, North Carolina, South Carolina, and Washington, or a uranium conversion facility in Illinois. For purposes of analysis in the SPD EIS, the commercial nuclear fuel fabrication facility in Wilmington, North Carolina, was used as a representative site. DOE has no preference as to where conversion would occur.

[22] Some materials are already in a final disposition form (i.e., irradiated fuel) and will not require further action before disposal. These materials are not included in the SPD EIS.

(36 tons) would be used to fabricate MOX fuel, which would be irradiated in existing, domestic, commercial reactors. The proposed reactors are the Catawba Nuclear Station near York, South Carolina; the McGuire Nuclear Station near Huntersville, North Carolina; and the North Anna Power Station near Mineral, Virginia.[23] The resulting spent fuel would be placed in a potential geologic repository pursuant to the NWPA.

Pursuing the hybrid approach provides the best opportunity for U.S. leadership in working with Russia to implement similar options for reducing Russia's excess plutonium in parallel. Further, it sends the strongest possible signal to the world of U.S. determination to reduce stockpiles of surplus weapons-usable plutonium as quickly as possible and in a manner that would make it technically difficult to use the plutonium in weapons again. Pursuing both immobilization and MOX fuel fabrication also provides important insurance against uncertainties of implementing either approach by itself. The construction of new facilities for the disposition of surplus U.S. plutonium would not take place unless there were significant progress on plans for plutonium disposition in Russia.

DOE's preference for siting plutonium disposition facilities is as follows:

- **Pit Disassembly and Conversion at SRS.** Construct and operate a new pit conversion facility at SRS for the purpose of disassembling nuclear weapons pits and converting the plutonium metal to a declassified oxide form suitable for international inspection, and disposition using either immobilization or MOX/reactor approaches. SRS is preferred for the pit conversion facility because the site has extensive experience with plutonium processing, and the pit conversion facility complements existing missions and takes advantage of existing infrastructure. [Text deleted.]

- **Immobilization at SRS (new construction and Defense Waste Processing Facility).**[24] Construct and operate a new immobilization facility at SRS using the ceramic can-in-canister technology. This technology would immobilize plutonium in a ceramic form, seal it in cans, and place the cans in canisters filled with borosilicate glass containing radioactive high-level waste (HLW) at the existing Defense Waste Processing Facility (DWPF). This preferred can-in-canister approach at SRS complements existing missions, takes advantage of existing infrastructure and staff expertise, and enables DOE to use an existing facility (DWPF). SRS was previously designated to be part of DOE's Preferred Alternative for immobilization in the NOI issued in May 1997. The ceramic can-in-canister approach would involve slightly lower environmental impacts than the homogenous approach (wherein the plutonium is incorporated into a homogenous mixture of plutonium and fission products in a single waste form). The ceramic can-in-canister approach would involve better performance in a potential geologic repository due to the ceramic form's expected higher durability under repository conditions and its lower potential for long-term criticality. In addition, it would provide greater proliferation resistance than the glass can-in-canister approach because recovery of plutonium from the ceramic form would require a more chemically complex process than has yet been developed.

- **MOX Fuel Fabrication at SRS (new construction).** Construct and operate a new MOX facility at SRS and produce MOX fuel containing surplus weapons-usable plutonium for irradiation in existing

[23] No facility construction or MOX fuel fabrication or irradiation is to occur until the SPD EIS ROD is issued. Additionally, no MOX fuel is to be irradiated until the NRC amends the operating license of each selected reactor prior to the specific reactor receiving the MOX fuel. Such site-specific activities would depend on decisions in the ROD, and DOE's exercise of contract options to allow such activities would be contingent on the ROD.

[24] DOE is presently considering replacement alternatives for the In-Tank Precipitation (ITP) process at SRS. The ITP process was intended to separate soluble high-activity radionuclides from liquid HLW before vitrifying the high-level fraction in DWPF. Due to problems experienced with the operation of ITP as configured, DWPF is currently operating with sludge feed only. A supplemental EIS on DWPF operations is being prepared that analyzes three proposed alternatives: small tank precipitation, ion exchange, and direct grout. (Section 2.4.2.1 of the SPD EIS provides a more detailed discussion of these alternatives.)

domestic, commercial reactors. SRS is preferred for the MOX facility because this activity complements existing missions and takes advantage of existing support infrastructure and staff expertise. [Text deleted].

- **Lead Assembly Fabrication at LANL.** Based on consideration of the capabilities of the candidate sites and input from the contractor team chosen for the MOX approach, DOE prefers LANL for lead assembly fabrication. LANL is preferred because it already has fuel fabrication facilities that would not require major modifications, and takes advantage of existing infrastructure and staff experience. Additionally, the surplus plutonium dioxide that would be used to fabricate the lead assemblieswould already be in inventory at the site.

- **Postirradiation Examination at ORNL.** If postirradiation examination is necessary for the purpose of qualifying the MOX fuel for commercial reactor use, DOE prefers to perform that task at ORNL. ORNL has the existing facilities and staff expertise needed to perform postirradiation examination as a matter of its routine activities; no major modifications to facilities or processing capabilities would be required. In addition, because ORNL is about 500 km (300 mi) from the McGuire Nuclear Station, the reactor that would irradiate the fuel, it is the closest candidate site for postirradiation examination activities.

S.2 SUMMARY OF MAJOR ISSUES IDENTIFIED DURING THE COMMENT PERIODS AND CHANGES TO THE SPD DRAFT EIS

Public Involvement Process for the SPD Draft EIS and the *Supplement to the SPD Draft EIS*

DOE issued the SPD Draft EIS in July 1998 and received public comments. The comment period ran from July 17, 1998, through September 16, 1998, although DOE considered all comments submitted after the close of the 60-day comment period. In August 1998, DOE held five public hearings at the following locations in the vicinity of the four candidate DOE sites and at one regional location:

Richland, Washington	August 4, 1998
Amarillo, Texas	August 11, 1998
North Augusta, South Carolina	August 13, 1998
Portland, Oregon	August 18, 1998
Idaho Falls, Idaho	August 20, 1998

DOE received comments on the SPD Draft EIS by mail, a toll-free telephone and fax line, the Office of Fissile Materials Disposition Web site, and at the public hearings. Altogether, DOE received approximately 3,400 comment documents from individuals and organizations. All comments are presented in Volume III, Parts A and B, of the Comment Response Document of the SPD Final EIS. Approximately 65 percent of the comments received consisted of mail-in postcard campaigns that expressed either support of or opposition to the use of various sites or technologies. About 12 percent were collected during public hearings, 10 percent were in letters received by mail, 10 percent were received by fax, 2 percent were received by telephone, and 1 percent were received through the Web site.

In April 1999, DOE issued the *Supplement* and received public comments. The comment period ran from May 14, 1999, through June 28, 1999, although DOE considered all comments received after the close of the 45-day comment period. On June 15, 1999, DOE held a public hearing in Washington, D.C. DOE received approximately 77 comment documents from individuals and organizations, which are presented in Volume III, Part B, of the Comment Response Document of the SPD Final EIS. Approximately 21 percent of the comments received were collected during the public hearing, 34 percent were contained in letters received by mail,

26 percent were received by fax, 5 percent were received by telephone, and 14 percent were received through the Web site.

Summary of Major Issues Raised on the SPD Draft EIS During the Public Comment Period

The following paragraphs highlight comments and issues that the public raised concerning information provided in the SPD Draft EIS. These comments were collected during the two separate public comment periods for the SPD Draft EIS and the *Supplement*. (Comments received on information specifically provided in the *Supplement* are summarized in the next section.) Changes made to the SPD EIS in response to a comment are described.

Russian Disposition Program. A number of commentors expressed concern over Russian disposition activities and tying U.S. activities to Russian activities. The United States and Russia recently made progress in the management and disposition of plutonium. In July 1998, Vice President Gore and Russian Prime Minister Sergei Kiriyenko signed a 5-year agreement to provide the scientific and technical basis for decisions concerning how surplus plutonium will be managed. In September 1998, Presidents Clinton and Yeltsin held a Moscow summit and signed a statement of principles with the intention of removing approximately 50 t (55 tons) of plutonium from each country's stockpile. The United States does not currently plan to implement a unilateral program; however, it will retain the option to begin certain disposition activities in order to encourage the Russians and set an international example. DOE has updated the SPD EIS to reflect the agreement and statement of principles and included copies in Appendix A.

Site Selection. A large number of comments were received advocating one candidate site over another for various reasons, including the presence of existing facilities that could prove beneficial to plutonium disposition, skilled workers, safety records, reduced transportation, and perceived economic benefits. DOE has chosen SRS as its preferred site for the three surplus plutonium disposition facilities, as outlined in Section S.1

Approach to Plutonium Disposition. A number of commentors protested DOE's preference for the hybrid approach and the use of MOX fuel for surplus plutonium disposition. Among the comments received on this issue were many advocating the use of the immobilization approach for all of the surplus plutonium. Commentors argued that the immobilization approach was safer, cheaper, and faster. They also pointed out that the immobilization approach resulted in less transportation. Because specific reactors in North Carolina, South Carolina, and Virginia have been proposed for plutonium disposition, the transportation requirements associated with several hybrid alternatives that include the MOX facility at SRS and Pantex have decreased (because the proposed reactors are closer to the sites than the 4,000-km [2,500-mi] bounding distance analyzed in the SPD Draft EIS). As a result, these several hybrid alternatives would require less transportation than some of the 50-t (55-ton) immobilization alternatives. Other commentors viewed the MOX approach as a Federal Government subsidy of the commercial nuclear power industry. Use of MOX fuel in domestic, commercial reactors is not proposed in order to subsidize the commercial nuclear power industry. Rather, the purpose is to safely and securely disposition surplus plutonium by meeting the Spent Fuel Standard.[25]

Safety and Health. Comments were received that questioned the safety and health aspects of operating the surplus plutonium disposition facilities. Commentors pointed out that DOE's safety record at other nuclear facilities had been poor in the past and questioned DOE's ability to safely operate the disposition facilities. The health and safety of workers and the public is a priority of the surplus plutonium disposition program, regardless

[25] "Spent Fuel Standard" is a term coined by the National Academy of Sciences (NAS, 1994, *Management and Disposition of Excess Weapons Plutonium*, National Academy Press, Washington, D.C., pg. 12) and modified by DOE (glossary from Office of Fissile Materials Disposition Web site at http://www.doe-md.com) denoting the main objective of alternatives for the disposition of surplus plutonium: that such plutonium be made roughly as inaccessible and unattractive for weapons use as the much larger and growing stock of plutonium in civilian spent nuclear fuel.

of which approach is chosen. Operation of the disposition facilities would comply with applicable Federal, State, and local laws and regulations governing radiological and hazardous chemical releases. Within these limits, DOE believes that the radiation exposure and the level of contamination should be kept as low as is reasonably achievable.

Aqueous Processing of Plutonium. Some commentors questioned DOE's ability to produce clean plutonium dioxide that could be used in MOX fuel using the dry process proposed in the SPD Draft EIS. Questions were raised about the ability of this process to remove gallium and other pit materials from the plutonium before it is fabricated into MOX fuel. On the basis of public comments received on the SPD Draft EIS and the analysis performed as part of the MOX procurement, DOE has included plutonium polishing (a small-scale aqueous process) as a component of the MOX facility to ensure adequate impurity removal from the plutonium dioxide. Appendix N (which addressed plutonium polishing in the SPD Draft EIS) was deleted from the SPD Final EIS, and the impacts discussed therein were included in the impacts presented for the MOX facility in Chapter 4. Section 2.4.3 was also revised to include a discussion of plutonium polishing.

No attempt was made to evaluate the use of DOE's existing aqueous processing lines capable of dissolving pits, as advocated by some commentors. DOE determined that such aqueous processing, while a proven technology, is not a reasonable alternative for pit conversion because current aqueous processes using existing facilities would produce significant amounts of waste, and aqueous processing would complicate international inspection regimes because of classification issues.

Reprocessing. Several comments were received related to the reprocessing of plutonium and the civilian use of plutonium. The use of U.S. surplus plutonium in existing domestic, commercial reactors does not involve reprocessing. The proposed use of MOX fuel is consistent with the U.S. nonproliferation policy and would ensure that plutonium that was produced for nuclear weapons and subsequently declared excess to national security needs is never again used for nuclear weapons. The MOX facility would be built and operated subject to the following strict conditions: construction would take place at a secure DOE site, it would be owned by the U.S. Government, operations would be limited exclusively to the disposition of surplus plutonium, and the MOX facility would be shut down at the completion of the surplus plutonium disposition program. At the end of the useful life of the facility, DOE would evaluate options for D&D or reuse of the facility for other purposes.

Inclusion of Generic Reactor Information in the SPD Draft EIS. Many comments were received on the inclusion of generic reactor information in the SPD Draft EIS. At the time the Draft was released, DOE did not know which specific reactors would be proposed for the MOX program. Subsequently, the Catawba, McGuire, and North Anna reactors were chosen as part of the contractor team that would implement the MOX option should the decision be made in the SPD EIS ROD to go forward with the hybrid approach (i.e., both immobilization and MOX). Specific reactor information provided as part of the procurement process was evaluated by DOE in an Environmental Critique in accordance with DOE's NEPA regulations at 10 CFR 1021.216. The Environmental Critique was considered by DOE before awarding the contract. An Environmental Synopsis, based on the Environmental Critique, was prepared and was released to the public for comment in the *Supplement*. The comments received on the *Supplement* are summarized and responded to in Volume III, Part B, of the Comment Response Document. An opportunity for public comment will likely be provided by NRC during the reactor operating license amendment process.

Transportation Concerns. Commentors raised concerns about the transportation involved with moving the surplus plutonium from storage locations to disposition sites and, in some cases, MOX fuel to reactor sites. Requests were made to limit the transportation where possible, to present the transportation information in a more understandable manner, and to ensure that the transportation was conducted as safely as possible. Additional information has been added to Chapter 2 of the SPD Final EIS, which shows the total transportation associated with each alternative and gives a graphic depiction of the transportation needed for each disposition approach

(immobilization and MOX). As discussed in the SPD EIS, safe transportation is a major concern of DOE. All shipments of surplus plutonium would be accomplished using the safe, secure trailer/SafeGuards Transport (SST/SGT) system.[26] Since the establishment of the DOE Transportation Safeguards Division in 1975, the SST/SGT system has transported DOE-owned cargo over more than 151 million km (94 million mi) with no accidents that resulted in a fatality or release of radioactive material.

Cost of Plutonium Disposition. Many commentors focused on the cost of various surplus plutonium disposition facilities. Because cost issues are beyond the scope of the SPD EIS, commentors are referred to DOE's *Cost Analysis in Support of Site Selection for Surplus Weapons-Usable Plutonium Disposition* (DOE 1998a) and *Plutonium Disposition Life Cycle Costs and Cost-Related Comment Resolution Document* (DOE 1999b). Cost comments concerning the basis for DOE's cost estimates or requesting cost information were forwarded to DOE's cost analysis team.

Summary of Major Issues Raised on the *Supplement to the SPD Draft EIS* During the Public Comment Period

Frequency of Reactor Accidents in Reactors Using MOX Fuel. A number of comments argued that the frequency of reactor accidents would be greater due to the use of MOX fuel. The consequences of a beyond-design-basis accident using MOX fuel are generally higher than those expected in the same reactor using low-enriched uranium (LEU) fuel. However, there is no basis for concluding that the frequency of these accidents would increase due to the use of MOX fuel. No change in the frequencies of reactor accidents due to the use of MOX fuel has been made in the SPD Final EIS.

Risk Associated With Reactors Using MOX Fuel. Many commentors were concerned that there is an increase in accident risk from reactors using MOX fuel and that the plutonium in MOX fuel makes a reactor accident more dangerous to human health. There are differences in the expected risk of reactor accidents from the use of MOX fuel. Some accidents would be expected to result in lower consequences to the surrounding population, and thus, lower risks, while others would be expected to result in higher consequences and higher risks. The largest estimated increase in risk to the surrounding population due to the use of MOX fuel is an estimated 14 percent increase in the risk of latent cancer fatalities associated with an interfacing systems loss-of-coolant accident at North Anna. The likelihood of this accident occurring at North Anna is estimated to be 1 chance in 4.2 million per year. Before any MOX fuel is used for plutonium disposition, NRC would perform a comprehensive safety review that would include information prepared by the reactor plant operators as part of their license amendment applications. Expected risk is discussed in Section 4.28 of the SPD EIS.

Environmental Impacts Associated With Using MOX Fuel Versus LEU Fuel. Comments were received expressing a concern that the SPD Draft EIS failed to recognize avoided environmental impacts associated with using MOX fuel versus LEU fuel in existing commercial reactors. While the consequences of a beyond-design-basis accident might be higher and a slight increase in spent fuel could be expected by using MOX fuel, the impacts associated with mining, milling, and enriching uranium are avoided. Section 4.28.3 has been added to the SPD Final EIS to address this issue.

[26] The SST/SGT is a specially designed component of an 18-wheel tractor-trailer vehicle. Although the details of the vehicle enhancements are classified, key characteristics are not, and include: enhanced structural supports and a highly reliable tie-down system to protect cargo from impact; heightened thermal resistance to protect the cargo in case of fire; deterrents to protect the unauthorized removal of cargo; couriers who are armed Federal officers and receive rigorous training and are closely monitored through DOE's Personnel Assurance Program; an armored tractor to protect the crew from attack; advanced communications equipment; specially designed escort vehicles containing advance communications and additional couriers; 24-hr-a-day real-time monitoring of the location and status of the vehicle; and significantly more stringent maintenance standards.

Low-Level Waste. Comments were received on the isotopic breakdown of the low-level waste (LLW) that would be generated at the reactors using MOX fuel and the effect of this waste on existing burial grounds. There are differences in fission product inventories and activation products between an LEU and MOX core during a fuel cycle. However, the only time significant quantities of fission products could be released to the environment or end up in LLW would be in the event of a large-scale fuel leak. In regard to normal operations, experience with fabricating MOX fuel indicates a leakage rate of less than one-tenth of one percent. The use of MOX fuel would not be expected to result in any additional LLW because the reactors would continue to operate on the same schedule as if they were using only LEU fuel.

Public Hearings. A number of comments were received regarding the need to hold public hearings near the proposed reactor locations. DOE's NEPA regulations require that at least one public hearing be held to receive comments on a draft EIS (10 CFR Part 1021.313[b]). A public hearing was held in Washington, D.C., to collect public comments on the *Supplement*. No additional hearings were held near the specific reactor sites, but comments were solicited in the areas surrounding the proposed reactors. The *Supplement* was sent to interested groups and individuals near each of the reactors and an informational meeting about the proposed use of MOX fuel, sponsored by a South Carolina State Senator, was attended by DOE during the comment period. The transcript of this meeting is presented as Appendix A of the Comment Response Document.

