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Changes Needed To The Surplus Plutonium Disposition Program

SUPPLEMENT ANALYSIS
AND
AMENDED RECORD OF DECISION

U.S. Department of Energy
National Nuclear Security Administration
Office of Fissile Materials Disposition
Washington, D.C.

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List of Acronyms

AFS	alternate feedstock
CFR	Code of Federal Regulations
DOE	U.S. Department of Energy
EIS	environmental impact statement
ERPG	Emergency Response Planning Guideline
ER	Environmental Report
FR	Federal Register
HEPA	high-efficiency particulate air (filter)
LCF	latent cancer fatality
LLW	low-level radioactive waste
MAR	material at risk
MOX	mixed oxide
MOX CAR	*Mixed Oxide Fuel Fabrication Facility Construction Authorization Request*
MOX ER	*Mixed Oxide Fuel Fabrication Facility Environmental Report*
NEPA	National Environmental Policy Act
NNSA	National Nuclear Security Administration
NRC	U.S. Nuclear Regulatory Commission
PEIS	programmatic environmental impact statement
RFETS	Rocky Flats Environmental Technology Site
ROD	Record of Decision
SA	supplement analysis
SCDHEC	South Carolina Department of Health and Environmental Control
SEIS	Supplemental Environmental Impact Statement
SPD EIS	*Surplus Plutonium Disposition Environmental Impact Statement*
SRS	Savannah River Site
TEEL	Temporary Emergency Exposure Limits
TRU	transuranic
WIPP	Waste Isolation Pilot Plant

Units of Measure

µCi	microcurie
µg	microgram
µm	micrometer
Bq	Becquerel
Ci	curie
dBA	decibel A-weighted
ft	foot
ft^2	square foot
g	gram
gal	gallon
kg	kilogram
l	liter
m	meter
m^3	cubic meter
mg	milligram
mi	mile
mi^2	square mile
mm	millimeter
mrem	millirem
MT	metric ton
MWh	megawatt-hour
ppm	parts per million
rem	roentgen equivalent man
sec	second
yd^3	cubic yard
yr	year

Chapter 1
Introduction

On April 19, 2002, the U.S. Department of Energy/National Nuclear Security Administration (DOE/NNSA) issued an amended Record of Decision (ROD) (67 *Federal Register* [FR] 19432) for the *Surplus Plutonium Disposition Environmental Impact Statement* (SPD EIS) (DOE/EIS-0283, November 1999) and the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (*Storage and Disposition PEIS*) (DOE/EIS-0229, December 1996). This ROD cancelled the immobilization component of the U.S. surplus plutonium disposition program for surplus weapons-usable[1] (weapons-grade[2] and non-weapons-grade) plutonium described in the two EISs, and selected the alternative of immediate implementation of consolidated long-term storage at the Savannah River Site (SRS) of surplus non-pit plutonium now stored separately at the Rocky Flats Environmental Technology Site (RFETS). The ROD also explained that DOE's current disposition strategy involves a mixed oxide (MOX)-only approach, under which DOE would dispose of up to 34 metric tons (MT) of surplus plutonium by converting it to MOX fuel and irradiating it in nuclear power reactors. The ROD indicated that the 34-MT disposition program would implement the September 2000 *Agreement Between the Government of the United States and the Government of the Russian Federation Concerning the Management and Disposition of Plutonium Designated as No Longer Required for Defense Purposes and Related Cooperation* (U.S.–Russia Agreement). The ROD further indicated that no final decisions would be made with respect to the MOX portion of the revised disposition program until DOE completes further analysis pursuant to the National Environmental Policy Act (NEPA).

This Supplement Analysis (SA), the aforementioned additional NEPA analysis, is being prepared in accordance with Council on Environmental Quality and DOE regulations implementing NEPA. Council on Environmental Quality regulations at Title 40, Section 1502.9(c) of the Code of Federal Regulations (40 CFR 1502.9[c]) require Federal agencies to prepare a supplement to an EIS when an agency makes substantial changes in the proposed action that are relevant to environmental concerns or there are significant new circumstances or information relevant to environmental concerns and bearing on the proposed action or its impacts. DOE regulations at 10 CFR 1021.314(c) direct that when it is unclear whether a supplement to an EIS is required, an SA be prepared to assist in making that determination. This SA addresses changes in the surplus plutonium disposition program that are pertinent to deciding whether in light of proposed changes to the MOX portion of the disposition program the SPD EIS should be supplemented, a new EIS should be prepared, or no further NEPA documentation is necessary. As described herein, DOE/NNSA has concluded that the environmental impacts associated with the changes needed for the revised program are not significant, and therefore that no supplemental EIS is necessary.