Changes to the SPD Draft EIS and the *Supplement*

DOE revised the SPD Draft EIS and its *Supplement* in response to comments received from other Federal agencies; tribal, State, and local governments; nongovernmental organizations; the general public; and DOE reviews. The text was changed in the SPD Final EIS to provide additional environmental baseline information, reflect new technical data, make editorial corrections, respond to comments, and clarify text. Some of these changes involved recalculations of the impacts discussed in Chapter 4. In addition, DOE updated information due to events or decisions made since the SPD Draft EIS and *Supplement* were provided for public comment. Sidebars are used throughout the SPD Final EIS to indicate where changes have been made. Below is a brief discussion of significant (i.e., noneditorial) changes.

Revised Preferred Alternative. In the SPD Draft EIS, DOE's Preferred Alternative for siting the proposed facilities was identified as either Alternative 3 (the pit conversion, immobilization and MOX facilities at SRS) or Alternative 5 (the pit conversion facility at Pantex and the immobilization and MOX facilities at SRS). Under either alternative, the hybrid approach (i.e., immobilizaton and MOX) was preferred with the immobilization technology being the can-in-canister approach. No preference was identified in the SPD Draft EIS for the lead assembly or postirradiation examination activities, nor were the specific reactors that would use MOX fuel identified.

The *Supplement* identified SRS as the preferred site for the construction and operation of the pit conversion, immobilization, and MOX facilities. The *Supplement* also identified LANL as the preferred site for lead assembly activities and ORNL as the preferred site for postirradiation examination activities. Section 1.6 of the SPD Final EIS now identifies Alternative 3 as DOE's Preferred Alternative. In addition, Section 2.1.3 now identifies the three reactor sites that have been named as candidates for using MOX fuel subject to NRC license amendment. They are the Catawba Nuclear Station in York County, South Carolina; the McGuire Nuclear Station in Mecklenburg County, North Carolina; and the North Anna Power Station in Louisa County, Virginia.

Changes to the Immobilization Facility. Since the issuance of the SPD Draft EIS, and as described in the *Supplement*, DOE has developed a more detailed conceptual design for the can-in-canister immobilization facility. Changes in the size of the immobilization facility have been reflected in Chapter 2 of the SPD Final EIS and the associated impact analyses throughout Chapter 4. No changes have been made to the basic processes

proposed in the SPD Draft EIS for immobilization, to the amount of material being considered for immobilization, or to the rate of throughput.

As stated in the *Supplement*, the eight alternatives that included using portions of Building 221–F for immobilization (SPD Draft EIS Alternatives 3B, 5B, 6C, 6D, 7B, 9B, 12B, and 12D) were eliminated. These alternatives are no longer reasonable because the amount of new construction required for the proposed immobilization facility is now nearly the same whether the facility is located entirely in a new building or uses a portion of Building 221–F. Thus, there is no longer any advantage associated with the use of Building 221–F at SRS.

Changes Resulting From the MOX Procurement Process. As stated in the *Supplement*, information provided as part of the MOX procurement process relating to the MOX facility, including the addition of a plutonium-polishing step to the front end of the MOX facility, was analyzed by DOE in an Environmental Critique and summarized in an Environmental Synopsis prepared pursuant to DOE's NEPA regulations in 10 CFR 1021.216. The Synopsis was included in the *Supplement* and has been added to the SPD Final EIS as Appendix P. Appendix N, *Plutonium Polishing*, has been deleted from the SPD Final EIS, with the information in Appendix N incorporated into the body of the EIS. A description of the polishing step has been added to Section 2.4.3, and the impacts analysis has been incorporated into Chapter 4 of the SPD Final EIS. The polishing step is included in the MOX facility, so plutonium polishing is no longer considered as a contingency for the pit conversion facility.

As described in the *Supplement*, the size of the MOX facility has increased. The larger MOX facility is described in Chapter 2 of the SPD Final EIS, and the associated environmental impacts are presented throughout Chapter 4. No changes have been made in the amount of material proposed to be made into MOX fuel, the facility's throughput, or in the overall process to be used to fabricate the fuel.

Information related to the affected environment for the specific domestic commercial reactors that would irradiate the MOX fuel was provided in the *Supplement* and has been added to the SPD Final EIS as a new Section 3.7. Environmental impacts analyzed for the actual reactor sites was also provided in the *Supplement* and has been added to Section 4.28 of the SPD Final EIS.

Possible Delay of the Construction of the Actinide Packaging and Storage Facility. As stated in the *Supplement*, the schedule for the Actinide Packaging and Storage Facility (APSF) is uncertain at this time, and therefore, the proposed facilities at SRS analyzed in the SPD Final EIS were modified to disregard any benefit to the proposed facilities as a result of APSF being present. Chapter 4 of the SPD Final EIS presents the environmental impacts that would be associated with the construction and operation of surplus plutonium disposition facilities at SRS that are stand-alone and include no reliance on storage space or other functions at APSF. Throughout the SPD Final EIS, references to APSF have been qualified by the phrase "if built," and no credit has been taken in the environmental analyses for the presence of APSF.

Pit Repackaging Requirements. The SPD Final EIS was changed to reflect new decisions on the repackaging of pits at Pantex for long-term storage and the impacts of that decision on the need to repackage the pits for offsite transportation.

Pit repackaging for long-term storage. As discussed in the *Supplement*, work is currently under way to repackage all pits at Pantex from the AL–R8 container into the AL–R8 sealed insert (SI) container for long-term storage, described in the *Supplement Analysis for: Final Environmental Impact Statement for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components—AL–R8 Sealed Insert Container* (DOE 1998c). This effort would be completed over 10 years, and the estimated dose to involved workers received from this repackaging activity would be about 104 person-rem. The SPD Draft EIS analyzed

the repackaging of pits in an AT–400A container. The change to the AL–R8 SI changes the undisturbed long-term storage period for pits from 50 to 30 years because of the need to replace a seal in the container after 30 years; the AT–400A does not require that activity. This change has been incorporated into Chapter 4.

Pit repackaging for offsite transportation. The AL–R8 SI is not an offsite shipping container as was the AT–400A analyzed in the SPD Draft EIS. Therefore, if the decision were made to site the pit conversion facility at a site other than Pantex, the surplus pits would have to be taken out of the AL–R8 SI and placed in a shipping container.[27] This operation would also require the replacement of some pit-holding fixtures to meet transportation requirements. It is expected that this change would result in a total repackaging dose to involved workers of 208 person-rem. If the decision were made to locate the pit conversion facility at Pantex, then the pits could be moved from their storage location to the pit conversion facility in the AL–R8 SI using onsite transportation vehicles. Under this option, there would be no increased exposures due to repackaging. This change has been incorporated into Chapter 4.

Environmental Impacts Associated With MOX Fuel Versus LEU Fuel. Section 4.28.3 was added to the SPD Final EIS to address the impacts associated with using MOX fuel versus LEU fuel in exitsing commerical reactors.

Uranium Conversion Impacts. Section 4.30.3, Incremental Impacts Associated With Uranium Conversion, was added to address potential impacts of the conversion of depleted uranium hexafluoride to uranium dioxide. (See Sections 1.5 and 2.4 of the SPD EIS for a discussion on conversion.)

New/Revised Documents and Changes to Cumulative Impacts. Section 1.7 of the SPD Draft EIS, Relationship to Other Actions and Programs (Section 1.8 in the Final), was updated to reflect new or revised planning documents and related NEPA documents, such as the *Environmental Assessment for the Parallex Project Fuel Manufacture and Shipment*, the *ROD for the Department of Energy's Waste Management Program: Treatment of Non-Wastewater Hazardous Waste*, the *Advanced Mixed Waste Treatment Project Final EIS* and ROD, and the *Final Environmental Impact Statement on Management of Certain Plutonium Residues and Scrub Alloy Stored at the Rocky Flats Environmental Technology Site* and RODs. The information in the most recent programmatic and site documents has been used to update the discussion of cumulative impacts in Section 4.32 of the SPD Final EIS. In addition, cumulative impacts information has been added for LLNL and LANL (two candidate sites for lead assembly fabrication), ORNL (a candidate site for postirradiation examination), and the three reactor sites (Catawba, McGuire, and North Anna).

Affected Environment. Information on the affected environment for ORNL, a candidate site for postirradiation examination, has been added to Chapter 3 of the SPD Final EIS.

Consultations. Appendix O was added to provide the correspondence related to ecological resources, cultural resources, and Native American consultations. Table 5–2 of the SPD EIS provides a summary of these consultations, and Section 4.26 discusses the results of the consultations.

FFTF. Appendix D of the SPD Draft EIS was deleted. The SPD Final EIS does not address using FFTF because the current DOE proposals do not include the use of surplus plutonium as a fuel source for FFTF.

---

[27] At the present time, DOE is using the FL container for the offsite shipment of pits. There are not enough of these containers to meet the plutonium disposition mission. No new FL containers can be manufactured because of certification restrictions. Further, the current FL containers cannot be certified for a specific type of surplus pit. The Defense Nuclear Facilities Safety Board, in its Recommendation 99–1 (August 1999), noted that there is no container suitable for shipping pits from Pantex. Should DOE make any decisions that would require shipment of pits from Pantex, DOE would ensure the availability of a certified shipping container in a timeframe that would support those decisions.

Comment Response. Volume III, the Comment Response Document, was added to the SPD Final EIS. The comments received during the two comment periods and their responses are presented in a side-by-side format.

S.3 ALTERNATIVES AND MATERIALS ANALYZED

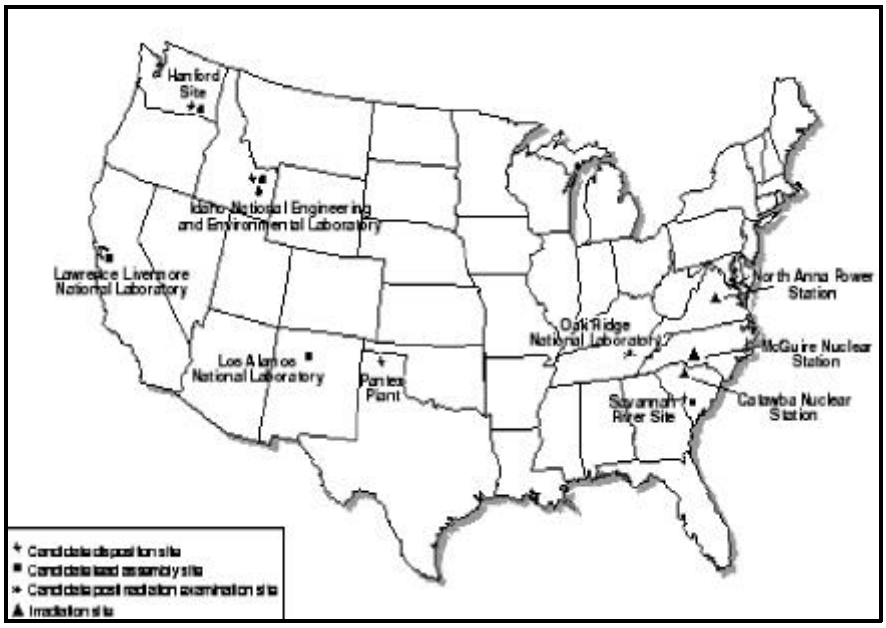


Figure S–2. Proposed Locations of Surplus Plutonium Disposition Facilities

The SPD EIS analyzes the potential environmental impacts associated with implementing pit disassembly and conversion of the recovered plutonium and clean plutonium metal at four candidate sites; conversion and immobilization of plutonium from nonpit sources at two candidate sites, and MOX fuel fabrication activities at four candidate sites. The SPD EIS also evaluates immobilizing plutonium in ceramic or glass forms, and compares the can-in-canister approach with the homogenous ceramic immobilization and vitrification approaches that were evaluated in the *Storage and Disposition PEIS*. As part of the MOX option, the SPD EIS also evaluates the potential impacts of fabricating MOX fuel lead assemblies (for test irradiation in domestic, commercial nuclear power reactors) at five candidate DOE sites, subsequent postirradiation examination of the lead assemblies at two candidate DOE sites, and addresses the impacts of irradiating MOX fuel in domestic, commercial reactors. Figure S–2 is a map of the United States that identifies the proposed locations of the surplus plutonium disposition facilities.

There are 15 surplus plutonium disposition alternatives and the No Action Alternative, which are shown in Table S–1 and are described in more detail in Chapter 2 of the SPD EIS. The 15 action alternatives are organized into 11 sets of alternatives, reflecting various combinations of facilities and candidate sites, as well as the use of new or existing buildings. For example, Alternative 6, which would locate the pit conversion and MOX facilities at Hanford, and the immobilization facility at SRS, has two variations, denoted as 6A and 6B. The variations occur because the MOX facility could be in new construction or in FMEF at Hanford.

Each of the 15 alternatives includes a pit conversion facility, but additional facilities in each alternative vary depending on the amount of plutonium to be immobilized. Alternatives 2 through 10 involve the hybrid approach of immobilizing 17 t (19 tons) of surplus plutonium and using 33 t (36 tons) for MOX fuel, and therefore require all three facilities. Alternatives 11 and 12 involve immobilizing all 50 t (55 tons), and therefore only include a pit conversion facility and an immobilization facility. Alternative 1, the No Action Alternative, does not involve

disposition of surplus weapons-usable plutonium, but instead addresses continued storage of the plutonium in accordance with the *Storage and Disposition PEIS* ROD, as amended.[28]

Immobilization Technology Alternatives

The *Storage and Disposition PEIS* discusses several immobilization technologies, including the homogenous ceramic immobilization and vitrification alternatives that were evaluated in detail, as well as the variants of those alternatives, which include the ceramic and glass can-in-canister approaches and another homogenous approach using an adjunct melter (discussed further in Appendix C of the SPD EIS). The ROD for the *Storage and Disposition PEIS* states that DOE would make a determination on the specific technology on the basis of "the follow-on EIS." The SPD EIS is that follow-on EIS, and it identifies the ceramic can-in-canister approach as the preferred immobilization technology.

In order to bound the estimate of potential environmental impacts associated with ceramic and glass immobilization technologies, the *Storage and Disposition PEIS* analyzes the construction and operation of vitrification and ceramic immobilization facilities that employ a homogenous approach. These facilities are based on generic designs that do not involve the use of existing facilities or specific site locations. These generic designs allow for surplus plutonium to be immobilized in a homogenous form, either within a ceramic matrix and formed into disks, or vitrified as borosilicate glass logs.

In order to support a decision on the immobilization technology and form, the SPD EIS evaluates the potential environmental impacts of the ceramic and glass can-in-canister technologies, and compares those impacts with the impacts of the homogenous facilities evaluated in the *Storage and Disposition PEIS.* This comparison is presented in Chapter 4 of the SPD EIS.

MOX Fuel Fabrication Alternatives

Alternatives that involve the fabrication of MOX fuel include the use of the fuel in existing domestic, commercial nuclear power reactors. The environmental impacts of using MOX fuel in these reactors are evaluated generically in the *Storage and Disposition PEIS*. When the SPD Draft EIS was published, the specific reactors were not known; therefore, that generic analysis was incorporated by reference in the SPD Draft EIS, summarized in Chapter 4, and included in the discussion of the integrated impacts of the MOX fuel alternatives presented in Chapter 2 of that document and Section S.6 of the Draft Summary. This was done with the understanding that by the time the SPD Final EIS was published, the specific reactors would have been identified and reactor-specific analyses would replace the generic analyses.

In May 1998, DOE initiated a procurement process to obtain MOX fuel fabrication and irradiation services. The Request for Proposals (RFP) defined limited activities that may be performed prior to issuance of the SPD EIS ROD. These activities include non-site-specific work primarily associated with the development of the initial conceptual design for the fuel fabrication facility, and plans (paper studies) for outreach, long lead-time procurements, regulatory management, facility quality assurance, safeguards, security, fuel qualifications, and deactivation. In compliance with its NEPA regulations at 10 CFR 1021.216, DOE requested that each offeror provide, as part of its proposal, environmental information specific to its proposed MOX facility design and the domestic, commercial reactors proposed to be used for irradiation of the fuel. That information was analyzed by

[28] DOE is considering leaving the repackaged surplus pits in Zone 4 at Pantex for long-term storage. An appropriate environmental review will be conducted when the specific proposal for this change has been determined (e.g., whether additional magazines need to be air-conditioned). The analysis in the SPD EIS assumes that the surplus pits are stored in Zone 12 in accordance with the ROD for the *Storage and Disposition PEIS*. Should the No Action Alternative be chosen, the ROD pursuant to the SPD EIS would also address the movement of the remaining surplus nonpit plutonium from RFETS in support of its planned closure in 2006.

DOE to identify potential environmental impacts of the proposals and documented in an Environmental Critique prepared pursuant to 10 CFR 1021.216(g). That analysis was considered by the selection official as part of the award decision.

DOE awarded a contract to the team of Duke Engineering & Services, COGEMA Inc., and Stone & Webster (DCS) in March 1999 to provide the requested services. These services include design, licensing, construction, operation, and eventual deactivation of the MOX facility, as well as irradiation of the MOX fuel in six domestic, commercial reactors at three sites. The reactors proposed by DCS are Duke Power Company's Catawba Nuclear Station, Units 1 and 2; and McGuire Nuclear Station, Units 1 and 2; and Virginia Power Company's North Anna Power Station, Units 1 and 2. No construction, fabrication, or irradiation of MOX fuel would occur until the SPD EIS ROD is issued. Such site-specific activities, and DOE's exercise of contract options to allow those activities, would be contingent on decisions in the ROD.

"216 Process"

DOE's NEPA Implementing Regulations (10 CFR Part 1021) include special provisions to enable a source selection official to consider, as part of the procurement decision, the environmental impacts of the offerors' proposals. As provided in 10 CFR 1021.216, DOE may require that offerors submit environmental data and analyses as a discrete part of the offeror's proposal. DOE will then:

- independently evaluate and verify the submitted information;
- prepare an environmental critique (subject to confidentiality requirements of the procurement process) for offers in the competitive range, addressing environmental issues pertinent to a decision on the proposals; and
- prepare a publicly available environmental synopsis, based on the environmental critique, to document consideration given to environmental factors in the selection process.

After a selection has been made, the environmental synopsis shall be filed with EPA, made publicly available, and incorporated in an EIS prepared for the action.

If the NEPA process is not completed before the award, the contract work must be made contingent on completion of the NEPA process, and contract work must be phased to allow the NEPA process to be completed in advance of a go/no-go decision.

As provided in 10 CFR 1021.216(h), an Environmental Synopsis, based on the Environmental Critique, was provided to the U.S. Environmental Protection Agency (EPA), made available to the public, and incorporated as Appendix P to the SPD EIS. In addition, Section 3.7 was added to describe the affected environment at the three reactor sites. Section 4.28 was revised to include the reactor-specific impact analyses, and relevant sections of Chapters 2 and 4 were revised as necessary to incorporate information provided by DCS about the proposed MOX facility, where different from that presented in the SPD Draft EIS. Sections of the SPD EIS that were revised or added to include reactor-specific information, including the new Appendix P presenting the Synopsis, were also distributed as the *Supplement to the SPD Draft EIS*.[29] An NOA was published in the Federal Register on May 14, 1999 (64 FR 264019), providing a 45-day public comment period on the *Supplement*. This *Supplement* was distributed to interested parties in the local communities surrounding the Catawba, McGuire, and North Anna reactor sites; to stakeholders who received the SPD Draft EIS; and others as requested. Comments are addressed in Volume III, Part B, of the Comment Response Document, and, where appropriate, revisions have been included in the SPD Final EIS.

Under the hybrid alternatives, DOE could produce up to 10 MOX fuel assemblies for testing in domestic, commercial reactors before commencement of full-scale MOX fuel irradiation, although it is likely that only

[29] On June 15, 1999, DOE held a public hearing in Washington, D.C., to solicit comments on the *Supplement to the SPD Draft EIS*.

2 lead assemblies would be needed.[30] These lead assemblies would be available for irradiation to support NRC licensing and fuel qualification efforts. Potential impacts of MOX fuel lead assembly fabrication are analyzed for three of the candidate sites for MOX fuel fabrication (Hanford, ANL–W at INEEL, and SRS), and two additional sites, LANL and LLNL. Pantex was not considered for lead assembly fabrication because it does not currently have any facilities capable of MOX fuel fabrication. Postirradiation examination of the lead assemblies, if required to support NRC licensing activities, would be conducted. Two potential sites for postirradiation examination are discussed in the SPD EIS: ANL–W and ORNL. As discussed previously, DOE's preferred locations for lead assembly fabrication and postirradiation examination are LANL and ORNL, respectively.

Materials Analyzed

As described in the following graphic, there are eight general categories used to describe the 50 t (55 tons) of surplus plutonium, which represent the physical and chemical nature of the plutonium. Two of the categories—clean metal (including pits) and clean oxide—could either be fabricated into MOX fuel or immobilized. The remaining six categories of material—impure metals, plutonium alloys, impure oxides,uranium/plutonium oxides, alloy reactor fuel, and oxide reactor fuel—would be immobilized.

DESCRIPTION OF SURPLUS PLUTONIUM BY DISPOSITION FEED CATEGORIES

PLUTONIUM FEED FOR IMMOBILIZATION OR MOX FUEL FABRICATION:

Clean Metal. Pure plutonium metal generally with less than 100 parts per million (ppm) of any given chemical impurity. The metal may have some oxidation or casting residues on the surface. The only major chemical impurities are gallium and radioactive decay products such as americium, neptunium, or uranium. Examples of pure metal items include unalloyed "buttons" of plutonium metal, billets, ingots, castings or rough machined items, finished machined weapon components such as "pits," and other miscellaneous small metal pieces and parts.

Clean Oxide. Plutonium oxides with less than 3 percent by weight of impurities.

FEED FOR IMMOBILIZATION:

Impure Metal. Items with impurities that are more than 100 ppm, but less than 50 percent by weight.

Plutonium Alloys. Plutonium-containing alloys with impurities that are less than 50 percent by weight. Examples of plutonium alloy items include alloyed plutonium "buttons," casting products, machined product items, and ingots.

Impure Oxide. Plutonium oxides with at least 3 but less than 50 percent by weight of impurities. Examples in this category include plutonium oxides containing uranium oxides and plutonium oxides containing neptunium, thorium, beryllium, or zirconium.

Uranium/Plutonium Oxide. Plutonium oxides mixed with enriched uranium oxides. Examples include powders or pellets that have been either low-fired (heated at temperatures below 700 °C) or high-fired (heated at temperatures greater than 700 °C).

Alloy Reactor Fuel and Oxide Reactor Fuel. Plutonium-containing reactor fuel that has been manufactured, but not irradiated in a reactor. The plutonium consists of 12 to 26 percent of plutonium 240 with total plutonium compositions being 13 to 27 percent of the material in the fuel. The fuel can be either alloy reactor fuel or reactor fuel containing plutonium oxide mixed with uranium oxide. The majority of alloy reactor fuel in DOE's plutonium inventory is fuel elements for the Zero Power Physics Reactor at ANL–W. Oxide fuels include experimental capsules, elements, and pins.

[30] The potential impacts of fabricating 10 lead assemblies and irradiating 8 of them were analyzed in the SPD EIS. As discussed in Sections 2.18.2 and 4.27 of the SPD EIS, should fewer lead assemblies than analyzed be fabricated or irradiated, the potential impacts would be lower than those described in the SPD EIS.

S.4 DEVELOPMENT OF THE ALTERNATIVES

Development of Facility Siting Alternatives

In the ROD for the *Storage and Disposition PEIS*, DOE identified a large number of possible options to locate three surplus plutonium disposition facilities at four sites, and limited the immobilization options to Hanford and SRS. In addition to the four different sites for potential facility locations, the options were further increased by considering the use of either existing or new facilities at the sites, and by considering whether disposition would occur by the hybrid approach (MOX fuel fabrication and immobilization) or only through immobilization.

The following equally weighted screening criteria were used to reduce the large number of possible facility and site combinations to a range of reasonable alternatives:

- *Worker and public exposure to radiation.* This criterion was used to exclude the site combinations that would involve large amounts of handling, packaging, and repackaging of the surplus plutonium for either intersite or intrasite transportation.

- *Proliferation concerns due to transportation of materials.* Application of this criterion eliminated those options that would increase the transfers of the surplus plutonium, usually involving three sites.

- *Infrastructure.* This criterion was used to exclude the site combinations where a single disposition facility would be located at a site with no benefit for the program or DOE. For example, collocation of two of the three hybrid case disposition facilities at a site would reduce program infrastructure costs such as those associated with safeguards and security features, whereas locating each facility at a separate site would not allow such functions to be shared.

Over 64 options were evaluated, yielding a range of 20 reasonable alternatives that met all of the criteria. Examples of options that were eliminated include all those options placing three facilities at three different sites. In its NOI, DOE proposed to collocate the pit conversion and immobilization facilities for the immobilization-only alternatives. However, during the public scoping process, the comment was made that, under all situations, Pantex should be considered as a candidate site for the pit conversion facility because most of the surplus pits are currently stored there. After confirming that they met all of the screening criteria, three additional immobilization-only alternatives, which place the pit conversion facility at Pantex, were included in the range of reasonable alternatives evaluated in the SPD Draft EIS. The number of reasonable alternatives was reduced to 15 in the *Supplement* when DOE determined that Building 221–F at SRS was no longer a reasonable location for the immobilization facility, as discussed in Section S.2.

[Text deleted.]

Since the issuance of the SPD Draft EIS, DOE has developed a more detailed conceptual design for the can-in-canister immobilization facility. To accommodate design modifications (such as the lengthening of process gloveboxes and the material conveyor), the proposed immobilization facility has increased in size in terms of floor space. The MOX facility has also increased in size since the issuance of the SPD Draft EIS. This increase is due to the inclusion of the plutonium-polishing capability and additional process space proposed by DCS.

Alternatives Considered but Eliminated From Detailed Study

Technology alternatives for surplus plutonium disposition that were evaluated in the *Storage and Disposition PEIS*, but were not selected in the ROD and, therefore, are not being considered in the SPD EIS are: (1) deep-borehole direct disposition; (2) deep-borehole immobilized disposition; (3) electrometallurgical treatment; (4) MOX fuel irradiation in a partially completed light water reactor; and (5) MOX fuel irradiation in an evolutionary (advanced) light water reactor. The reasons why these technologies were not selected are explained in the ROD for the *Storage and Disposition PEIS*.

Alternatives considered for inclusion in the SPD EIS but later eliminated from further analysis fall into four categories: amounts of material to be dispositioned; disposition facility siting; feed preparation methods; and immobilization technologies.

Amounts of Material to Be Dispositioned. In the *Storage and Disposition PEIS* ROD, DOE committed to immobilizing at least 8 t (9 tons) of surplus, low-purity, nonpit plutonium. Since the ROD was issued, however, DOE has determined that because of the level of impurities and additional processing that would be required to meet MOX fuel specifications, an additional 9 t (10 tons) of low-plutonium-content materials would be immobilized. Therefore, the SPD EIS does not evaluate in detail MOX fuel fabrication for all of the nominal 50 t (55 tons) of surplus plutonium.

Disposition Facility Siting Alternatives. In addition to alternatives eliminated by the screening process described earlier, the following facility options were eliminated from further study.

Locating all three surplus plutonium disposition facilities in FMEF at Hanford was listed as Alternative 2 in Table 1 of the NOI for preparation of the SPD EIS. After further evaluation of space requirements, DOE concluded that the available space in FMEF would not be sufficient to accommodate the efficient operation and maintenance of all three facilities. Therefore, Alternative 2 was modified to collocate only the pit conversion and the immobilization facilities in FMEF, with the MOX facility (new construction) adjacent to FMEF.

The *Storage and Disposition PEIS* ROD stated that "to accomplish the plutonium disposition mission, DOE will use, to the extent practical, new as well as modified existing buildings and facilities for portions of the disposition missions." The subsequent NOI for the SPD EIS further stated that "construction of these facilities would be on previously disturbed land and could include the modification of existing facilities where practicable, to reduce local environmental impacts, reduce costs, and shorten schedules." As a result, DOE analyzed immobilization alternatives that included Building 221–F at SRS in the SPD Draft EIS. This building was originally built to house operations to chemically separate plutonium from irradiated targets and will be available to support other missions after these activities have been completed. The availability of Building 221–F coincides with the schedule for the proposed surplus plutonium disposition activities.

However, based on revised space requirements for the immobilization facility, the eight alternatives (3B, 5B, 6C, 6D, 7B, 9B, 12B, and 12D) in the SPD Draft EIS that proposed using a portion of Building 221–F for immobilization activities have, as discussed in the *Supplement*, been removed from consideration in the SPD Final EIS. These alternatives are no longer considered reasonable because the amount of new construction required for the proposed immobilization facility is now expected to be nearly the same whether the facility were located entirely in a new building or built in addition to using the available portion of Building 221–F. Deletion of the Building 221–F alternatives does not eliminate SRS from any of the immobilization alternatives under consideration. DOE is still evaluating alternatives that involve construction of a new immobilization facility at SRS.

[Text deleted.]

Feed Preparation Methods for Immobilization. The homogenous ceramic immobilization facility evaluated in the *Storage and Disposition PEIS* was based on a wet-feed preparation process. Although the ceramic form of the can-in-canister approach evaluated in the SPD EIS could also use a wet-feed process, it would require larger quantities of water and generate greater amounts of waste than would a dry-feed process. For these reasons, wet-feed preparation processes for the ceramic can-in-canister approach were not considered to be reasonable, and were not considered further in the SPD EIS.

Immobilization Technology Alternatives. DOE considered locating an adjunct melter adjacent to DWPF at SRS. In the adjunct melter, a mixture of borosilicate glass frit and plutonium would be melted together and added directly to borosilicate glass containing HLW from DWPF. Subsequent evaluations, however, have indicated that the adjunct melter approach would be less technically viable, would take longer to implement, and would cost twice that of the can-in-canister approach. A description of the vitrification process using the adjunct melter is presented in Appendix C of the SPD EIS, but this option is not evaluated as a reasonable alternative.

The technology variants for the new immobilization facilities discussed in the *Storage and Disposition PEIS* considered using either radioactive cesium 137 or HLW as a radiation barrier. However, the *Storage and Disposition PEIS* further identified that, in the can-in-canister approach, the use of HLW to produce a radiation barrier eliminates the need for introducing cesium 137 (from cesium capsules currently in storage at Hanford) into the immobilization process, which in turn reduces radiation shielding requirements and potential exposures to workers and the public. Therefore, the SPD EIS does not include the use of these cesium 137 capsules in the can-in-canister analyses as a reasonable alternative.

S.5 OVERVIEW OF PROPOSED SURPLUS PLUTONIUM DISPOSITION FACILITIES AND TRANSPORTATION

As discussed previously, three facilities are proposed for surplus plutonium disposition: pit conversion, immobilization, and MOX fuel fabrication. The three disposition facilities are proposed for locations where the plutonium would have the levels of protection and control required by applicable DOE safeguards and security directives.[31] See Figure S–3 for a description of the proposed surplus plutonium disposition processes. Safeguards and security programs would be integrated programs of physical protection, information security, nuclear material control and accountability, and personnel assurance. Security for the facilities would be commensurate with the usability of the material in a nuclear weapon or improvised nuclear device. Each facility would be located at an existing DOE site that has sitewide security measures in place, including access control. In addition to DOE sitewide security services, each facility would have appropriate security features. Physical barriers; access control systems; detection and alarm systems; procedures, including the two-person rule (which requires at least two people to be present when working with special nuclear materials in the facility); and personnel security measures, including security clearance investigations and access authorization levels, would be used to ensure that special nuclear materials stored and processed inside are adequately protected. Nuclear material control and accountability would be ensured through a system that monitors storage, processing, and transfers. Closed-circuit television, intrusion detection, motion detection, and automated materials monitoring methods would be employed as part of the material control and accountability program. At any time, the total amount of special nuclear material in each facility, or in any material balance area within a specific facility, would be known. Physical inventories, measurements, and inspections of

[31] The physical protection and safeguards and security for the MOX facility would be acceptable to NRC. Physical protection and safeguards and security at the domestic, commercial reactors would meet NRC regulations.

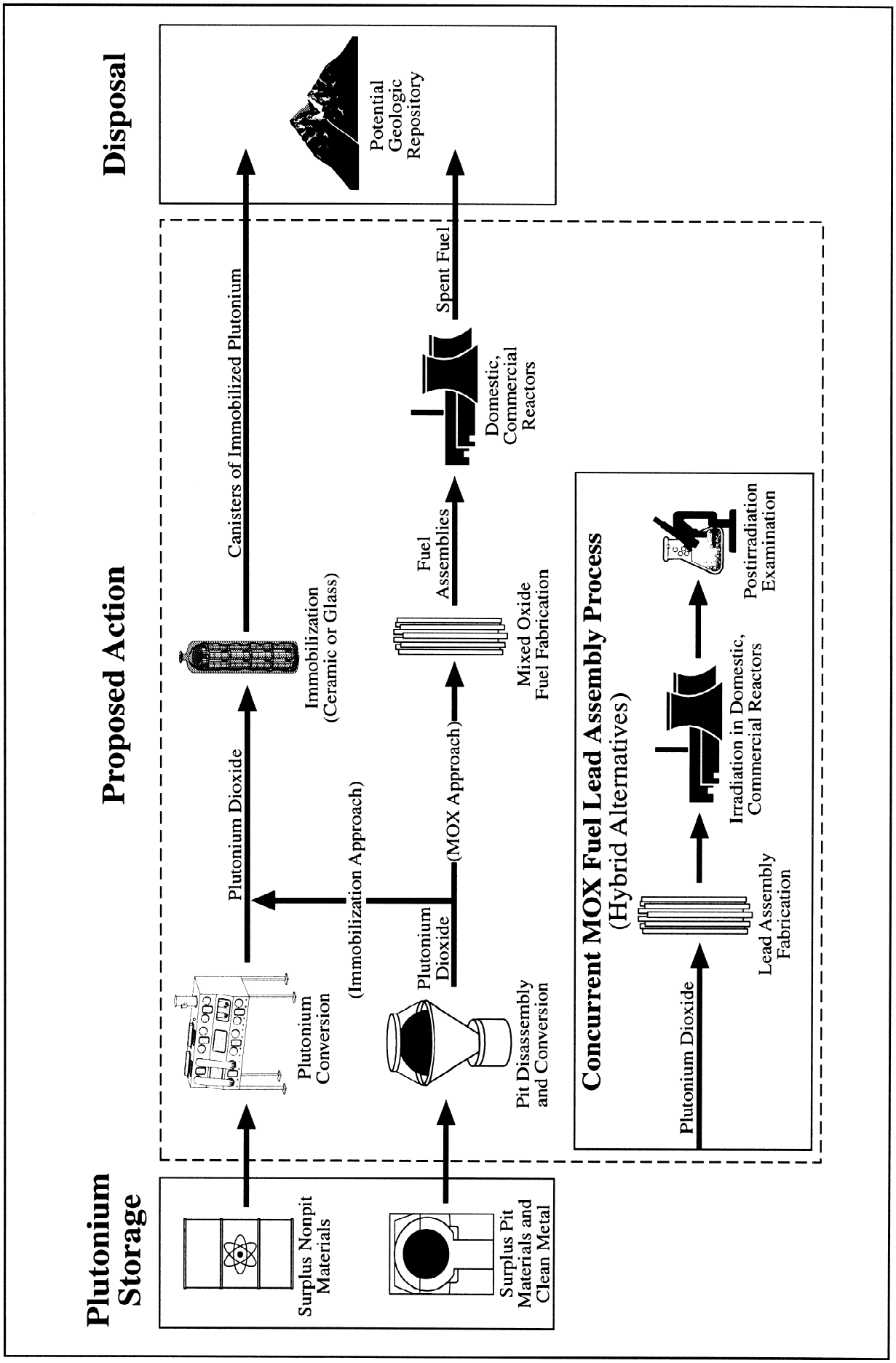


Figure S–3. Proposed Surplus Plutonium Disposition Processes

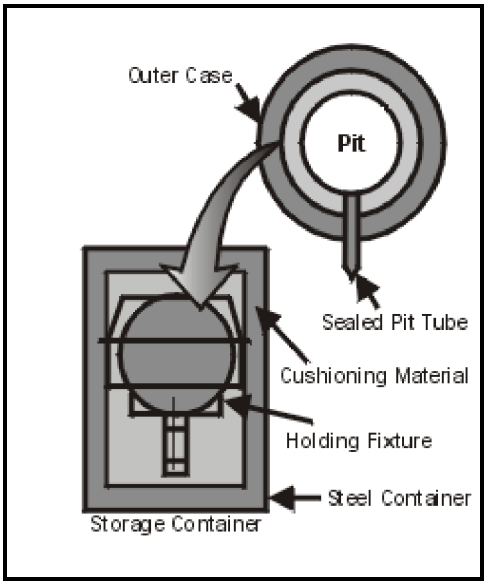
material both in process and in storage would be used to verify inventory records. In addition, each of the three facilities would need to provide space, and to varying degrees, access for international inspection.

Each of the disposition facilities is proposed to operate for about 10 years. However, the operating life of the facilities may vary somewhat, depending on facility startup experiences and international negotiations regarding the pace of disposition. Also, the MOX facility could operate for as long as 13 years to accommodate the fuel cycles of the reactors in which the MOX fuel would be used. Slightly more or less material could be processed in any given year, potentially extending or shortening the operating period of any of the disposition facilities. Also, for the hybrid approach, it may be necessary, based on feed material quality, to process slightly more material by immobilization than currently envisioned. An analysis of how these adjustments could incrementally affect the potential impacts evaluated in the SPD EIS is provided in Section 4.30.