[1] Weapons-usable plutonium is plutonium in forms (e.g., metals or oxides) that can be readily converted for use in nuclear weapons. Weapons-grade, fuel-grade, and power-reactor-grade plutonium are all weapons-usable.

[2] Weapons-grade plutonium is plutonium with an isotopic ratio of plutonium-240 to plutonium-239 of no more than 0.10.

1.1 BACKGROUND

The Office of Fissile Materials Disposition, now part of DOE/NNSA, has prepared a number of NEPA documents regarding the surplus plutonium disposition program. The *Storage and Disposition PEIS* evaluated the potential environmental consequences of alternative strategies for the long-term storage of weapons-usable plutonium and highly enriched uranium and the disposition of weapons-usable plutonium that has been or may be declared surplus to national security needs. The ROD for the *Storage and Disposition PEIS*, issued on January 21, 1997 (62 FR 3014), outlines DOE's decision to pursue a hybrid disposition strategy that allows for both the immobilization of some (and potentially all) of the surplus plutonium and the use of some of the surplus plutonium as MOX fuel in existing domestic, commercial reactors.

The SPD EIS, which tiered from the *Storage and Disposition PEIS*, evaluates site-specific alternatives for the construction and operation of as many as three facilities to disposition up to 50 MT[3] of surplus plutonium. The ROD for the SPD EIS, issued on January 11, 2000 (65 FR 1608), affirmed DOE's decision to implement a hybrid approach for the safe and secure disposition of up to 50 MT of surplus plutonium. Clean metals and oxides were identified as feed for the MOX facility. Impure metals, plutonium alloys, impure oxides, uranium/plutonium oxides, alloy reactor fuel, and oxide reactor fuel were identified to be immobilized. As part of this decision, SRS was selected as the site for construction and operation of the three disposition facilities: the pit disassembly and conversion facility, the MOX fuel fabrication facility (MOX facility), and the plutonium conversion and immobilization facility (immobilization facility).

The *Storage and Disposition PEIS* ROD noted that "the timing and extent to which either or both of these disposition approaches (immobilization or MOX) are ultimately deployed will depend upon the results of future technology development and demonstrations, follow-on (tiered) site-specific environmental review, contract negotiations, and detailed cost review, as well as nonproliferation considerations, and agreements with Russia and other nations." In 2001, the schedule for design, construction, and operation of the immobilization facility was delayed due to budgetary constraints. In April 2002, DOE/NNSA issued the amended ROD canceling the immobilization program and indicating that additional NEPA analyses would be conducted before decisions were made on changes to the MOX portion of the disposition program under which additional plutonium, including some of the plutonium previously destined for immobilization, would be fabricated into MOX fuel.

1.2 PROPOSED CHANGES TO THE SURPLUS PLUTONIUM DISPOSITION PROGRAM

As a result of the April 19, 2002 amended ROD, DOE's surplus plutonium disposition program is smaller than the program analyzed in the SPD EIS in two respects. First, the SPD EIS analyzed a program for the disposition of up to 50 MT of surplus plutonium, whereas the current program extends only to the 34 MT needed to implement the U.S.–Russia Agreement.[4] Second,

[3] This amount (50 MT) accommodates the potential declaration of additional surplus plutonium in the future. To date, 38 MT of weapons-grade plutonium have been declared surplus. Of this amount, approximately 4 MT is already in the form of waste or spent nuclear fuel.

[4] As DOE formulates future proposals for the disposal of additional surplus plutonium, DOE will conduct additional analyses under NEPA as appropriate.

because DOE now proposes to dispose of all 34 metric tons of the material by fabricating it into MOX fuel, with the cancellation of the immobilization portion of the program, only two disposition facilities, the MOX facility and the pit disassembly and conversion facility, will be needed.

This SA focuses on changes to the MOX facility[5] made during the detailed design process and those necessitated by the proposed change in the MOX fuel fabrication portion of the program brought about by the contemplated fabrication into MOX fuel of more plutonium, including plutonium previously destined to be immobilized. It also takes into account those impacts predicted in the SPD EIS that no longer would occur because the immobilization facility will not be built. In addition, this SA includes an update to the status of the commercial reactor portion of the MOX fuel fabrication program.

1.2.1 Changes to the MOX Facility

Changes to the assumptions used in the analysis of the MOX facility in the SPD EIS result from two sources: the detailed design process for the MOX facility and the proposed fabrication into MOX fuel of more plutonium than previously analyzed for disposition in this manner, including plutonium previously destined to be immobilized. As discussed in this section, both have changed the design of the MOX facility from that described in the SPD EIS. The latter has also changed the amount and composition of the surplus plutonium proposed to be converted into MOX fuel.