Because the disposition facilities would operate for about 10 years and would meet stringent safety and natural hazard requirements, they could still be used for other programs or activities. As discussed in Section 4.31 of the SPD EIS, after completion of the surplus plutonium disposition mission, equipment would be removed, decontaminated, and either reused at other DOE facilities or disposed of, and the facilities would be stabilized to a condition suitable for reuse. It is expected that this facility deactivation would take 3 years or less to complete. During this time, DOE would perform engineering evaluations, environmental studies, and further NEPA review to assess the consequences of different courses of action with respect to these facilities.

Pit Disassembly and Conversion

Each surplus plutonium disposition action alternative requires a pit conversion facility to produce appropriate plutonium dioxide feed material. That facility would recover plutonium from pits and process clean plutonium metal; convert the plutonium to an unclassified (i.e., no longer exhibiting any characteristics that are protected for reasons of national security) oxide; and then transfer the oxide to either the immobilization facility or the MOX facility. This process would include the removal of gallium, beryllium, or other materials that may be considered impurities in plutonium dioxide feed for MOX fuel fabrication.[32] Given the national security sensitivity of information on pit materials and assembly, pit conversion facility operations would be classified (i.e., access restricted) through the material processing steps, and possibly through the final canning stage.



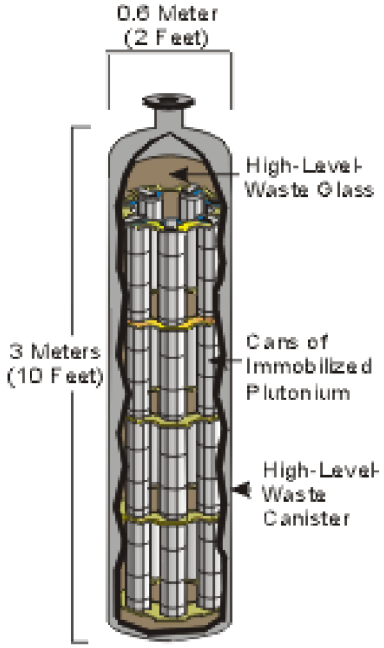
Depiction of Pit

The pit conversion facility would be designed to process up to 3.5 t (3.8 tons) of plutonium metal into plutonium oxide annually. Facility operations would require a staff of about 400 personnel. The pit conversion facility would be built in a hardened space of thick-walled concrete that meets all of the standards for processing special nuclear material. Areas of the facility in which plutonium would be processed or stored would be designed to survive natural phenomena such as earthquakes, floods, and tornadoes, as well as potential accidents associated with radioactive and fissile materials. In addition to the pit conversion facility, ancillary buildings would also be required for support activities.

[32] Because the plutonium-polishing process evaluated as a contingency in Appendix N of the SPD Draft EIS has been incorporated into the MOX facility, the thermal gallium removal step may no longer be needed in the pit conversion facility. Both the pit conversion and MOX facilities, however, were analyzed in the SPD EIS with their respective gallium (and other impurity) removal processes.

Plutonium Conversion and Immobilization

The immobilization facility would perform two operations on the surplus nonpit plutonium materials: (1) the conversion of miscellaneous surplus plutonium that is not in pit form into plutonium dioxide for immobilization; and (2) the immobilization of this plutonium dioxide, and possibly the plutonium dioxide from pits (if it were decided to also immobilize plutonium from pits), in a ceramic or glass form. This material would then be sealed in cans, and these cans would be placed inside canisters that would subsequently be filled with vitrified HLW from either the HLW vitification facility at Hanford or DWPF at SRS (i.e., the can-in-canister approach). Filled and sealed waste canisters would be placed into storage for ultimate disposition in a potential geologic repository pursuant to the NWPA. The immobilization facility would be open to international inspection.



Filled Canister

The immobilization facility would consist of two primary components: a main process building and an HLW vitrification facility (the planned HLW vitrification facility at Hanford, or DWPF at SRS). The facility would be designed to immobilize up to 5 t (5.5 tons) of plutonium metal per year. This annual throughput would consist of up to 1.7 t (1.9 tons) of surplus nonpit plutonium and up to 3.3 t (3.6 tons) of surplus plutonium derived from pits. Operation of the facility would involve three shifts 7 days per week for 10 years and would require a workforce ranging from about 335 to 412 personnel.[33] For 11 of the alternatives considered in the SPD EIS, a total plutonium immobilization throughput of 17 t (19 tons) was assumed. These alternatives involve the hybrid approach of disposition through both immobilization and MOX fuel fabrication. Four alternatives involve disposition only by immobilization, and the facility design for the two candidate sites would accommodate the assumed 50-t (55-ton) throughput of plutonium metal. The lower throughput for the hybrid approach would be reflected in differences in operational employment and resource requirements, but would not affect construction requirements.

MOX Fuel Fabrication

The MOX facility would produce completed MOX fuel assemblies for use in domestic, commercial nuclear power reactors. Feed materials would be the plutonium dioxide from the pit conversion facility and uranium dioxide made from either the DOE stockpile of depleted uranium hexafluoride from a representative DOE site (i.e., Portsmouth Gaseous Diffusion Plant) or another source selected by the fuel fabricator (DCS) and approved by DOE. MOX fuel fabrication involves blending the plutonium dioxide with uranium dioxide; forming the mixed oxide into pellets; loading the pellets into fuel rods; and assembling the fuel rods into fuel assemblies. Once assembled, each of the fuel assemblies would be transported in SST/SGTs to one of the domestic, commercial reactors for use. Following irradiation, the MOX fuel would be removed from the reactor and managed at the reactor site as spent fuel. Final disposition would be at a potential geologic repository pursuant to the NWPA.

[33] Personnel needed to operate the planned HLW vitrification facility at Hanford, or DWPF at SRS, are not included, because these facilities are required regardless of the immobilization alternatives presented in the SPD EIS.

The proposed MOX facility would also include a small-scale aqueous process to remove impurities, in particular gallium, from the plutonium dioxide feed prior to MOX fuel fabrication. This initial plutonium-polishing step would be essentially that described in Appendix N of the SPD Draft EIS. The potential impacts of the MOX facility, including plutonium polishing, are evaluated in Chapter 4 of the SPD EIS and would be the same regardless of the exact location of the plutonium-polishing equipment within the MOX facility.

The MOX facility would be designed to process up to 3.5 t (3.8 tons) of surplus plutonium (as plutonium dioxide from the pit conversion facility) annually. Facility operations would require a staff of about 385 personnel. The MOX facility would be a two-story, hardened, reinforced-concrete structure with a below-grade basement and an at-grade first floor. The facility would meet all applicable standards for processing special nuclear material. The walls, floors, and roof of the building would be constructed of about 46 cm (18 in) thick reinforced concrete. Areas of the facility in which plutonium would be processed or stored would be designed to survive natural phenomena such as earthquakes, floods, and tornadoes, as well as potential accidents associated with processing fissile and radioactive materials. In addition to the MOX facility, ancillary buildings would also be required for support activities.

Lead Assembly Fabrication

Lead assembly fabrication would involve the same basic process as the full-scale fabrication of MOX fuel. Although DOE plans to produce only 2 lead assemblies, as many as 10[34] could be fabricated at the lead assembly fabrication facility. The fabrication effort would be implemented in existing facilities at the selected location, and the fabrication phase would be completed in about 3 years. Up to 4 fuel assemblies would be produced in any given year, for a maximum of 10 assemblies at the end of the 3-year fabrication phase. At this rate of production, about 100 kg (220 lb) of plutonium would be made into MOX fuel each year. Including hot startup, a total of about 321 kg (708 lb) of plutonium would be used. The plutonium would come from pits dismantled during the Pit Disassembly and Conversion Demonstration Project or from existing supplies of surplus metal and oxides at LANL. Two extra MOX fuel rods would be fabricated with each lead assembly to be maintained as unirradiated archives. The archived rods would be stored at the lead assembly facility until the completion of all the lead assembly fabrication, irradiation, and testing. The rods would then be shipped to the MOX facility for storage until it was determined that the rods were no longer needed as archived material for fuel qualification purposes. At that time, the archived rods would either be irradiated or dismantled and the materials reused in the MOX fabrication process.

Transportation Activities

The plutonium disposition alternatives examined in the SPD EIS would require DOE to ship surplus plutonium-bearing materials from their current storage locations to the proposed disposition facility locations for processing. Table S–2 is an overview of the different types of shipments that would be required for each proposed disposition facility, and the vehicles in which the shipments would be made.

The overland transportation of any commodity involves a risk to both the transportation crew and members of the public. The risk results directly from transportation-related accidents and indirectly from the increased levels of pollution from vehicle emissions, regardless of the cargo. The transportation of hazardous or

[34] Should fewer lead assemblies than analyzed be fabricated or irradiated, the potential impacts would be lower than those described in Sections 2.18.2 and 4.27 of the SPD EIS.

Table S–2. Facility Transportation Requirements

Required Shipment	Vehicle[a] [b]
Pit Conversion Facility	
Intersite shipment of surplus pits and clean metal to the pit conversion facility	SST/SGT[c]
Recovered HEU from the pit conversion facility to ORR	SST/SGT
[Text deleted.]	
Plutonium dioxide to the immobilization or MOX facility	SST/SGT
Immobilization Facility	
Under Alternatives 11B and 12B, plutonium dioxide from the pit conversion facility[d]	SST/SGT
Surplus nonpit plutonium to the immobilization facility[e]	SST/SGT
DUF_6 from one of DOE's sites at a gaseous diffusion plant to a conversion facility (ceramic immobilization option only)[f]	Commercial truck
Uranium dioxide from the conversion facility to the immobilization facility (ceramic immobilization option only)	Commercial truck
Immobilized plutonium from immobilization facility to the HLW vitrification facility (intrasite transport)	Special transport vehicle
Vitrified HLW with immobilized plutonium to a potential geologic repository[g]	Commercial truck
MOX Facility[h]	
Under Alternatives 4 and 5, plutonium dioxide from the pit conversion facility[i]	SST/SGT
DUF_6 from one of DOE's sites at a gaseous diffusion plant to a commercial conversion facility[f]	Commercial truck
Uranium dioxide from the conversion facility to the MOX facility	Commercial truck
Uranium fuel rods from a commercial fuel fabrication facility to the MOX facility[j]	Commercial truck
MOX fuel bundles to selected domestic, commercial reactors	SST/SGT
MOX spent fuel from domestic, commercial reactors to a potential geologic repository[k]	Commercial truck
Lead Assembly Fabrication Facility	
Plutonium dioxide from LANL to a lead assembly facility at a location other than LANL	SST/SGT
For lead assembly fabrication at LANL, intrasite movement of plutonium materials	Special transport vehicle
DUF_6 from one of DOE's sites at a gaseous diffusion plant to a commercial conversion facility[f]	Commercial truck
Uranium dioxide from the conversion facility to the lead assembly facility	Commercial truck
Uranium fuel rods from a commercial fuel fabrication facility to the lead assembly facility	Commercial truck
MOX fuel bundles to the selected domestic, commercial reactor	SST/SGT
Irradiated lead assemblies or rods from the reactor to an examination site	Commercial truck
Spent fuel from an examination site to INEEL for storage[l]	Commercial truck
Spent fuel from INEEL to a potential geologic repository[k]	Commercial truck

[a] All containers and vehicles will meet Department of Transportation requirements.

[b] Commercial trucks will be driven by drivers certified to meet all radioactive materials transportation requirements.

[c] SST/SGT is a specially designed semitrailer, pulled by a specially designed tractor, that is used for the safe, secure transportation of cargo containing nuclear weapons or special nuclear material.

[d] Under Alternatives 11A and 12A, the two facilities would be collocated; therefore, the transfer of the plutonium dioxide would not require any over-the-road transportation.

[e] For cases where the surplus nonpit plutonium requires offsite transportation.

[f] DOE is considering building one or more facilities at the gaseous diffusion plant(s) to convert DUF_6 to an oxide form.

[g] The *Final Waste Management Programmatic EIS for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* analyzed a number of options for shipping using either trucks or trains. The SPD EIS has taken the most conservative analytical approach and assumed that all shipments would be made by truck.

[h] Some equipment for the MOX facility may be manufactured in Europe and shipped to the United States. No nuclear or radiologically contaminated materials would be transported. Any such shipments would be made by commercial vessel, and no impacts other than those occurring from routine commercial shipping would be expected.

[i] Under Alternatives 2, 3, 6A, 6B, 7, 8, 9, and 10, the two facilities would be collocated; therefore, the transfer of the plutonium dioxide would not require any over-the-road transportation.

[j] For cases where the fuel assemblies are a combination of MOX and low-enriched uranium fuel rods.

[k] Shipments of spent fuel are analyzed in the *Draft EIS for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada.*

[l] Shipments of spent fuel within the DOE complex are analyzed in the *DOE Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final EIS.*

Key: DUF_6, depleted uranium hexafluoride; HEU, highly enriched uranium; HLW, high-level waste; LANL, Los Alamos National Laboratory; ORR, Oak Ridge Reservation; SST/SGT, safe, secure trailer/SafeGuards Transport.

radioactive materials poses an additional risk due to the unique nature of the material being transported. Chapter 4 and Appendix L of the SPD EIS discuss the risks associated with the transportation of these materials and the steps taken to mitigate these risks.

S.6 APPROACH TO ENVIRONMENTAL IMPACT ANALYSIS

Topics Analyzed in the SPD EIS Include:

- ➜ Air Quality and Noise
- ➜ Waste Management
- ➜ Socioeconomics
- ➜ Human Health Risk
- ➜ Facility Accidents
- ➜ Transportation
- ➜ Environmental Justice
- ➜ Geology and Soils
- ➜ Water Resources
- ➜ Ecological Resources
- ➜ Cultural and Paleontological Resources
- ➜ Land Use and Visual Resources
- ➜ Infrastructure

The environmental impact analysis addresses the full range of natural and human resource areas pertinent to the sites considered for the surplus plutonium disposition alternatives. To focus the impact analyses on those areas where the greatest potential exists for effects on the environment, the following topics are discussed in detail: air quality and noise, waste management, socioeconomics, human health risk, facility accidents, transportation, and environmental justice. The remaining resource areas (i.e., geology and soils, water resources, ecological resources, cultural and paleontological resources, land use and visual resources, and infrastructure), analyses have shown that the proposed disposition activities would not have major impacts that varied significantly at each of the candidate sites regardless of the disposition alternative being considered. Therefore, impacts on these resources were evaluated in detail and discussed in the SPD EIS in terms of the alternative that would have the greatest impact on the resource. The alternative analyzed and discussed is generally that which would locate the largest number of surplus plutonium disposition facilities at a given site. For example, the maximum impact on these resource areas at Pantex would be Alternative 9 or 10, both of which consider building both a pit conversion facility and a MOX facility on the site. In another example, at SRS, the alternative having the greatest impact would be Alternative 3.[35] [Text deleted.]

A region of influence (ROI) for each topic or resource area is identified and analyzed for each candidate site for surplus plutonium disposition. Air quality impacts focus on the potential for increases in air pollutant concentrations and discuss those increases relative to the National Ambient Air Quality Standards (NAAQS), National Emissions Standards for Hazardous Air Pollutants (NESHAPs), and State air quality standards. The potential for increases in noise levels is also assessed. Geology and soils are evaluated in terms of site suitability and soil erosion potential. For water resources, the water consumption requirements are compared to the availability of surface and groundwater sources at each site, the potential effects of wastewater discharges on surface and groundwater availability and quality are evaluated, and the site's location relative to floodplains assessed. Biological resources are evaluated in terms of the potential for impacts to terrestrial and aquatic resources, wetlands, and threatened and endangered species. Because most of the facility construction associated with the proposed actions would take place on previously disturbed lands, few impacts would be expected on plant and animal species and the overall biodiversity of the candidate sites. Cultural and paleontological resources address the potential for disturbance to prehistoric, historic, Native American, and paleontological resources. Land resources address land-use compatibility with existing land-use plans, controls, and policies; land requirements for construction and new facilities; and the potential for visual resource impacts. Site

[35] During the conduct of the cultural resources impacts analysis, it was determined that construction of surplus plutonium disposition facilities at SRS could produce impacts to archaeologic resources requiring mitigation (see Section 4.26.4.4.1 of the SPD EIS). DOE plans to avoid these sites, and it will not be necessary to disturb these areas.

infrastructure impacts are assessed by comparing the electrical power, fuel, water, and transportation network requirements against the existing capacities at each candidate site.

Additional wastes generated by each alternative are compared with existing and planned treatment, storage, and disposal capacities for potential impacts to the waste management infrastructure. Waste management methods are contingent on decisions made based on the *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (DOE 1997c). Employment and income effects of new job creation and the attendant demands on community services and local transportation are analyzed for socioeconomic impacts.

Maximally Exposed Individual (MEI)

In keeping with standard risk assessment methodology, DOE analyzed the impacts on a "maximally exposed individual." The MEI is the hypothetical person within a receptor group who has the highest exposure. This individual is assumed to be located at the point of maximum concentration of contaminants 24 hours a day, 7 days a week, for the period of operations analyzed in the SPD EIS.

Both the public and onsite worker exposure to ionizing radiation and hazardous chemicals and the resultant increase in cancer fatality risk are assessed for normal operations and accident conditions. For the public, impacts on individuals (maximally exposed and average exposed) and on the population within 80 km (50 mi) of the site are evaluated; for workers, the focus is on individual workers and on the total facility workforces. The evaluation includes a comparison with health and safety standards established by DOE, EPA, the Occupational Safety and Health Administration, and where appropriate, NRC.

The increased number of potential fatalities from truck accidents during the intersite transportation of surplus plutonium and other materials among the various DOE sites and proposed facilities is evaluated. The evaluation of environmental justice identifies minority and low-income populations that could be affected by implementation of the various alternatives. Populations at risk within 80 km (50 mi) of DOE sites and within 1.6 km (1 mi) of representative transportation routes were evaluated to determine if disproportionately high and adverse effects on minority or low-income populations would result from implementation of the alternatives.

Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. The cumulative impact analysis for the SPD EIS involves combining the impacts of the SPD EIS alternatives (including No Action) with the impacts of other past, present, and reasonably foreseeable activities in an ROI. In general, cumulative impacts are calculated by adding the values for the baseline,[36] the proposed action, and other reasonably foreseeable future actions. This cumulative value is then weighed against the appropriate impact indicators to determine the potential for impact. For this cumulative impact assessment, it is conservatively assumed that all facilities would operate concurrently at the DOE sites.

Impacts in all resource areas are analyzed consistently. The impact values are estimated using a consistent set of input variables and computations. Moreover, efforts were made to ensure that calculations in all areas use accepted protocols and up-to-date models, as well as the most recent information available. Finally, like presentations were developed to facilitate the comparison of alternatives.