Detailed Design Process. DOE selected Duke Cogema Stone & Webster (DCS)[6] to design, construct, and operate the MOX facility in accordance with U.S. Nuclear Regulatory Commission (NRC) regulations. As DCS has progressed in designing the MOX facility, some elements of the design have changed from those assumed in the SPD EIS. Chief among those changes are an increase in facility size and the addition of a separate building where certain MOX facility wastes will be treated along with wastes from the pit disassembly and conversion facility. The design changes have resulted in an increase in the estimated volume of waste, in particular transuranic (TRU) waste, that would be generated during the life of the MOX facility.

DCS originally submitted the *Mixed Oxide Fuel Fabrication Facility Environmental Report* (MOX ER) (Revision 0) to the NRC (Docket Number 070-03098) in December 2000, in support of its application for a 10 CFR 70 license to possess and use special nuclear material in the MOX facility it will operate for DOE at SRS. The MOX ER describes construction and operation of the MOX facility, and is based on a more detailed design than the facility described in the SPD EIS. Specifically, the MOX ER updates previous evaluations of the MOX facility with additional facility, process, and site-specific information; and incorporates more recent environmental baseline information. The original MOX ER did not include changes to the MOX

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[5] Detailed design for the pit disassembly and conversion facility is proceeding more sbwly than for the MOX facility. To date, changes to the pit disassembly and conversion facility are neither significant nor substantial relevant to environmental concerns. As the design progresses, DOE will examine changes that could alter the environmental impacts predicted in the SPD EIS, and conduct additional NEPA analyses as appropriate.

[6] Through a competitive procurement, DOE awarded a contract to the team of Duke Cogema Stone & Webster to provide MOX fuel fabrication and reactor irradiation services. These services include design, licensing, construction management, operation, and deactivation of the MOX facility, as well as irradiation of the MOX fuel in commercial reactors.

facility that are necessary to process impure plutonium originally intended for immobilization because it was prepared before DOE/NNSA's contemplated change in disposition strategy. DCS submitted a revised MOX ER (Revision [Rev] 1&2) to the NRC in July 2002 to reflect changes to the MOX facility, including those needed to process impure plutonium. The revised MOX ER (DCS 2002a) is used as the basis for NRC to evaluate the impacts of construction and operation of the MOX facility and to issue its own EIS. The NRC issued its draft EIS in February 2003 (68 FR 9728, February 28, 2003); the final EIS is scheduled for September 2003. This EIS provides updated NEPA analysis for the MOX facility, including the waste solidification building. Construction of the MOX facility would not commence until NRC completes its EIS and authorizes construction.

The SPD EIS ROD (65 FR 1608) selected the preferred alternative (SPD EIS Alternative 3), the construction and operation of three disposition facilities at SRS. Accordingly, this SA compares the proposed changes to the MOX facility within the context of that alternative, recognizing that with the cancellation of the immobilization facility, the number of disposition facilities to be constructed and operated at SRS has been reduced to two.

Fabrication of MOX Fuel from the Impure Plutonium. When DOE signed the U.S.–Russia Agreement, it anticipated using both the MOX fuel and immobilization approaches to implement the agreement. In order to implement a MOX-only program, DOE proposes to convert to MOX fuel 6.5 MT[7] of the 17 MT of impure plutonium originally intended for immobilization. This would require adding equipment to the MOX facility to homogenize and reduce the particle size of some of the impure plutonium feedstock and to remove the additional impurities. This impure plutonium, referred to as alternate feedstock (AFS), is currently in storage at various sites around the DOE complex. The majority of this material is at RFETS. The remainder is located primarily at the Hanford Reservation, SRS, the Lawrence Livermore National Laboratory, and the Los Alamos National Laboratory.

Increase in the Amount of Plutonium Converted into MOX Fuel. A 34-MT MOX-only program to implement the U.S.–Russia Agreement requires processing of 1 MT, approximately 3 percent, more surplus plutonium than the 33 MT analyzed in the SPD EIS. Over the proposed operating life of the enhanced MOX facility, this additional throughput would equate to an average annual increase of 0.1 MT above the levels considered in the SPD EIS preferred alternative. However, this nominal increase in throughput would remain within the 3.5-MT/yr operating envelope (i.e., 35 MT over a 10-year processing period) that serves as the basis for the SPD EIS impact analyses. This SA evaluates the impacts of processing 34 MT of surplus plutonium, including the AFS, and compares them to the impacts presented in the SPD EIS. The new analyses are based on information in the MOX ER, Rev 1&2, which includes modifications to the aqueous polishing process needed to process the AFS. Since the MOX ER, Rev 1&2,[8] evaluates processing both the surplus plutonium originally intended for MOX fuel fabrication

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[7] DOE/NNSA initially believed that approximately 8.5 MT of impure plutonium could reasonably be purified and used as feedstock for MOX fuel fabrication. However, DOE/NNSA has determined that it may not be cost effective to purify the most heavily contaminated approximately 2 MT, and that further review of disposal options is warranted before making investment decisions for that material. Technical viability studies are being conducted to assess disposition options. Appropriate environmental analysis would be performed before any decisions are made. To implement the U.S.–Russia Agreement, this 2 MT would be replaced with a future declaration of additional surplus weapons-grade plutonium.