S.7 SUMMARY OF IMPACTS OF CONSTRUCTION AND OPERATION OF SURPLUS PLUTONIUM DISPOSITION FACILITIES

[36] The conditions attributable to actions, past and present, by DOE and other public and private entities.

This section summarizes the potential impacts associated with the activities necessary to implement DOE's disposition strategy for surplus plutonium. The summary addresses the environmental information to be considered for each of the decisions contemplated as part of this strategy. A detailed comparison table is provided in Chapter 2 of the SPD EIS that summarizes impacts on key environmental resource areas related to the surplus plutonium disposition facilities and provides that information by alternative, and within each alternative, by site. That comparison of impacts is summarized here. Key resource areas analyzed include air quality, waste management, employment, land disturbance, human health risk, facility accidents, and transportation. Summarized impacts are presented in this section for the No Action Alternative as well as for each of the 15 alternatives that encompass the range of reasonable alternatives for both the 50-t (55-ton) immobilization and the hybrid approaches to plutonium disposition. This section also compares the potential impacts related to implementation of lead assembly fabrication at five candidate sites and postirradiation examination at two candidate sites. To provide an overview of the impacts associated with full implementation of the MOX fuel approach to disposition, this section presents an integrated assessment of the potential impacts of the MOX facility, lead assembly fabrication, postirradiation examination, and use of the MOX fuel at the Catawba, McGuire, and North Anna reactor sites. To facilitate the evaluation of proposed immobilization technologies, this section compares the impacts associated with the can-in-canister immobilization technology with the homogenous technologies described in the *Storage and Disposition PEIS* for the ceramic immobilization and vitrification alternatives.

Summary of Impacts by Alternative and Site

Impacts on air quality are expected to be low for all alternatives. In all cases, the incremental concentrations from surplus plutonium disposition operations would contribute less than 2 percent of the applicable regulatory standard. Total site air concentrations, which also factor in the amount associated with the No Action Alternative,[37] would be no more than 21 percent of the applicable annual regulatory standard, with the highest occurring in the alternatives that would have the immobilization facility located at SRS. That particular value represents projected sulfur dioxide concentrations as a percent of the annual NAAQS; the corresponding value for the No Action Alternative is also 21 percent, demonstrating that the increment associated with plutonium disposition facilities would be very small.[38]

Expected waste generation is estimated for transuranic (TRU) waste, LLW, mixed LLW, hazardous waste, and nonhazardous waste[39] from construction activities and 10 years of expected facility operation. As shown in Chapter 4 of the SPD EIS, impacts associated with management of nonhazardous wastes would be minor and would not tend to be a discriminator among alternatives.

Total TRU waste generation for the construction period and 10 years of operation would range from 1,400 m^3 (1,832 yd^3) to 1,810 m^3 (2,368 yd^3), and total LLW generation would range from 1,700 m^3 (2,224 yd^3) to 2,400 m^3 (3,140 yd^3). The largest amounts of TRU waste and LLW would be generated by the hybrid alternatives. Total mixed LLW generation would range from 20 m^3 (26 yd^3) for immobilizing all 50 t (55 tons) (Alternatives 11A, 11B, 12A, and 12B) to 50 m^3 (65 yd^3) for each of the hybrid alternatives. Hazardous waste generation would range from 770 m^3 (1,007 yd^3) (Alternatives 11A and 11B) to 940 m^3 (1,230 yd^3) (Alternatives 3, 5, 6A, 6B, 7, and 9).

[37] As indicated in Appendix G, the No Action Alternative projects air emissions to the year 2005, when plutonium disposition facility operations under the disposition alternatives would begin, and includes emissions from existing and other planned facilities.

[38] This conclusion assumes that activity levels under the No Action Alternative remain the same beyond 2005.

[39] Waste type definitions are provided in Appendix F.8 of the SPD EIS.

Impacts on the waste management infrastructure from implementing alternatives for surplus plutonium disposition are expected to be minor. All of the waste expected to be generated from the different alternatives analyzed could be accommodated within existing or planned capacities for waste treatment, storage, and disposal at all of the candidate sites, except for TRU waste at Pantex. At Pantex, a maximum of 860 m^3 (1,125 yd^3) of TRU waste would be generated under Alternatives 9 or 10. Because TRU waste is not routinely generated and stored at Pantex, TRU waste storage space would be designated within the pit conversion and MOX facilities. TRU waste would be shipped to the Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico, for disposal.

Although the surplus plutonium disposition facilities are still in the early stages of engineering and design, the program would integrate pollution prevention practices that include waste stream minimization, source reduction and recycling, and DOE procurement processes that preferentially procure products made from recycled materials. The surplus plutonium disposition facility designs would minimize the size of radiologically controlled areas, thereby minimizing the generation of radioactive waste. To the extent practical, the DOE facilities would not use solvents or other chemicals that, after use, are regulated by the Resource Conservation and Recovery Act (RCRA), thereby minimizing the amount of hazardous and mixed waste generated. Wastewater would be recycled to the extent possible to minimize effluent discharge.

The number of direct jobs generated by the proposed facilities under each alternative is estimated. All of the action alternatives would generate employment opportunities at the facilities. Expected annual peak construction employment ranges from 463 workers (Alternative 11A) to 2,143 workers (Alternative 5).[40] Annual employment during operations would range from 751 (Alternatives 12A and 12B) to 1,165 workers (Alternatives 2 and 4B).

Latent Cancer Fatalities (LCFs)

Fatalities associated with acute and chronic environmental exposures to chemicals or radiation that occur as a result of operational processes specified within the SPD EIS.

Potential effects on human health from facility construction, 10 years of operation, postulated facility accidents, and intersite transportation of radioactive materials are analyzed. Doses to workers from 10 years of routine operation of the three surplus plutonium disposition facilities at DOE sites would result in up to 2.0 latent cancer fatalities (LCFs) for both the hybrid alternatives and the 50-t (55-ton) immobilization alternatives. No LCFs would be expected to occur in the general population during routine operations. Under the No Action Alternative, continued storage of the surplus plutonium also would not be expected to result in any LCFs to the general population during routine operations. Doses to workers from the long-term storage (up to 50 years) of the surplus plutonium would result in up to 2.4 LCFs.

The most severe nonreactor design basis accident scenario is also analyzed. For Alternative 4B, a criticality in the MOX facility would result in the most severe consequences. For all other alternatives except the No Action Alternative, a design basis fire in the pit conversion facility resulting in a tritium release would result in the most severe consequences. However, no design basis accident would be expected to result in LCFs in the general population. Under all of the alternatives analyzed in the SPD EIS, the most severe design basis accident would pose a small risk to the public. The risk would also be small for minority and low-income groups within the general population. Thus, implementation of the alternatives for disposition of surplus plutonium disposition would not be expected to pose disproportionately high and adverse risks to minority and low-income populations due to design basis accidents.

[40] Represents the combined peak annual construction workforces at each site. Peak construction employment under Alternative 11A is composed of the 463 construction workers at Hanford in 2003. Peak construction employment under Alternative 5 is composed of the 451 construction workers at Pantex in 2002 and the 1,692 construction workers at SRS in 2003.

No major consequences for the maximally exposed involved worker would be expected from leaks, spills, and smaller fires. These accidents are such that involved workers would either be able to evacuate immediately or would not be affected by the events. Explosions, on the other hand, could result in immediate injuries from flying debris, as well as the uptake of plutonium and uranium particulates through inhalation. If a criticality were to occur, workers within tens of meters could receive very high to fatal radiation exposures from the initial burst. The dose would strongly depend on the magnitude of the criticality (number of fissions), the distance from the criticality, and the amount of shielding provided by the structures and equipment between the workers and the criticality. Beyond-design-basis earthquakes would also have substantial consequences, ranging from workers being killed by debris from collapsing equipment and structures to high radiation exposures and uptakes of radionuclides. For most accidents, immediate emergency response actions should reduce the consequences to workers near the accident.

Materials transportation is analyzed to determine potential radiological and nonradiological impacts from routine and accident conditions. Transportation includes the movement of surplus plutonium from storage and among the proposed disposition facilities; depleted uranium hexafluoride from, for example, Portsmouth to a conversion facility; uranium dioxide from the conversion facility to the immobilization and MOX facilities; recovered HEU from the pit conversion facility to ORR; MOX fuel to the Catawba, McGuire, and North Anna reactors; spent nuclear fuel resulting from lead assembly irradiation at McGuire to the postirradiation examination site and then to storage at INEEL; and the immobilized plutonium to a potential geologic repository.[41] No traffic fatalities from nonradiological accidents or LCFs from radiological exposures or vehicle emissions would be expected. For the hybrid alternatives, the number of trips would range from 1,917 (Alternative 10) to 2,530 (Alternatives 3, 6A, 6B, and 7), and the cumulative distances traveled would range from 3.6 million km (2.2 million mi) (Alternative 10) to 8.7 million km (5.4 million mi) (Alternatives 6A and 6B). Immobilization-only alternatives would require from 1,877 trips for Alternative 11B to 2,236 trips for Alternative 12B. Cumulative distances traveled for immobilization-only alternatives would range from 2.5 million km (1.5 million mi) (Alternative 11B) to 4.4 million km (2.7 million mi) (Alternative 12A).

Land disturbance relates to impacts on ecological resources, cultural resources, geology and soils, and land use and visual resources. The amount of land that would be disturbed for the hybrid alternatives would range from 19 hectares (47 acres) in Alternative 8, to 32 hectares (79 acres) in Alternatives 3, 5, and 9. Because these land areas are in or adjacent to previously disturbed areas and represent a very small percent of the land available at the candidate sites, the impacts on geology and soil and land use would be minor. Land disturbance associated with immobilizing 50 t (55 tons) of surplus plutonium would range from 9.5 hectares (23 acres) in Alternative 11B to 20 hectares (49 acres) in Alternative 12A or 12B. Construction and operation of the proposed facilities would not effect a significant change in any natural features of visual interest in the area of any of the candidate sites. No major impact is anticipated for any threatened or endangered species because there have been no sightings near the proposed facility locations at the candidate sites. Cultural resource impacts would be minor at all sites except SRS because at all sites except SRS, construction of facilities would be in mostly disturbed or developed areas; at SRS, cultural resource areas would be avoided. Archaeological investigations near F-Area have discovered five sites that could be impacted by construction of surplus plutonium disposition facilities. Two of these sites have been recommended to the South Carolina State Historic Preservation Officer (SCSHPO) as eligible for nomination to the National Register of Historic Places. Potential adverse impacts could be mitigated through either avoidance or data recovery. DOE currently plans to mitigate impacts by avoiding sites that are eligible or potentially eligible for nomination to the National Register of Historic Places. Cultural resource compliance activities would be conducted in accordance with the *Programmatic Memorandum of Agreement for the Savannah River Site* (SRARP 1989:179–188).

[41] Shipments of spent fuel to a potential geologic repository are analyzed in the *Draft Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada* (DOE/EIS-0250D) (DOE 1999c).

Impacts were also assessed on water availability and quality, and infrastructure including requirements for roads, electricity, and fuel. These evaluations indicated that all impacts would be minor. [Text deleted.] None of the alternatives were found to pose a significant risk (when probability is considered) to the general population, nor would implementation of any of the alternatives result in a significant risk of disproportionately high and adverse impacts to minority or low-income groups within the general population.

Summary of Lead Assembly Fabrication and Postirradiation Examination Impacts

The impacts on key resources from fabrication of lead assemblies at the five candidate sites (ANL–W, Hanford, LLNL, LANL, and SRS) and from postirradiation examination at ANL–W or ORNL, are presented in Chapter 4 of the SPD EIS and summarized here. These areas include waste management, human health risk during normal operations, facility accidents, and transportation.

Impacts from lead assembly and postirradiation examination activities are based on the fabrication of 10 assemblies, although it is likely that only 2 would be needed. If less than 10 lead assemblies were fabricated, the impacts would be lower than those presented in the SPD EIS. Impacts from facility modifications would not be expected to change because the facility modifications would be the same regardless of the number of assemblies produced. Impacts from routine operations, such as resources used, personnel exposure, waste generation, and transportation, would be expected to be reduced in proportion to the number of assemblies produced. The consequences of facility and transportation accidents would be expected to remain the same because the material at risk at any one time would likely not change. However, the risk of these accidents occurring would be reduced as the number of lead assemblies decreased. Because facility modification activities would occur inside existing buildings (i.e., no new buildings would be constructed and no additional land would be disturbed), there should be little increase in air pollutants; land disturbances would be minimal; and the number of construction workers would be low. Little or no impacts are expected on any other resource areas.

There are no appreciable differences in environmental impacts among the five lead assembly candidate sites. There would be little difference in the volume of waste generated at any of the sites. The small differences in TRU waste and LLW would be due to wastes generated during modification of contaminated areas of existing buildings at ANL–W and LANL. No LCFs for either workers or the general population would be expected to result from fabrication of lead assemblies at any of the proposed locations during routine operations. The average annual dose to facility workers would be 500 mrem, for an annual dose to the total facility workforce of 28 person-rem. Impacts on involved workers from facility accidents would be expected to be the same as those described previously for the disposition facilities. No LCFs would be expected in the general population at any site from the postulated bounding design basis accident.

The impacts of postirradiation examination at ANL–W and ORNL, as evaluated in Chapter 4, would be minimal. No construction waste would be generated. With the exception of nonhazardous wastewater at ANL–W, all categories of waste generated during routine operations would use less than 1 percent of either site's applicable treatment, storage, and disposal capacity. Nonhazardous wastewater at ANL–W would use about 6 percent of that site's applicable capacity. No LCFs would be expected to either workers or the public from routine postirradiation examination activities. There would be no routine releases of radioactivity to the environment, and thus no radiological impacts on the public. The average annual dose to facility workers would be 177 mrem, for an annual dose to the total facility workforce of 1.8 person-rem. The most severe accident would be a nuclear criticality. Such an accident could result in high, though probably not fatal, radiological exposures to hot cell workers. No LCFs would be expected in the general population.

The transportation analysis includes the shipment of plutonium dioxide from LANL to the candidate site; depleted uranium hexafluoride from Portsmouth to the representative conversion facility; uranium dioxide from the conversion facility to the lead assembly fabrication facility; MOX fuel rods from the lead assembly facility

to the McGuire reactor for irradiation; and irradiated fuel rods from McGuire to a postirradiation examination facility. Comparison of lead assembly transportation impacts shows little differences among the sites, with no expected traffic fatalities or LCFs. Likewise, there are not expected to be any appreciable differences between the two postirradiation examination sites. Transportation impacts for postirradiation examination at ANL–W are included in lead assembly impacts presented in Chapter 4. Transportation impacts for postirradiation examination at ORNL would be lower than those included for ANL–W because the distance traveled would be less.

If DOE were to decide to immobilize all 50 t (55 tons) of surplus plutonium, no lead assembly activities would be required. If DOE decided to pursue the MOX option, but not fabricate lead assemblies, such activities would not occur at any of the five sites or at the postirradiation examination locations. Under both of these scenarios, current operations would continue at each site and the environmental conditions would remain at baseline levels. Chapter 3 of the SPD EIS provides a description of the current environmental conditions of the sites.

Summary of MOX Fuel Integrated Impacts

The impacts from implementing the MOX fuel fabrication alternatives would not be limited to those associated with the MOX facility, but would also include impacts from lead assembly fabrication, irradiation, and postirradiation examination; and the use of reactors for irradiation of the MOX fuel assemblies. Any new construction would occur at existing DOE sites. MOX-related operations at all sites would be compatible with, or similar to, activities already occurring at those locations.

Section 2.18.3 of the SPD EIS describes the potential impacts of implementation of the MOX alternatives, from fabrication of the MOX fuel assemblies and lead assemblies to irradiation of the assemblies in domestic, commercial nuclear power reactors, and the transportation for all radioactive material movements. While these impacts would be cumulative over the life of the campaign, they would not be concurrent.

Air emissions would result primarily from building heating and vehicular emissions. Releases of criteria pollutants are provided as a range with the lowest emissions at Hanford, where electricity is the method of heating, and the highest at INEEL, where coal-fired boilers produce steam for heating and travel distances for personnel result in vehicular emissions double those estimated for other candidate sites. There are no nonradiological emissions from these facilities that are regulated under NESHAPs. A discussion of radiological emissions relative to NESHAPs may be found in the health effects discussion. Lead assembly fabrication and postirradiation examination activities are relatively small efforts that are not expected to measurably increase air emissions at any of the candidate sites. There would be no incremental difference in the air emissions from Catawba, McGuire, or North Anna related to using MOX fuel. Criteria, toxic, and hazardous pollutant emissions are not related to the type of reactor fuel. Rather, emission of these pollutants from the reactor sites would be related to ancillary processes such as operation of diesel generators, periodic testing of emergency diesel generators, and facility operations.

TRU waste and LLW would be generated during operation of both the lead assembly and full-scale MOX facilities. The amount of waste generated would be process-specific, and would not vary appreciably by site. Lead assembly fabrication is expected to generate a total of 132 m^3 (173 yd^3) of TRU waste and about 700 m^3 (916 yd^3) of LLW over a 3-year period. The larger amount of waste generated on an annual basis by lead assembly fabrication, as compared to full-scale fabrication, would be attributed to operational differences between fabricating MOX fuel on a laboratory rather than commercial scale. Similarly, activities such as material recycle may not be implemented to as great an extent on the smaller scale. No increase is expected in the amount of waste generated at the reactor sites as a result of using MOX fuel.

More spent fuel could be generated at the reactor sites as a result of the disposition of surplus plutonium as MOX fuel. It is expected that approximately 5 percent additional spent fuel would be generated as a result of MOX fuel irradiation at the reactor sites. Even so, there would be sufficient space at the reactor sites (in either the spent fuel pools or dry storage) to store the additional spent fuel until it could be sent to a potential geologic repository pursuant to the NWPA. DOE's environmental impact statement for a potential geologic repository (DOE/EIS-0250D, July 1999) includes the MOX fuel that would be generated from this program.

Existing infrastructure would be adequate to support the MOX fuel alternatives, although it has been estimated that 2 km (0.62 mi) of new roads would be needed for the MOX facility. Consumption of coal, natural gas, and electricity vary greatly from site to site, for both the MOX and the lead assembly fabrication facilities, depending on the type of fuel used for heating. For example, electricity needed for MOX fuel fabrication would be 30,000 megawatt hours per year (MWh/yr) at all sites but Hanford. Hanford, which is estimated to use one and one-half times the electricity of the other sites (46,000 MWh/yr), uses electricity to heat its buildings. INEEL and SRS use coal for heating and Pantex uses natural gas. No additional infrastructure needs would result from the use of MOX fuel at the proposed reactors.

The impacts on workers at the MOX facility are based on operating experience at existing MOX facilities in Europe (DOE 1999d). Impacts on workers at the postirradiation facility are based on operating experience at ORNL. The impacts at the lead assembly fabrication facilities are based on an average annual dose rate of 500 mrem/yr. This is an administrative limit that has been set in accordance with ALARA principles. This exposure over the life of the MOX campaign (10 years for the MOX facility, 3 years for lead assembly fabrication, and 3 years for postirradiation examination) would result in an increased risk of fatal cancer of 2.6×10^{-4} at the MOX facility, 6×10^{-4} at the lead assembly site, and 2.2×10^{-4} at the postirradiation examination facility. The corresponding number of LCFs for MOX facility, lead assembly, and postirradiation examination workers from the MOX campaign would be 0.088, 0.033, and 0.002, respectively. No increase in the incremental dose to workers is expected at the proposed reactors from using MOX fuel during routine operations. [Text deleted.]

Understanding Scientific Notation

Scientific notation is used in the SPD EIS to express numbers that are so large or so small that they can be difficult to read or write. Scientific notation is based on the use of positive and negative powers (or exponents) of 10. A number written in scientific notation is expressed as the product of a number between 1 and 10 times a positive or negative power of 10. Some positive and negative powers of 10 include:

Positive Powers of 10	Negative Powers of 10
$10^1 = 10\times1 = 10$	$10^{-1} = 1/10 = 0.1$
$10^2 = 10\times10 = 100$	$10^{-2} = 1/100 = 0.01$
and so on; therefore,	and so on; therefore,
10^6 = 1,000,000 (or 1 million), etc.	10^{-6} = 0.000001 (or 1 in 1 million), etc.

The potential radiological impacts on the public from routine operations would be very small. Annual doses from the MOX facility to the maximally exposed individual (MEI) range from 1.8×10^{-3} to 1.5×10^{-2} mrem/yr, which translates to an increased risk of fatal cancer of 9.0×10^{-9} to 7.5×10^{-8} for 10 years of exposure. The lowest dose would be received at Hanford; the highest, Pantex. However, the population around Pantex would receive the lowest total population dose, and the lowest annual dose to the average individual. Estimated results at Hanford would be at the high end of the range for both of these parameters, 2.9×10^{-1} person-rem/yr and 7.5×10^{-4} mrem/yr, respectively. The annual dose to the average individual would still be extremely small, and would result in only a 3.8×10^{-9} increased risk of fatal cancer for 10 years of exposure. Offsite dose to the MEI resulting from lead assembly fabrication ranges from a low at SRS of 5.5×10^{-5} to 6.4×10^{-2} mrem/yr at LLNL. The associated risk of fatal cancer would be extremely low for the same MEI, ranging from 8.3×10^{-11} to 9.6×10^{-8}. Annual doses to the average individual at SRS and LLNL would be 8.8×10^{-6} and 1.4×10^{-4} mrem, respectively; risks of LCFs to the same individuals would be 1.3×10^{-11} and 2.1×10^{-10}. Routine

operations under all of the MOX fuel alternatives would pose no significant radiological risk to the public. Nor would routine operations pose a significant risk to groups within the general population, including minority and low-income populations. No change would be expected in the radiation dose to the general population from normal operations associated with the disposition of MOX fuel at the proposed reactors. Offsite dose to the MEI resulting from postirradiation examination would not be expected to change because the activities would not be additive but would displace similar activities already being done in these facilities.

Transportation impacts analyzed include radiological dose to the truck crew and the general population, nonradiological emissions from vehicle operation, potential traffic accident fatalities, and LCFs resulting from an accident involving a breach of containment and release of radioactive materials. Shipments analyzed include all those listed in Table S–4 for the MOX, lead assembly and postirradiation examination facilities, and shipments of fresh MOX fuel to the proposed reactor sites. The analysis shows that no traffic fatalities or LCFs would be expected from routine transportation activities or transportation accidents.

Accidents are unplanned events that would be different for each type of facility needed to implement the MOX approach. The accidents analyzed for the disposition facilities are presented in detail in Appendix K of the SPD EIS, and the consequences summarized by alternative in Chapter 4 of the SPD EIS. The design basis accident with the most severe consequences postulated for the MOX facility is a criticality. This accident would result in an estimated dose at a distance of 1 km (0.62 mi) from the facility of 0.15 rem at Hanford to 0.75 rem at INEEL. This same accident would result in doses at the site boundaries ranging from 1.6×10^{-2} rem at INEEL and SRS to 4.7×10^{-2} rem at Pantex. Population doses and LCFs within 80 km (50 mi) would range from 1.0 person-rem and 5.2×10^{-4} LCF at INEEL to 55 person-rem and 2.8×10^{-2} LCF at Hanford. The frequency of such an accident is estimated to be between 1 in 10,000 and 1 in 1,000,000 per year.

The design basis accident with the most severe consequences postulated for the proposed reactors using MOX fuel is a loss-of-coolant accident. This accident, based on the use of MOX fuel, would result in an increase in the estimated dose at a distance of 640 m (2,100 ft) from the reactor of 0.001 rem at North Anna to 0.15 rem at McGuire. The same accident would result in incremental increases in doses at the site boundaries ranging from 2.0×10^{-4} rem at North Anna to 6.0×10^{-2} rem at McGuire. The incremental change in population doses and LCFs within 80 km (50 mi) of the reactors would range from 0.9 person-rem and 5×10^{-4} LCF at North Anna to 110 person-rem and 0.06 LCF at Catawba. The frequency of such an accident is estimated to be between 1 in 48,000 and 1 in 130,000 per year.

The postulated design basis accident with the most severe consequences for proposed lead assembly operations using MOX fuel would be associated with a nuclear criticality. The accident would result in an incremental increase in estimated dose at the site boundaries ranging from 9.3×10^{-4} rem at SRS to 5.3×10^{-1} rem at LLNL. The same accident would result in incremental changes in population doses and LCF probabilities within 80 km (50 mi) ranging from 3.4×10^{-1} person-rem and 1.6×10^{-4} LCF at ANL–W to 6.6 person-rem and 3.2×10^{-3} LCF at LANL, respectively. The frequency of such an accident is estimated to be between 1 in 10,000 and 1 in 1,000,000 per year. A nuclear criticality would also be the most severe accident at the postirradiation examination facilities, but the amount of spent fuel necessary for such an accident to be physically possible is at least one to two orders of magnitude greater than would normally be available. Under all of the MOX fuel alternatives, the most severe design basis accident would pose no significant radiological risk to the public. Implementation of any of the MOX fuel alternatives would not pose disproportionately high and adverse risks to any group within the general population, including minority and low-income groups.

The SPD EIS also evaluates the potential impacts from a set of postulated highly unlikely accidents with potentially severe consequences at the proposed reactors using both uranium-only and MOX cores. Regarding effects of MOX fuel on accident probabilities, the National Academy of Sciences (NAS) report, *Management and Disposition of Excess Weapons Plutonium Reactor-Related Options*, states, ". . . no important overall

adverse impact of MOX use on the accident probabilities of the light water reactors (LWRs) involved will occur; if there are adequate reactivity and thermal margins in the fuel, as licensing review should ensure, the main remaining determinants of accident probabilities will involve factors not related to fuel composition and hence unaffected by the use of MOX rather than LEU fuel" (NAS 1995:352). Regarding the effects of MOX fuel on accident consequences, the report states, ". . . it seems unlikely that the switch from uranium-based fuel could worsen the consequences of a postulated (and very improbable) severe accident in a LWR by no more than 10 to 20 percent. The influence on the consequences of less severe accidents, which probably dominate the spectrum value of population exposure per reactor-year of operation would be even smaller, because less severe accidents are unlikely to mobilize any significant quantity of plutonium at all" (NAS 1995:355).

The incremental effects of using MOX fuel in the proposed reactors in place of LEU fuel were derived from a quantitative analysis of several highly unlikely severe accident scenarios for MOX and LEU fuel. The analysis considers severe accidents where sufficient damage could occur to cause the release of plutonium or uranium through a breach of the plant's containment. The consequences of these accident releases on the general population were found to range from minus 4 to plus 14 percent,[42] compared to LEU fuel, depending on the accident release scenario. This analysis is based on existing probabilistic risk assessments of severe accidents, and the release scenarios were modeled assuming projected population distributions near the proposed reactors in 2015.

The highest consequence accident at all three of the proposed reactors is an interfacing systems loss-of-coolant accident. However, there is an extremely small chance that this beyond-design-basis accident would ever occur. The likelihood of this accident occurring is 1 chance in 15 million at Catawba, 1 chance in 1.6 million at McGuire, and 1 chance in 4.2 million at North Anna. Were this accident to occur, the increase in the estimated dose at the site boundary for MOX fuel as compared with LEU fuel would be 2,000 rem at Catawba, 2,400 rem at McGuire, and 2,200 rem at North Anna. These increases are 14 percent, 12 percent, and 22 percent, respectively, above the doses expected from the same accident using LEU fuel. The incremental changes in population doses and LCFs within 80 km (50 mi) of the reactors have been estimated to be 3.2×10^{6} person-rem and 1,300 LCFs (15,600 to 16,900) at Catawba, 1.8×10^{6} person-rem and 800 LCFs (11,900 to 12,700) at McGuire, and 7.3×10^{5} person-rem and 410 LCFs (2,980 to 3,390) at North Anna. Prompt fatalities from this accident would be expected to increase from 815 to 843 at Catawba, 398 to 421 at McGuire, and from 54 to 60 at North Anna. The increase in risk to the population from this accident as a result of using MOX fuel would be 1.4×10^{-3} at Catawba, 8.0×10^{-3} at McGuire, and 1.6×10^{-3} at North Anna over the estimated 16-year life of the MOX fuel irradiation program.

[Text deleted.]

Comparison of Immobilization Technology Impacts

In order to provide a basis for evaluating alternative immobilization forms and technologies, the environmental impacts associated with operating the ceramic and glass can-in-canister immobilization facilities evaluated in the SPD EIS are compared with the corresponding environmental impacts associated with operating the homogenous ceramic immobilization and vitrification facilities evaluated in the *Storage and Disposition PEIS*.

Chapter 4 of the SPD EIS presents the comparable impacts for key environmental resources (e.g., air quality, waste management, human health risk, and resource requirements) at Hanford and SRS for the homogenous

[42] Accidents severe enough to cause a release of plutonium involve combinations of events that are highly unlikely. Estimates and analyses presented in the SPD EIS indicate an incremental range of postulated LCFs due to the use of MOX fuel of minus 7 to plus 1,600 (in the population within 80 km [50 mi] of the release point), with incremental attendant risks of LCFs over 16 years of reactor operation with MOX fuel of minus 1.3×10^{-3} and plus 1.7×10^{-3}, respectively.

ceramic immobilization/vitrification and the can-in-canister immobilization facilities. Impacts associated with facility accidents, intersite transportation, and environmental justice are also discussed.

The comparison of impacts is based upon immobilizing the full 50 t (55 tons) of surplus plutonium. The *Storage and Disposition PEIS* impact analyses are based on operating facilities that would convert the plutonium into an oxide in one new facility and immobilize it in a homogenous ceramic or glass form in another new facility. Impacts for a plutonium conversion facility are evaluated and itemized separately from the impacts for a ceramic immobilization or vitrification facility. In contrast, the SPD EIS considers the use of both new and existing facilities, and is based upon evaluating a collocated plutonium conversion and immobilization capability. To compare the impacts, it was therefore necessary to combine the separate *Storage and Disposition PEIS* impact values, as appropriate, to establish a suitable standard of comparison.

Generally, air quality impacts associated with the ceramic or glass can-in-canister technologies would be lower or about the same as those evaluated in the *Storage and Disposition PEIS* for ceramic immobilization or vitrification. With the exception of sulfur dioxide in the ceramic can-in-canister process, all criteria pollutant concentrations associated with either can-in-canister technology would range from being the same to being much lower. Pollutant levels would not be expected to differ between the ceramic and glass can-in-canister processes.

Potential volumes of most waste types resulting from operation of either the ceramic or glass can-in-canister technologies would be considerably less than the waste volumes expected from either ceramic immobilization or vitrification technology evaluated in the *Storage and Disposition PEIS*. For example, operation of a can-in-canister facility using the ceramic process at Hanford or SRS is estimated to result in TRU waste volumes of 126 m^3/yr (165 yd^3/yr), compared to the 647 m^3/yr (846 yd^3/yr) of TRU waste estimated in the *Storage and Disposition PEIS* from operation of the homogenous ceramic immobilization facility. Factors contributing to the reduced waste levels associated with the can-in-canister technology would include the use of dry-feed preparation techniques, coordination with existing HLW vitrification operations and the need for a smaller operating work force. Waste volumes would not be expected to differ appreciably between the ceramic and glass can-in-canister processes.

Chapter 4 of the SPD EIS also presents the potential radiological exposure and cancer risk to the public and involved workers from normal operation of the immobilization facilities. The potential risks to the public associated with either can-in-canister technology would be slightly higher than the homogenous technologies at Hanford, but lower at SRS. For example, operation of a can-in-canister facility using the ceramic process at Hanford or SRS is estimated to result in population doses of 1.6×10^{-2} or 5.8×10^{-3} person-rem/yr, respectively, compared to the population doses of 8.4×10^{-3} (at Hanford) or 6.6×10^{-2} (at SRS) person-rem/yr resulting from operation of the homogenous ceramic immobilization facility evaluated in the *Storage and Disposition PEIS*. These variations may be attributable to the incorporation of updated source terms, meteorology, population distribution, and other modeling variables in the analysis of the can-in-canister technologies. A comparison between the ceramic and glass can-in-canister technologies indicates operation of the ceramic process would result in slightly higher potential offsite impacts, regardless of whether it is located at Hanford or SRS. For example, the dose associated with operation of the can-in-canister facility at Hanford would result in a population dose of 1.6×10^{-2} person-rem/yr using the ceramic process and 1.5×10^{-2} person-rem/yr using the glass process; the same facility at SRS would result in a population dose of 5.8×10^{-3} person-rem/yr using the ceramic process, and a dose of 5.3×10^{-3} person-rem/yr using the glass process.

The estimated average worker dose and associated cancer risk for the can-in-canister technologies are slightly higher than estimated in the *Storage and Disposition PEIS* for the homogenous technologies. In all cases, however, the average worker dose would be within the DOE design objective of 1,000 mrem/yr. [Text deleted.] Potential radiological impacts on involved workers are not expected to differ appreciably between the ceramic and glass can-in-canister processes.

Although some potential hazardous chemical impacts were determined for the homogenous ceramic immobilization/vitrification technologies evaluated in the *Storage and Disposition PEIS*, none are expected for either the ceramic or glass can-in-canister technology because no hazardous chemical emissions would occur from operations.

Because of substantial differences between the *Storage and Disposition PEIS* and the SPD EIS in terms of the specific accident scenarios and supporting assumptions used in the determination of facility accident impacts, a standard basis for comparing between homogenous technology and can-in-canister technology accidents is not available. For example, a design basis earthquake scenario was not evaluated in the *Storage and Disposition PEIS* for the plutonium conversion facility, nor were any other design basis accidents evaluated for that facility that could be incorporated with like impacts to the ceramic immobilization or vitrification facility for direct comparison to the accident scenarios presented in the SPD EIS. A design basis earthquake associated with the homogenous approach at Hanford would result in 5.8×10^{-8} and 3.2×10^{-6} LCF in the general population for ceramic immobilization and vitrification, respectively; a design basis earthquake affecting the same facilities at SRS would result in 6.2×10^{-8} and 3.4×10^{-6} LCF, respectively. As discussed above, these values do not reflect the impact of such accidents on a plutonium conversion facility, and are therefore not directly comparable with the results for the can-in-canister approach shown in the SPD EIS. Comparison between the ceramic and glass can-in-canister processes indicates slightly higher impacts would be associated with the ceramic process. For example, a design basis earthquake at Hanford would result in 9.6×10^{-5} LCF in the general population using the ceramic process, and 8.4×10^{-5} LCF using the glass process. Similarly, a design basis earthquake at SRS would result in 3.6×10^{-5} LCF in the general population using a ceramic process, and 3.1×10^{-5} LCF using a glass process.

In terms of resource requirements, operation of the can-in-canister technologies would require lower amounts of electricity, fuel, land area, and water than would the homogenous technologies evaluated in the *Storage and Disposition PEIS*. Fewer workers would be required to operate the can-in-canister technologies, which in turn would result in lower socioeconomic impacts. Resource requirements differ between the ceramic and glass can-in-canister processes in that electricity requirements would be greater to support the ceramic process at either site (i.e., the ceramic process would require 29,000 or 24,000 MWh/yr at Hanford or SRS, respectively, compared with the 28,500 or 23,000 MWh/yr, respectively, required for the glass process).

The *Storage and Disposition PEIS* analysis assumes that canisters of plutonium immobilized with radionuclides would be transported to a potential geologic repository via rail. The SPD EIS analyses, however, conservatively assume that the immobilized canisters would be shipped by truck from the immobilization site to the repository, with one canister being transported per truck shipment.[43] The ceramic and glass can-in-canister technologies would result in fewer total potential fatalities from intersite transportation than would the homogenous ceramic immobilization/vitrification technologies evaluated in the *Storage and Disposition PEIS*. Because the ceramic can-in-canister process would produce fewer canisters, it would result in somewhat lower routine and accidental transportation impacts than the glass can-in-canister process.

Evaluations of both the homogenous ceramic immobilization/vitrification technologies and can-in-canister technologies included routine facility operations and transportation as well as accidents. No significant risk to the general population would be expected to occur for normal operations or in the event of a design basis accident. [Text deleted.] Similarly, implementation of these technologies would not result in a significant risk of disproportionately high and adverse impacts on minority or low-income groups within the general population.

[43] The *Draft Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada* (DOE/EIS-0250D) (DOE 1999c) analyzes spent fuel shipments to a potential geologic repository by rail and truck. No decision has been made as to the mode of transportation.

S.8 CUMULATIVE IMPACTS

This section summarizes the potential cumulative impacts from operation of the proposed surplus plutonium disposition facilities. A more detailed analysis is provided in Chapter 4 of the SPD EIS. The incremental impacts of the operation of plutonium disposition facilities were added to the impacts of other past, present, and reasonably foreseeable future actions in the vicinity of the candidate sites.

Impacts from the following are considered in the cumulative impacts assessment:

- Current activities at or in the vicinity of the candidate sites
- Construction and operation of the proposed surplus plutonium disposition facilities
- Other site and offsite Federal and non-Federal activities that are reasonably foreseeable

The related programs considered in the cumulative impact assessment and the seven candidate DOE sites potentially affected are identified in Table S–3 (Section 4.32.8 of the SPD Final EIS discusses the reasonably foreseeable activities considered for the three reactor sites, which is summarized at the end of Section S.8). A bounding alternative was analyzed for each site. The bounding alternative is the alternative that involves the greatest amount of plutonium disposition construction and operation activity at the candidate site. For example, the bounding alternative for Hanford is Alternative 2, all facilities located at Hanford.