[8] DOE/NNSA has independently reviewed all versions of the MOX ER.

and the AFS, the impacts attributable to the 1 MT change in the proposed action are included in the overall impacts evaluated for the enhanced MOX facility.

1.2.2 Status of Commercial Reactors

The SPD EIS analyzes the use of six domestic commercial nuclear reactors to irradiate the MOX fuel. The SPD Draft EIS included a generic analysis, and was followed by a Supplement to the SPD Draft EIS (DOE/EIS-0283-DS, April 1999) with a reactor-specific analysis after the individual reactors were selected. Subsequent to issuance of the SPD Final EIS, the operator of two of the reactors (one reactor site) elected to withdraw from the program. DOE/NNSA intends to select replacements for these reactors, and would perform any necessary NEPA analyses once the additional reactors are identified.

Chapter 2
Proposed Changes and Impact Analysis

2.1 PROPOSED CHANGES

The MOX facility would be located on the north-northwest side of F-Area at SRS. Approximately 17 acres of the 41-acre site would be developed with buildings, facilities, or pavement. The remaining 24 acres would be landscaped in either grass or gravel (DCS 2002a:3-1). The MOX facility is in the design phase at this time. The MOX facility occupies about 440,000 ft^2, primarily on three levels (DCS 2002a:Figure 3-3; St. Pierre 2002). Site preparation work is anticipated to begin by October 2003, followed by construction beginning in 2004. The MOX facility is scheduled to operate for approximately 10 years beginning in 2008. Modifications to facility design needed for processing the AFS would be incorporated into the facility plans and be effected during construction. **Figure 2–1** depicts the MOX fuel fabrication process. The two shaded boxes indicate the only areas that would be modified to accommodate processing the AFS.

The aqueous polishing unit of the MOX facility is configured to accept high-purity plutonium oxide (provided in specially designed and certified packages) from the pit disassembly and conversion facility. This oxide would be dissolved in the aqueous polishing unit to remove residual impurities to meet the MOX fuel specification and to control the physical properties of the oxide. Because of a larger particle size and additional impurities (e.g., salts, chlorides, or other metals) present in the AFS, modifications to the aqueous polishing unit are necessary to prepare this material for MOX fuel fabrication. In particular, additional steps would be added to the beginning of the aqueous polishing process:

- Unpacking the AFS in new gloveboxes
- Crushing and milling the AFS to decrease particle size and homogenize the material
- Characterizing the AFS to determine impurity content
- Removing the additional impurities

Processing would begin with particle size reduction. AFS would be transferred from buffer storage to a milling station, where the size of the particles would be reduced to below 200 µm. Material with particle sizes above 1 mm would be crushed before being sent for milling. After milling, powder density would be measured and a sample would be sent to the MOX facility laboratory to determine impurity content. This laboratory analysis would determine processing requirements. After analysis, the plutonium oxide would be returned to the buffer storage area until needed for processing.