[Text deleted.]

In addition to reasonably foreseeable site activities, other activities within the region of the candidate sites were considered in the cumulative impact analysis for selected resources. Because of the distances between many of the candidate DOE sites and other existing and planned non-DOE facilities, there is little opportunity for interactions of facility emissions in terms of impacts to air quality, water quality, or waste management capacity. However, whenever possible, large source contributors have been evaluated for those impacts to human health risk and socioeconomics.

Hanford

Under Alternative 2, all three of the proposed disposition facilities would operate in the 400 Area with the pit conversion and immobilization facilities in FMEF, and a new MOX facility located nearby. In addition to the facilities proposed under Alternative 2, Hanford is being considered for lead assembly work.

Hanford would remain within its site capacity for its major resources. If Alternative 2 is implemented, the proposed surplus plutonium disposition facilities would require about 16 percent of the annual electricity used on the site and about 6 percent of the water; cumulatively, this would be about 24 percent of the site's electricity and 39 percent of the site's water capacity. The proposed activities would not be expected to contaminate the Columbia River or add to existing contamination at Hanford. The land used by these facilities would represent less than 1 percent of the developed land on the site; cumulatively, about 6 percent of the land would be used. Impacts on resource requirements were evaluated for the year 2007 (the peak year) because that would be the first full year in which all three surplus plutonium disposition facilities operate

Table S–3. Other Past, Present, and Reasonably Foreseeable Actions Considered in the Cumulative Impact Assessment for Candidate DOE Sites

Activities	Hanford	INEEL	Pantex	SRS	LLNL	LANL	ORNL
Storage and Disposition of Weapons-Usable Fissile Materials	X	X	X	X			X
Disposition of Surplus Highly Enriched Uranium				X			X
Interim Management of Nuclear Materials at SRS				X			

Activities	Hanford	INEEL	Pantex	SRS	LLNL	LANL	ORNL
[Text deleted.]							
Tritium Supply and Recycling				X			
Waste Management	X	X	X	X		X	
Spent Nuclear Fuel Management and INEL Environmental Restoration and Waste Management	X	X		X			
Foreign Research Reactor Spent Nuclear Fuel	X	X		X			
Tank Waste Remediation System	X						
Shutdown of the River Water System at SRS				X			
Radioactive releases from nuclear power plant sites, Vogtle and WNP[a]	X			X			
Hanford Reach of the Columbia River Comprehensive River Conservation Study	X						
FEIS and Environmental Information Report for Continued Operation of LLNL and SNL					X		
Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapons Components			X				
Stockpile Stewardship and Management			X	X	X		X
[Text deleted.]							
Management of Plutonium Residues and Scrub Alloy at Rocky Flats				X			
Spent Nuclear Fuel Management (SRS)				X			
DWPF Final Supplemental				X			
Supplemental EIS for In-Tank Precipitation Process Alternatives				X			
Construction and Operation of a Tritium Extraction Facility at SRS				X			
Supplement Analysis for Storing Plutonium in the Actinide Packaging and Storage Facility and Building 105–K at SRS				X			
Los Alamos Site-Wide EIS						X	
Hanford Remedial Action and Comprehensive Land Use Plan	X						
Advanced Mixed Waste Treatment Project		X					
Construction and Operation of the Spallation Neutron Source							X
Long-Term Management and Use of Depleted Uranium Hexafluoride							X

[a] NRC, 1996, *Dose Commitments Due to Radioactive Releases from Nuclear Power Plant Sites in 1992*.

Key: DWPF, Defense Waste Processing Facility; LANL, Los Alamos National Laboratory; LLNL, Lawrence Livermore National Laboratory; ORNL, Oak Ridge National Laboratory; SNL, Sandia National Laboratories; WNP, Washington Nuclear Power.

simultaneously, resulting in maximum impacts. While Hanford is also being considered for lead assembly work, lead assembly fabrication operations would be completed by 2006 and, therefore, would not contribute to the maximum impacts for the peak year (2007).

Over the life of the proposed activities, the number of LCFs in the general population from 15 years of Hanford operation would be expected to increase from 0.21 to 0.25 if all the proposed surplus plutonium disposition facilities were located there, including the addition of lead assembly work. Doses to the MEI are based on source location; summing the MEIs for each reasonably foreseeable and current activity would be both misleading and technically incorrect because the hypothetical MEI cannot be in a number of different locations simultaneously. However, to provide some comparative perspective, the hypothetical MEI for all reasonably foreseeable actions would receive an annual dose of 1.9 mrem from other site operations. This corresponds to an LCF risk from 15 years of site operation of 1.4×10^{-5}. The MEI would receive an additional 0.022 mrem/yr for a cumulative annual dose of 1.9 mrem from all activities and a corresponding risk of an LCF of 1.5×10^{-5} from 15 years of operation. The regulatory dose limits for individual members of the public are given in DOE orders and EPA and NRC regulations. The dose limit from airborne emissions is 10 mrem/yr, as required by Clean Air Act (CAA) regulations; the dose limit from drinking water is 4 mrem/yr, as required by Safe Drinking Water Act (SDWA) regulations; and the dose limit from all pathways combined is 100 mrem/yr, as given in DOE Order 5400.5 (DOE 1993) and NRC regulations (10 CFR 20). Thus, the dose to the MEI would be expected to remain well within the regulatory dose limits. Workers on the site would be expected to see an increase in the number of expected LCFs due to radiation from normal site operations over 15 years of 2.0, from about 17 to 19, if all the proposed surplus plutonium disposition activities were sited at Hanford. Doses to individual workers would be kept to minimal levels by instituting badged monitoring, administrative limits, and as-low-as-is-reasonably achievable (ALARA) programs (which would include worker rotations).

It is unlikely that there would be major impacts to the waste management infrastructure at Hanford for hazardous and nonhazardous wastes. Although a few cumulative waste volumes could exceed current storage capacities if the wastes were held in storage and not disposed of, this is not likely. Current schedules for shipment of TRU waste to WIPP indicate that TRU waste generated by the surplus plutonium disposition facilities would need to be stored on the site until 2016. Because Hanford is expected to begin shipping its existing inventory of TRU waste to WIPP in 2000, TRU waste generated by surplus plutonium disposition facilities could be stored in the space vacated by the waste shipped to WIPP. Likewise, it is unlikely that additional LLW storage capacity would be needed because this waste is routinely sent to onsite disposal. Additional mixed LLW disposal capacity could be required, but would likely be augmented by offsite commercial capacity.

Hanford is currently in compliance with all Federal, State, and local air quality regulations and guidelines, and would continue to remain in compliance even with consideration of the cumulative effects of all activities. The surplus plutonium disposition facilities' contribution to overall site concentration is extremely small. As discussed in Section 4.27.2 of the SPD EIS, incremental air pollutant concentrations from lead assembly activities at Hanford would be relatively small, with lead assembly operations completed by 2006. Thus, these emissions would not contribute to the maximum cumulative concentrations for Alternative 2.

Transportation requirements associated with Alternative 2 and the addition of lead assembly work at Hanford would include shipments to and from all of the proposed surplus plutonium disposition facilities. It is estimated that the total number of shipments to and from Hanford associated with site activities other than surplus plutonium disposition would be 416,475 truck shipments during the same timeframe the surplus plutonium disposition facilities would be built and operated. Surplus plutonium disposition activities would add 2,474 truck shipments to this estimate for a total of 418,949. The annual dose to the MEI from these shipments would be expected to increase from 1.68 mrem/yr to about 1.75 mrem/yr. This dose corresponds to an LCF risk from 15 years of transportation of 1.3×10^{-5} and would not represent a significant risk to the public.

INEEL

For INEEL, the bounding alternative for the SPD EIS would be Alternative 7. This alternative calls for the siting of the pit conversion facility in the Fuel Processing Facility and a new MOX facility located nearby. In addition to the facilities proposed under Alternative 7, INEEL is also being considered for lead assembly and postirradiation examination activities.

INEEL would remain within its site capacity for all major resources. If Alternative 7 were implemented at INEEL, the proposed surplus plutonium disposition facilities would require about 13 percent of the annual electricity used on the site and about 2 percent of the water; cumulatively, about 89 percent of the site's electric and 14 percent of the site's water capacity would be used. The land used by these facilities would represent less than 1 percent of the developed land on the site; cumulatively, about 2 percent of the land would be used. Impacts on resource requirements were evaluated for the year 2007 (peak year) because that would be the first full year in which both surplus plutonium disposition facilities operate simultaneously, resulting in maximum impacts. While ANL–W is being considered for lead assembly work, lead assembly fabrication operations would be completed by 2006 and, therefore, would not contribute to the maximum impacts for the peak year (2007). As a candidate for conducting postirradiation examination work, postirradiation examination activities at ANL–W would occur over the timeframe 2006–2009 and concurrently with the startup of surplus plutonium disposition activities. However, there would be no additional cumulative impacts on resource requirements (i.e., employment, electricity, water, land) associated with operation of the postirradiation examination facility at ANL–W, as these activities are routinely conducted at the site with the required infrastructure and workforce already in place.

Over the life of the proposed activities, the number of LCFs in the general population from 15 years of INEEL site operation would be expected to increase from 0.0040 to 0.015 if the proposed surplus plutonium disposition facilities were located there as described in Alternative 7, including the addition of lead assembly and postirradiation examination work. The MEI would receive an annual dose of 0.23 mrem from other site operations. This corresponds to an LCF risk from 15 years of site operation of 1.7×10^{-6}. The MEI would receive an additional 0.018 mrem/yr, for a cumulative annual dose from all activities of 0.25 mrem and a corresponding risk of an LCF of 1.9×10^{-6} from 15 years of operation. The regulatory dose limits for individual members of the public are given in DOE orders and EPA and NRC regulations. The dose limit from airborne emissions is 10 mrem/yr, as required by CAA regulations; the dose limit from drinking water is 4 mrem/yr, as required by SDWA regulations; and the dose limit from all pathways combined is 100 mrem/yr, as given in DOE Order 5400.5 (DOE 1993) and NRC regulations (10 CFR 20). Thus, the dose to the MEI would be expected to remain well within the regulatory dose limits. Workers on the site would be expected to see an increase in the number of expected LCFs due to radiation from normal site operations over 15 years of 0.80, from about 1.2 to 2.0, if the pit conversion and MOX facilities were sited at INEEL and lead assembly and postirradiation examination activities were also conducted at the site. Doses to individual workers would be kept to minimal levels by instituting badged monitoring, administrative limits, and ALARA programs (which would include worker rotations).

It is unlikely that there would be major impacts to the waste management infrastructure at INEEL because sufficient capacity should exist to manage the wastes that could be generated by planned activities. [Text deleted.]

INEEL is currently in compliance with all Federal, State, and local air quality regulations and guidelines, and would continue to remain in compliance even with consideration of the cumulative effects of all activities. The surplus plutonium disposition facilities' contribution to overall site concentration would be extremely small. As discussed in Section 4.27.1 of the SPD EIS, incremental air pollutant concentrations from lead assembly activities at ANL–W would be relatively small, with lead assembly operations completed by 2006. Thus, these emissions would not contribute to the maximum cumulative concentrations for Alternative 7. In addition, should the

postirradiation examination facility be located at ANL–W, there would also be no additional cumulative impact on air pollutant concentrations as these activities are routinely conducted at the site.

Transportation requirements associated with Alternative 7 and the addition of lead assembly and postirradiation examination work at INEEL would include shipments to and from the proposed facilities. It is estimated that the total number of shipments to and from INEEL associated with site activities other than surplus plutonium disposition would be 59,373 truck shipments during the approximately 15-year timeframe the surplus plutonium disposition facilities would be built and operated. Surplus plutonium disposition activities would add 2,565 truck shipments to this estimate for a total of 61,938. The annual dose to the MEI from these shipments would be expected to increase from 1.05 mrem/yr to about 1.12 mrem/yr. This dose corresponds to an LCF risk from 15 years of transportation of 8.4×10^{-6}, which does not significantly increase the risk to the public.

Pantex

For Pantex, the bounding alternative for the SPD EIS would be Alternative 9. This alternative calls for the siting of the new pit conversion and MOX facilities in Zone 4 West.

Pantex would remain within its site capacity for all major resources. If Alternative 9 is implemented, the proposed surplus plutonium disposition facilities would require about 25 percent of the annual electricity used on the site and about 10 percent of the water; cumulatively, this would require about 43 percent of the site's electric and 30 percent of the site's water. For comparison, the estimated maximum cumulative water usage of 1,133 million l/yr (299.3 million gal/yr) would be less than 5 percent of the 23.6 billion l (6.2 billion gal) of water pumped from the Carson County well fields by the city of Amarillo in 1995, and about 1 percent of the 101 billion l (26.7 billion gal) of water applied for irrigation in Carson County in 1995. The land used by these facilities would represent 1 percent of the developed land on the site; cumulatively, about 23 percent of the land would be developed. Impacts on resource requirements were evaluated for the year 2007 (the peak year) because that would be the first full year in which both surplus plutonium disposition facilities operate simultaneously, resulting in maximum impacts.

Over the life of the proposed activities, the number of LCFs in the general population from 15 years of Pantex site operation would be expected to increase from 5.6×10^{-5} to 3.1×10^{-3} if the proposed surplus plutonium disposition facilities were located there as described in Alternative 9. The hypothetical MEI for all reasonably foreseeable actions would receive an annual dose of 7.4×10^{-4} mrem, which corresponds to an LCF risk from 15 years of site operation of 5.5×10^{-9}. The MEI for Alternative 9 would receive an additional 0.077 mrem/yr, for a cumulative annual dose from all activities of 0.078 mrem and a corresponding risk of an LCF of 5.8×10^{-7} from 15 years of operation. The regulatory dose limits for individual members of the public are given in DOE orders and EPA and NRC regulations. The dose limit from airborne emissions is 10 mrem/yr, as required by CAA regulations; the dose limit from drinking water is 4 mrem/yr, as required by SDWA regulations; and the dose limit from all pathways combined is 100 mrem/yr, as given in DOE Order 5400.5 (DOE 1993) and NRC regulations (10 CFR 20). Thus, the dose to the MEI would be expected to remain well within the regulatory limits. Workers on the site would be expected to see an increase in the number of expected LCFs due to radiation from normal site operations over 15 years of 0.86, from about 0.48 to 1.3, if the pit conversion and MOX facilities were sited at Pantex. Doses to individual workers would be kept to minimal levels by instituting badged monitoring, administrative limits, and ALARA programs (which would include worker rotations).

Because there is not any TRU waste currently stored at Pantex, space for storage of TRU waste would be provided within the new surplus plutonium disposition facility. It is unlikely that additional LLW or hazardous waste storage capacity would be needed at Pantex because those wastes are routinely sent to offsite disposal.

Pantex is currently in compliance with all Federal, State, and local air quality regulations and guidelines, and would continue to remain in compliance even with consideration of the cumulative effects of all activities. The surplus plutonium disposition facilities' contribution to overall site concentrations would be extremely small.

Transportation requirements associated with Alternative 9 at Pantex would include shipments to and from the proposed pit conversion and MOX facilities. It is estimated that the total number of shipments to and from Pantex associated with site activities other than surplus plutonium disposition would be 5,460 truck shipments during the approximately 15-year timeframe the surplus plutonium disposition facilities would be built and operated. Alternative 9 would add 2,000 truck shipments to this estimate for a total of 7,460. The annual dose to the MEI from these shipments would be expected to increase from 0.97 mrem/yr to about 1.0 mrem/yr. This dose corresponds to an LCF risk from 15 years of transportation of 7.7×10^{-6}, which does not significantly increase the risk to the public.

SRS

For SRS, the bounding alternative for the SPD EIS would be Alternative 3. Alternative 3 calls for the siting of new pit conversion, immobilization, and MOX facilities near APSF in F-Area, if built. [Text deleted.] SRS is also being considered as a possible lead assembly site.

If Alternative 3 is implemented, the proposed surplus plutonium disposition facilities would require about 9 percent of the annual electricity used on the site and about 3 percent of the water; cumulatively, about 14 percent of the site's electricity and 74 percent of the water would be used. The land used by these facilities would represent less than 1 percent of the developed land on the site; cumulatively, about 9 percent of the land would be used. Impacts on resource requirements were evaluated for the year 2007 because that would be the first full year in which all three surplus plutonium disposition facilities operate simultaneously, resulting in maximum impacts. While SRS is being considered for lead assembly work, lead assembly fabrication operations would be completed by 2006 and, therefore, would not contribute to the maximum impacts for the peak year (2007).

Over the life of the proposed activities, the number of LCFs in the general population from 15 years of SRS operation would be expected to increase from 0.34 to 0.35 if the proposed surplus plutonium disposition facilities were located there as described in Alternative 3, including the addition of lead assembly work. The hypothetical MEI for all reasonably foreseeable actions would receive an annual dose of 1.1 mrem. This corresponds to an LCF risk from 15 years of site operation of 7.9×10^{-6}. The MEI would receive a maximum additional dose of 0.0074 mrem/yr for a cumulative annual dose from all activities, which rounds to 1.1 mrem, and a corresponding risk of an LCF of 8.0×10^{-6} from 15 years of operation. The regulatory dose limits for individual members of the public are given in DOE orders and EPA and NRC regulations. The dose limit from airborne emissions is 10 mrem/yr, as required by CAA regulations; the dose limit from drinking water is 4 mrem/yr, as required by the SDWA regulations; and the dose limit from all pathways combined is 100 mrem/yr, as given in DOE Order 5400.5 (DOE 1993) and NRC regulations (10 CFR 20). Thus, the dose to the MEI would be expected to remain well within the regulatory dose limits. Workers on the site would be expected to see an increase in the number of expected LCFs due to radiation from normal site operations over 15 years of 1.9, from about 2.9 to 4.8, if all the proposed surplus plutonium disposition activities were sited at SRS. Doses to individual workers would be kept to minimal levels by instituting badged monitoring, administrative limits, and ALARA programs (which would include worker rotations).

It is unlikely that there would be major impacts to the waste management infrastructure at SRS for TRU waste and nonhazardous waste. Although the cumulative waste volume for hazardous waste could exceed the storage capacity, it is unlikely that there would be major impacts on the waste management infrastructure at SRS because hazardous waste is generally not held in long-term storage and is disposed of in offsite facilities. [Text deleted.]

Likewise, it is unlikely that additional LLW storage capacity would be needed because this waste is routinely sent to onsite disposal.

SRS is currently in compliance with all Federal, State, and local air quality regulations and guidelines, and would continue to remain in compliance as a result of the cumulative effects of all activities. The surplus plutonium disposition facilities' contribution to overall site concentrations is extremely small. As discussed in Section 4.27.5 of the SPD EIS, incremental air pollutant concentrations from lead assembly activities at SRS would be relatively small, with lead assembly operations completed by 2006. Thus, these emissions would not contribute to the maximum cumulative concentrations for Alternative 3.