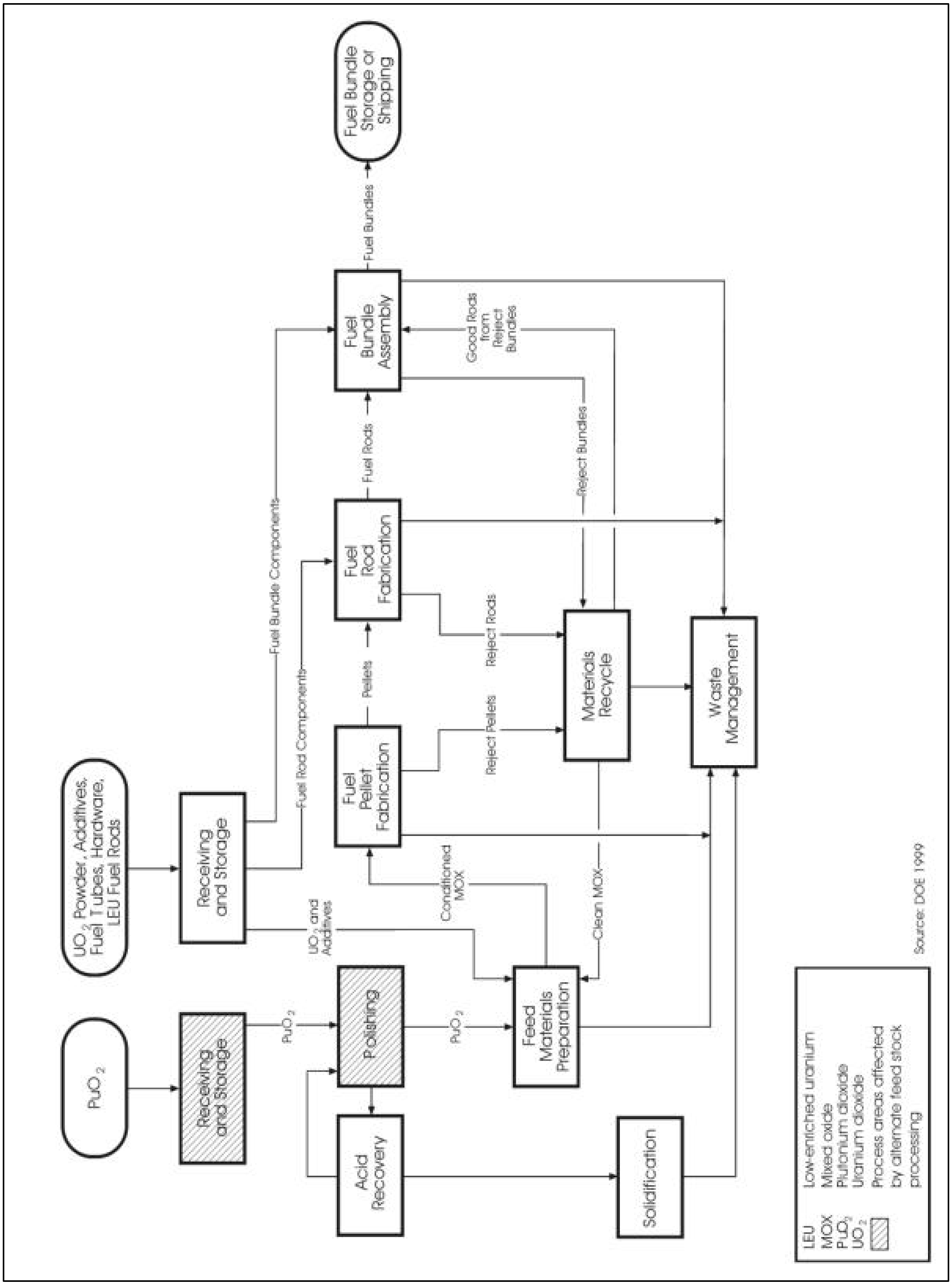

Figure 2–1 MOX Fuel Fabrication Process

Additional aqueous processing steps are necessary to remove the impurities from the AFS. Chlorides would be removed from the AFS before the chloride-depleted oxide is processed further. The chlorine would be removed as a gas that would be passed through a scrubber to convert the chlorine into a sodium chloride solution. This solution would be disposed of as a low-level radioactive waste (LLW).

Modifications to the MOX facility would be necessary to accommodate the additional processing. Equipment needed for milling and crushing includes mills, a crusher, powder density measurement equipment, and additional laboratory equipment to characterize the AFS.

A pretreatment buffer storage area would also be needed to store the plutonium prior to initial milling, and to store the cans of sampled plutonium between characterization and processing. This buffer storage would have a capacity of about 750 to 1,000 kg of oxide and would be similar to the existing buffer storage between the aqueous polishing and MOX processes.

Additional equipment for chloride removal includes two dissolution lines, an enlarged annular tank to increase the blending capability in the buffer tank and a chlorine gas wash column. Chlorinated liquid wastes would be collected in waste storage tanks prior to transfer to the F- and H-Area Effluent Treatment Facility.

Approximately 4 MT of AFS in the form of plutonium oxide would be processed at the MOX facility over approximately 2 to 3 years. The additional 2.5 MT of AFS in the form of plutonium metal would be converted to plutonium oxide at a later date, prior to processing in the MOX facility. The SPD EIS analyzed converting 35 MT of plutonium metal (up to 3.5 MT annually for 10 years), primarily in the form of pits, into plutonium oxide in the pit disassembly and conversion facility. The 2.5 MT of metal would be converted to oxide in a similar manner. The impacts of converting this additional metal are within the impacts analyzed in the SPD EIS, since the current program extends only to 34 MT and 4 MT of plutonium will already be in oxide form.