Transportation requirements associated with Alternative 3 and the addition of lead assembly work at SRS would include shipments to and from all of the proposed surplus plutonium disposition facilities. The total number of shipments to and from SRS associated with site activities other than surplus plutonium disposition would be 115,187 truck shipments during the approximately 15-year timeframe in which the surplus plutonium disposition facilities would be built and operated. Surplus plutonium disposition activities would add 2,557 truck shipments to this estimate for a total of 117,744. The annual dose to the MEI from these shipments would be expected to increase from 0.59 mrem/yr to about 0.66 mrem/yr. This dose corresponds to an LCF risk from 15 years of transportation of 4.9×10^{-6}, which does not represent a significant increase in risk to the public.

LLNL

The baseline for LLNL includes activities connected to the operation of the National Ignition Facility and the continued operation of the laboratory. Lead assembly alternative impacts discussed in the SPD Final EIS provide bounding conditions for the assessment of cumulative impacts from potential plutonium disposition activities at LLNL. Cumulative impacts have been assessed for the 5-year period, 2001–2005, which represents the time needed to modify facilities to conduct the proposed lead assembly work.

There would be no increase in site employment at LLNL due to surplus plutonium disposition activities as it is expected that existing employees would be used to perform lead assembly tasks. Proposed activities would require less than 1 percent of the annual electricity used on the site and less than 1 percent of the water used annually. Cumulatively, 40 percent of the available electricity and 31 percent of the available water would be used by the laboratory. No change in land development would be required due to lead assembly activities. Impacts on resource requirements were evaluated for the year 2003 because that would be the first full year of lead assembly activities, resulting in maximum impacts.

Over the life of the proposed activities, the cumulative LCFs in the general population from 5 years of LLNL operation would be expected to increase from 0.0045 from other site activities to 0.0062 from the addition of lead assembly activities. The hypothetical MEI for all reasonably foreseeable activities would receive an annual dose of 1.4 mrem, which corresponds to an LCF risk from 5 years of site activities of 3.5×10^{-6}. The MEI for the lead assembly alternative at LLNL would receive an additional annual dose of 0.064 mrem, for a cumulative annual dose of approximately 1.5 mrem, which results in a corresponding risk of an LCF of 3.7×10^{-6}. The regulatory limits for individual members of the public are given in DOE orders and EPA regulations. The dose limit from airborne emissions is 10 mrem/yr, as required by CAA regulations; the dose limit from drinking water is 4 mrem/yr, as required by SDWA regulations; and the dose limit from all pathways is 100 mrem/yr, as given in DOE Order 5400.5 (DOE 1993). Thus, the dose to the MEI would be expected to remain well within the regulatory dose limits. Workers on the site would be expected to see little increase in the number of expected LCFs due to radiation from lead assembly activities, 0.034, making the laboratory's total expected LCFs for the period of the proposed activities 0.088. Doses to individual workers would be kept to minimal levels by instituting badged monitoring, administrative limits, and ALARA programs (which would include worker rotations).

Although some of the cumulative waste volumes could exceed current storage capacities if the wastes were held in storage and not disposed, this is not likely. Wastes are routinely shipped for offsite disposal. In the case of LLW, LLNL ships waste to the Nevada Test Site. Mixed waste would be treated and disposed of in accordance with the LLNL Site Treatment Plan. Hazardous waste would be packaged and shipped off the site to RCRA-permitted treatment, storage, and disposal facilities.

LLNL is currently in compliance with applicable Federal, State, and local regulations and guidelines, with the exception of the 1-hr average nitrogen oxides concentration. The 1-hr standard for ozone may be exceeded on occasion, as indicated by the ozone nonattainment designation for the San Francisco Bay Area Air Quality Management District. Nitrogen oxides and hydrocarbons are precursors in the formation of ozone. Reductions in nitrogen oxide emissions along with a reduction in hydrocarbon emissions can result in a reduction in peak ozone concentrations. Since the production of ozone takes place over a period of time in the presence of sunlight, it is a regional issue and elevated localized concentrations of precursor pollutants do not necessarily correspond to elevated ozone concentrations and exceedances of the ozone standard. Lead assembly activities' contribution to overall site concentrations is extremely small.

Transportation requirements associated with lead assembly activities at LLNL would include shipments of uranium dioxide from a uranium conversion facility to LLNL and shipments of MOX fuel assemblies from LLNL to McGuire for irradiation. The total number of offsite shipments to and from LLNL associated with site activities other than surplus plutonium disposition during the 5-year period of the lead assembly program is estimated to be 2,228. The lead assembly activities proposed for LLNL would add an additional 71 trips to this estimate for a total of 2,299. The annual dose to the MEI from these shipments would be expected to increase from 0.17 mrem/yr to about 0.20 mrem/yr. This dose corresponds to an LCF risk from 5 years of transportation of 5.1×10^{-7}, which would only slightly increase the risk to the public.

LANL

The baseline for LANL includes activities connected to the extended operation of the laboratory. Lead assembly alternative impacts discussed in the SPD Final EIS provide bounding conditions for the assessment of cumulative impacts from potential plutonium disposition activities at LANL. Cumulative impacts have been assessed for the 5-year period, 2001–2005, which represents the time needed to modify facilities to conduct the proposed lead assembly work.

There would be no increase in site employment at LANL due to plutonium disposition activities as it is expected that existing employees would be used to perform lead assembly tasks. The electric power system that serves LANL is near capacity and future projections indicate that electricity demand will exceed capacity. Consideration of options to increase system capacity is complicated by the fact that the systems for major power users in the region are also nearing capacity and demand from these users is also projected to exceed capacity. No specific proposals to rectify this situation have been fully developed. Water use is projected to remain within existing water rights, and no reduction in the discharge volume from springs in the area is foreseen. Lead assembly activities would require less than 1 percent of the annual electricity used on the site and less than 1 percent of the water used annually. Cumulatively, the laboratory would require 157 percent of the available electricity and 96 percent of the available water. Changes to the current overall land-use categories are not expected, with the exception of a change to the land-use designation at TA–67 if that site is chosen for the development of a new LLW disposal facility. Impacts on resource requirements were evaluated for the year 2003 because that would be the first full year of lead assembly activities, resulting in maximum impacts. Doses to individual workers would be kept to minimal levels by instituting badged monitoring, administrative limits, and ALARA programs (which would include worker rotations).

Over the life of the proposed activities, the number of LCFs in the general population from 5 years of LANL operation would not be expected to increase from 0.08 due to lead assembly activities. Thus, no additional LCFs would be expected as a result of these activities. The hypothetical MEI for all reasonably foreseeable activities would receive an annual dose of 5.44 mrem, which corresponds to an LCF risk from 5 years of site activities of 1.4×10^{-5}. The MEI for the lead assembly alternative at LANL would receive an additional annual dose of 0.027 mrem for a cumulative annual dose of 5.47 mrem, which results in a corresponding risk of an LCF of 1.4×10^{-5}. The regulatory limits for individual members of the public are given in DOE orders and EPA regulations. The dose limit from airborne emissions is 10 mrem/yr, as required by CAA regulations; dose limit from drinking water is 4 mrem/yr, as required by SDWA regulations; and the dose limit from all pathways is 100 mrem/yr, as given in DOE Order 5400.5 (DOE 1993). Thus, the dose to the MEI would be expected to remain well within the regulatory dose limits. Workers on the site would be expected to see little increase in the number of expected LCFs due to radiation from lead assembly activities, 0.04, leaving the laboratory's total expected LCFs among the workforce at 1.7 for the period of the proposed activities.

Although some of the cumulative waste volumes could exceed current treatment and storage capacities, this is not likely. Wastes are routinely disposed of on the site or shipped for offsite disposal. Hazardous waste would be packaged and shipped off the site to RCRA-permitted treatment and disposal facilities. Mixed waste would be treated and disposed of in accordance with the LANL site treatment plan. Most LLW would be disposed of on the site without the need for treatment or long-term storage. Alternatives have been evaluated in the LANL Site-Wide EIS for expanding LLW disposal capabilities on the site or shipping LLW for offsite disposal.

LANL is currently in compliance with all Federal, State, and local regulations and guidelines, and would continue to remain in compliance with all projected cumulative activities. Lead assembly activities' contribution to overall site air polluntant concentrations is extremely small.

Transportation requirements associated with lead assembly activities at LANL would include shipments of uranium dioxide from a uranium conversion facility to LANL and shipments of MOX fuel assemblies from LANL to McGuire for irradiation. The total number of offsite hazardous and radioactive material shipments to and from LANL associated with site activities other than surplus plutonium disposition during the 5-year period of the lead assembly program is estimated to be 17,630. The lead assembly activities proposed for LANL would add an additional 15 trips to this estimate for a total of 17,645. The annual dose to the MEI from these shipments would be expected to increase from 0.38 mrem/yr to about 0.39 mrem/yr. This dose corresponds to an LCF risk from 5 years of transportation of 9.5×10^{-7}, which would only slightly increase the risk to the public.

ORNL

The baseline for ORNL includes those activities connected to operation of the Spallation Neutron Source as detailed in the *Final Environmental Impact Statement, Construction and Operation of the Spallation Neutron Source* (DOE 1999e) and continued operation of the laboratory. Postirradiation examination alternative impacts discussed in the SPD Final EIS provide bounding conditions for the assessment of cumulative impacts from potential surplus plutonium disposition activities at ORNL. Cumulative impacts have been assessed for the 3-year period, 2006–2009, which represents the time during which proposed postirradiation examination activities would be conducted.

There would be no additional cumulative impacts on resource requirements (i.e., employment, electricity, water, land) and air quality associated with the normal operation of the postirradiation examination facility at ORNL, as these activities are routinely conducted at the site.

Over the life of the proposed activities, the number of LCFs in the general population from 3 years of ORNL operation would not be expected to increase from 0.029 as a result of the addition of postirradiation examination.

It is not expected that any discernable radiological impacts on the public would be incurred from postirradiation examination activities at ORNL because all the work would be accomplished in heavily shielded hot cells that are built specifically to contain radiation, thereby protecting workers and the public from potential radioactive emissions. Thus, no additional LCFs would be expected as a result of these activities. The hypothetical MEI for all reasonably foreseeable activities would receive an annual dose of about 3.2 mrem, which corresponds to an LCF risk of 4.8×10^{-6} from 3 years of site activities. The MEI would not be expected to receive any additional dose from postirradiation examination activities. The regulatory limits for individual members of the public are given in DOE orders and EPA regulations. The dose limit from airborne emissions is 10 mrem/yr, as required by CAA regulations; the dose limit from drinking water is 4 mrem/yr, as required by SDWA regulations; and the dose limit from all pathways is 100 mrem/yr, as given in DOE Order 5400.5 (DOE 1993). Thus, the dose to the MEI would continue to remain well within the regulatory dose limits. Workers on the site would be expected to see a slight increase in the number of expected LCFs due to radiation from postirradiation examination activities, 0.002, making ORNL's total expected LCFs for the period of the proposed activities 0.13. Doses to individual workers would be kept to minimal levels by instituting badged monitoring, administrative limits, and ALARA programs (which would include worker rotations).

Although some of the LLW and hazardous cumulative waste volumes could exceed current treatment and storage capacities, this is not likely. Additional LLW treatment or storage capacity should not be needed because most LLW would be disposed of off the site, as is the current practice, without the need for treatment or long-term storage. In addition, it is unlikely that further hazardous waste treatment or storage capacity would be needed because these wastes are routinely sent off the site for treatment and disposal.

Transportation requirements associated with postirradiation examination activities at ORNL would include shipments of MOX spent fuel assemblies to ORNL. The total number of offsite hazardous and radioactive material shipments to and from ORNL associated with site activities other than surplus plutonium disposition during the 3-year period of the lead assembly program is estimated to be 24,385. The lead assembly work proposed for LANL would add an additional 8 trips to this estimate for a total of 24,393. The annual dose to the MEI from these shipments would not be expected to increase from 4.4 mrem/yr, which corresponds to an LCF risk from 3 years of transportation of 6.6×10^{-6}.

Reactor Sites (Catawba, McGuire, and North Anna)

Reasonably foreseeable future activities in the areas around Catawba, McGuire, and North Anna that could contribute to cumulative impacts include the potential for continued new home and road development. Activities near Catawba include the widening of the Buster Boyd Bridge on Highway 49 and the widening of a 27-km (17-mi) stretch of Interstate 77 from just south of Rock Hill north to Carowinds. In addition, the extension of water and sewer service in and around the area of the Catawba reactors is planned, along with a 4,000-home development on Highway 49 on the North Carolina side of Lake Wylie. Reasonably foreseeable future activities near McGuire include a 1,500-home development on Mountain Island Lake downstream from Lake Norman. In the areas around North Anna, residential development may include a 540-home subdivision with a golf course, although this project has been on hold since the late 1980s. In addition, Old Dominion Electric is considering building a 300- to 450-MW gas-fired generating station in Louisa County, although other sites are also being considered (Apter 1999).

Only minor modifications would be needed to accommodate using a partial MOX fuel core in place of a 100 percent LEU fuel core at the Catawba, McGuire, and North Anna reactors. Therefore, construction is expected to produce little or no impacts that could add to cumulative effects at these sites.

Normal operations using MOX fuel in place of LEU fuel at the Catawba, McGuire, and North Anna reactors are expected to produce little or no additional impacts at these sites. During normal operations with a partial MOX

fuel core, air and water emissions, waste generation, employment, land use, resource requirements, and utility usage are not expected to change appreciably from those experienced when using a full LEU core. Therefore, impacts related to resource requirements, air quality, waste management, and human health risk are not expected to change from current operations.

Transportation of MOX fuel to the reactors would be in place of a portion of the LEU fuel normally transported to the reactors. Transport of fresh MOX fuel to the reactors is likely to produce minimal additional impacts over the transport of LEU fuel.

Because the contributions to adverse effects of the proposed action would be extremely small, it is expected that activities associated with the proposed action would not exacerbate cumulative effects.

S.9 REFERENCES

Apter, R., 1999, Duke Engineering, Charlotte, NC, personal communication to B. Stevenson, U.S. Department of Energy, Office of Fissile Materials Disposition, Washington, DC, *Reactor Site Development Specifics*, September 20.

DOE (U.S. Department of Energy), 1993, *Radiation Protection of the Public and the Environment*, DOE Order 5400.5, Office of Environment, Safety and Health, January 7.

DOE (U.S. Department of Energy), 1996a, *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement*, DOE/EIS-0229, Office of Fissile Materials Disposition, Washington, DC, December.

DOE (U.S. Department of Energy), 1996b, *Disposition of Surplus Highly Enriched Uranium Final Environmental Impact Statement*, DOE/EIS-0240, Office of Fissile Materials Disposition, Washington, DC, June.

DOE (U.S. Department of Energy), 1996c, *Record of Decision for the Disposition of Surplus Highly Enriched Uranium Final Environmental Impact Statement*, 61 FR 40619, Office of the Federal Register, Washington, DC, August 5.

DOE (U.S. Department of Energy), 1997a, *Record of Decision for the Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement*, 62 FR 3014, Office of the Federal Register, Washington, DC, January 14.

DOE (U.S. Department of Energy), 1997b, *Notice of Intent to Prepare a Surplus Plutonium Disposition Environmental Impact Statement*, 62 FR 28009, Office of the Federal Register, Washington, DC, May 22.

DOE (U.S. Department of Energy), 1997c, *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste*, DOE/EIS-0200-F, Office of Environmental Management, Washington, DC, May.

DOE (U.S. Department of Energy), 1998a, *Cost Analysis in Support of Site Selection for Surplus Weapons-Usable Plutonium Disposition*, rev. 0, DOE/MD-0009, Office of Fissile Materials Disposition, Washington, DC, July 22.

DOE (U.S. Department of Energy), 1998b, *Pit Disassembly and Conversion Demonstration Environmental Assessment and Research and Development Activities*, DOE/EA-1207, Office of Fissile Materials Disposition, Washington, DC, August.

DOE (U.S. Department of Energy), 1998c, *Supplement Analysis for: Final Environmental Impact Statement for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components—AL–R8 Sealed Insert Container*, Albuquerque Operations Office, Amarillo Area Office, Amarillo, TX, August.

DOE (U.S. Department of Energy), 1999a, *Environmental Assessment for the Parallex Project Fuel Manufacture and Shipment*, DOE/EA-1216, Office of Fissile Materials Disposition, Washington, DC, January.

DOE (U.S. Department of Energy), 1999b, *Plutonium Disposition Life-Cycle Costs and Cost-Related Comment Resolution Document*, MD-0013, Office of Fissile Materials Disposition, Washington, DC, November.

DOE (U.S. Department of Energy), 1999c, *Draft Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada*, DOE/EIS-0250D, Office of Civilian Radioactive Waste Management, North Las Vegas, NV, July.

DOE (U.S. Department of Energy), 1999d, *MOX Fuel Fabrication Facility and Nuclear Power Reactor Data Report*, MD-0015, Office of Fissile Materials Disposition, Washington, DC, August.

DOE (U.S. Department of Energy), 1999e, *Final Environmental Impact Statement, Construction and Operation of the Spallation Neutron Source*, DOE/EIS-0247, Office of Science, Germantown, MD, April.

NAS (National Academy of Sciences and National Research Council), 1995, *Management and Disposition of Excess Weapons Plutonium, Reactor-Related Options*, National Academy Press, Washington, DC.

[Text deleted.]

NRC (U.S. Nuclear Regulatory Commission), 1996x, *Dose Commitments Due to Radioactive Releases from Nuclear Power Plant Sites in 1992*, NUREG/CR-2850, PNL–4221, vol. 14, Washington, DC, March.

Paperiello, C.J., 1999, U.S. Nuclear Regulatory Commission, Office of Nuclear Material Safety and Safeguards, Washington, DC, personal communication (letter) to L. Barrett, U.S. Department of Energy, Office of Civilian Radioactive Waste Management, Washington, DC, *U.S. Department of Energy Plans for Disposal of Surplus Weapons Plutonium*, January 25.

SRARP (Savannah River Archaeological Research Program), 1989, *Archaeological Resource Management Plan of the Savannah River Archaeological Research Program*, South Carolina Institute of Archaeology and Anthropology, University of South Carolina, Columbia, SC, December.

White, V.S., 1997, *Initial Data Report in Response to the Surplus Plutonium Disposition Environmental Impact Statement Data Call for the UO_2 Supply*, rev. 1, ORNL/TM-13466, Lockheed Martin Energy Research Corporation, Oak Ridge, TN, November.

White House, 1993, *Nonproliferation and Export Control Policy*, Office of the Press Secretary, Washington, DC, September 27.

White House, 1994, *Joint Statement by the President of the Russian Federation and the President of the United States of America on Non-Proliferation of Weapons of Mass Destruction and the Means of Their Delivery*, Office of the Press Secretary, Washington, DC, January 14.