The MOX and pit disassembly and conversion facilities analyzed in the SPD EIS include waste processing equipment to treat and solidify LLW and TRU waste. The current design moves these waste processing capabilities and equipment to a separate building, the waste solidification building, to be located in the vicinity of the pit disassembly and conversion facility. This change would take advantage of an economy-of-scale in that similar waste streams from both the MOX and pit disassembly and conversion facilities can be treated together in the same location, rather than having duplicate equipment installed in both facilities.

2.2 IMPACT ANALYSIS

This section evaluates the environmental impacts of the proposed changes needed to implement the 34-MT MOX-only program relative to the impacts evaluated in the SPD EIS. This section demonstrates that although the impacts associated with certain of the proposed changes represent an increase from those in the SPD EIS, the increase in impacts is neither substantial nor significant. The changes include:

- The amount of TRU waste estimated to be generated. As discussed in Section 2.2.2, the amount of TRU waste generated by the MOX facility is expected to increase from approximately 68 m^3/yr to approximately 500 m^3/yr, and by both the MOX and pit disassembly and conversion facilities, from 180 m^3/yr to 518 m^3/yr. This additional TRU waste can be attributed primarily to design changes occurring since the SPD EIS was issued. However, management of this volume of TRU waste is well within the capability and capacity of the SRS waste management infrastructure.

  Furthermore, the approximately 5,180 m^3 that would be generated during the life of the surplus plutonium disposition facilities is included in the *Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement* (WIPP SEIS), which indicated that up to 7,000 m^3 of TRU waste could be generated by surplus plutonium disposition activities for disposal at WIPP (DOE 1997a:1-13; 5-183). This 5,180 m^3 of TRU waste would be less than 3 percent of the 175,600 m^3 total available disposal volume at WIPP, and less than 8 percent of the currently projected excess capacity of 68,000 m^3 based on a current projected disposal volume of 107,600 m^3 (DOE 2000:41).

  Transportation impacts would remain within those evaluated in the WIPP SEIS. Approximately 57 shipments per year, for a total of 570 shipments would be required to transport MOX facility TRU waste from SRS to WIPP. Adding these shipments to the current estimate of 1,829 TRU waste shipments from SRS results in a total of approximately 2,399 shipments from SRS to WIPP. This number of shipments remains within the range of shipments from SRS to WIPP analyzed in the WIPP SEIS, and would represent only a small fraction of the 29,766 total DOE complex-wide shipments evaluated as part of the WIPP SEIS proposed action (DOE 1997a:E-15).

- The amount of land needed for the MOX facility. The amount of land needed for the MOX facility would increase from 15 acres to 41 acres, and the amount of land that would be disturbed during construction would increase from 29 acres to 106 acres. As discussed in Section 2.2.6, this increase in disturbed area results from a number of changes, including the increase in operating area for the MOX facility, grading, and transmission line relocation. From a programmatic perspective, approximately 106 acres would be disturbed during construction of both the MOX facility analyzed in the MOX ER and the pit disassembly and conversion facility, rather than the 79 acres needed for construction of three facilities in the SPD EIS preferred alternative. Land required for operating areas for the MOX and pit disassembly and conversion facilities is about 48 acres as compared to 29 acres for the preferred alternative in the SPD EIS. However, there is adequate land available for construction of surplus plutonium disposition facilities in F-Area. These facilities would be consistent with other SRS uses and with the surrounding industrial land use.

2.2.1 Air Quality

The SPD EIS modeled concentrations for criteria and toxic pollutants using both SRS site emissions and estimated surplus plutonium disposition facility emissions, and indicated that none of the ambient air quality standards would be exceeded at the SRS boundary (DOE 1999:4-55.) Likewise, concentrations for criteria and toxic pollutants emitted during construction would not exceed the ambient air quality standards at the SRS boundary (DOE 1999:4-51.) Maximum air pollutant concentrations, including the contribution from MOX facility construction activities, are shown in **Table 2–1**. Air pollutant concentrations shown in the MOX ER are greater than those estimated in the SPD EIS for construction activities. Construction of the larger MOX facility and additional site work over the larger disturbed area would require increased use of diesel equipment. This in turn would result in higher fuel consumption, and more vehicular and fugitive emissions than estimated in the SPD EIS. However, the increases in overall site concentrations estimated in the MOX ER resulting from construction of the MOX facility are minor.

Table 2–1 Air Pollutant Concentrations Associated with Construction of the MOX Facility

Pollutant	Averaging Period	Most Stringent Standard or Guideline[a] (μg/m^3)	SPD EIS		MOX ER	
			MOX Facility Contribution (μg/m^3)	Total Site Concentration (μg/m^3)	MOX Facility Contribution (μg/m^3)	Total Site Concentration (μg/m^3)
Criteria pollutants						
Carbon monoxide	8 hours	10,000	0.547	672	16.7	82.7
	1 hour	40,000	2.48	5,100	54.8	308.8
Nitrogen dioxide	Annual	100	0.0207	11.4	0.17	17.4
PM_{10}	Annual	50	0.0185	4.96	0.29	7.29
	24 hours	150	1.8	87.5	23.5	120.5
Sulfur dioxide	Annual	80	0.0021	16.7	0.015	24
	24 hours	365	0.0517	222	1.3	338.3
	3 hours	1,300	0.31	725	5.6	1,176
Other regulated pollutants						
Total suspended particulates	Annual	75	0.0321	45.4	0.53	46.5
Hazardous and other toxic compounds						
Other toxics[b]	24 hours	150	0.000224	20.7	0.0002	20.7

[a] The more stringent of the Federal and state standards is presented.
[b] Various toxic air pollutants, e.g., lead, benzene, and hexane, could be emitted during construction and were analyzed as benzene.
Source: DOE 1999:Table G-66; DCS 2002a:Table 5-2.

Table 2–2 shows the estimated nonvehicular emissions from operation of the MOX facility. These emissions were used to calculate maximum potential concentrations of air pollutants from the MOX facility at the site boundary shown in **Table 2–3**. Vehicle emissions associated with operation of the MOX facility are the same in both the SPD EIS and the MOX ER. Total vehicle emissions associated with activities at SRS would likely decrease somewhat from baseline emissions because of the expected decrease in overall site employment. Changes to the MOX facility would result in increases in emissions from the emergency and standby diesel generators, increases in process emissions, and emissions of chlorine gas from the chloride removal process (DCS 2002a:5-81). The increase in the size of the MOX facility requires larger generators with an attendant increase in the emissions from periodic testing of these units as shown in Table 2–2. In addition, the MOX ER shows process emissions including volatile organic compound evaporative emissions from diesel fuel storage tanks and nitrogen dioxide from the aqueous polishing process. The MOX facility contribution for most pollutants for most averaging periods increases over those shown in the SPD EIS. These changes would be reflected in changes to the Title V operating permit. The chlorine emissions resulting from AFS processing are expected to be "non-detectable" amounts that would not be captured by the scrubber (Bowling 2002a). Total site concentrations shown in Tables 2–1 and 2–3 from the MOX ER reflect changes in the baseline contribution from other activities at SRS. These changes result from changes in the site emissions inventory. As shown in Table 2–3, the increase in overall site concentrations is minor, and ambient air quality standards would be expected to continue to be met (DCS2002a:5-13, 5-14, 5-91).

Programmatic Effects. Air quality impacts for both construction and operation of the surplus plutonium disposition program based on the MOX facility in the MOX ER and the pit disassembly and conversion facility are approximately the same as those for the preferred alternative in the SPD EIS.

Table 2–2 Nonvehicular Emissions from Operation of the MOX Facility (kg/yr)

Pollutant	SPD EIS				MOX ER		
	Boilers[a]	Emergency Generator	Process	Total	Emergency and Standby Generators with AFS[b]	Process[c]	Total
Carbon monoxide	2,040	374	0	2,410	1,855	0	1,860
Nitrogen dioxide	5,640	1,740	0	7,380	19,355	1,303	20,700
PM_{10}	276	122	0	398	182	0	182
Sulfur dioxide	31,300	114	0	31,400	1,125	0	1,130
Volatile organic compounds	0	142	0	142	831	0.9	832
Total suspended particulates	276	122	0	398	182	0	182
Chlorine	0	0	0	0	0	15	15

[a] The MOX ER assumes an electric boiler from which there are no emissions.
[b] Four standby generators and three emergency generators.
[c] Process volatile organic compound emissions are evaporative emissions from diesel fuel storage tanks. Nitrogen dioxide process emissions are from the MOX facility stack, and result from the aqueous polishing process.
Source: DOE 1999:Table G-67; DCS 2002a:Table 5-7.

Table 2–3 Air Pollutant Concentrations Associated with Operation of the MOX Facility

Pollutant	Averaging Period	Most Stringent Standard or Guideline[a] (μg/m³)	SPD EIS		MOX ER	
			MOX Facility Contribution[b] (μg/m³)	Total Site Concentration (μg/m³)	MOX Facility Contribution (μg/m³)[b]	Total Site Concentration (μg/m³)
Criteria pollutants						
Carbon monoxide	8 hours	10,000	0.123	671	22.7	88.7
	1 hour	40,000	0.371	5,100	78.8	332.8
Nitrogen dioxide	Annual	100	0.0105	11.4	0.048	17.2
PM_{10}	Annual	50	0.00059	4.94	0.0004	7
	24 hours	150	0.0108	85.7	0.78	97
Sulfur dioxide	Annual	80	0.0387	16.7	0.002	24
	24 hours	365	0.531	222	4.8	342
	3 hours	1,300	1.39	726	22.4	1,193
Other regulated pollutants						
Total suspended particulates	Annual	75	0.00059	45.4	0.0004	46
Chlorine	24 hours	75	0	NR	0.04	0.04

[a] The more stringent of the Federal and state standards is presented.
[b] Concentrations are the maximum occurring at or beyond the site boundary or a public access road.
Key: NR, not reported.
Source: DOE 1999:Table G-68; DCS 2002a:Table 5-8, as updated by DCS 2002b.

2.2.2 Waste Management

Both the SPD EIS and the MOX ER discuss generation of wastes during MOX facility construction, and present the same estimate of waste volumes. It is anticipated that no TRU, LLW or mixed LLW, or soil contaminated with hazardous or radioactive materials would be generated during construction. The SPD EIS concluded that management of construction wastes at SRS should not have a major impact on the site's waste management infrastructure (DOE 1999:4-52, 4-53; DCS 2002a:5-80), and this conclusion remains valid.

The MOX facility analyzed in the SPD EIS included equipment for solidifying radioactively contaminated liquid wastes, but that equipment will now be located in a separate waste solidification building[9]. The SPD EIS estimates of radioactive waste generation (LLW and contact-handled TRU waste) for the MOX facility are treated volumes, and are generally presented as solid wastes. Most of the radioactively contaminated liquid wastes identified in the MOX ER would be treated in the waste solidification building, and the MOX ER identifies liquid waste volumes prior to treatment (i.e., evaporated and solidified). **Table 2–4** presents MOX facility waste generation data from both the SPD EIS and MOX ER for comparable waste forms. The MOX ER waste generation rates are maximum values that include wastes that would occasionally be generated due to startup or unplanned rinses and process changeovers. Waste generation, on average, would be expected to be less than these values.

The amount of nonhazardous liquid waste identified in the MOX ER is less than that in the SPD EIS, while the solid nonhazardous waste has increased. These changes can be attributed primarily to design changes occurring since the SPD EIS was issued. However, these estimates are well below that generated by the SRS site (approximately 69,000,000 m^3/yr liquid and 31,000 m^3/yr solid [DCS 2002a:5-87]) and would not be expected to have a major effect on the site's waste management infrastructure. In particular, the 17,000 m^3/yr (4.4 million gal/yr) of nonhazardous liquid waste would represent approximately 1 percent of the 400-million-gal/yr capacity of the Central Sanitary Wastewater Treatment Facility (DCS 2002a:4-41), and should not result in measurable impacts on the site waste management infrastructure.

The SPD EIS did not address liquid LLW; rather LLW was addressed only in solid form, as an output from the MOX facility. However, as described in the MOX ER, liquid LLW would be transferred to the F- and H-Area Effluent Treatment Facility for treatment. This facility treats similar wastewater generated at various SRS facilities and has a treatment capacity of 1,930,000 m^3/yr (DCS 2002a:5-23). The estimated volume of 1,500 m^3/yr of liquid LLW generated by the MOX facility that would require treatment in this fashion would be less than 0.1 percent of the capacity of the F- and H-Area Effluent Treatment Facility, and would therefore have negligible impact on its operation. The slightly contaminated LLW solvent would be accumulated, packaged, and transferred to SRS for disposal at an approved facility (DCS 2002a:3-17). Generation of additional LLW is well below the SRS site generation rate and infrastructure capability, and so would have only minimal impact on the site waste management infrastructure.

[9] The environmental impacts from construction and operation of the waste solidification building are small and are evaluated in more detail in the NRC's Draft EIS, NUREG-1767 (NRC 2003).

Table 2–4 Waste Generation from the MOX Facility (m^3/yr)

Waste Type	SPD EIS	MOX ER[a]
Nonhazardous		
Liquid	26,000	17,000
Solid	440	1,300
Hazardous		
Solid	1.1	None
Low-level radioactive		
Liquid	Not reported[b]	1,500[c]
Solvent	Not reported[b]	12
Solid	94	270[d]
Transuranic (contact handled)		
Solid	68	500[e]

a These are maximum waste generation values. Waste generation, on average, would be expected to be less.

b Comparable liquid waste volumes were not provided in the SPD EIS because most liquid waste streams were to be processed within the MOX facility.

c Liquid LLW treated at the F- and H-Area Effluent Treatment Facility

d Includes 170 m^3 of solidified waste that is produced during treatment of 46,000 gal of stripped uranium LLW in the waste solidification building.

e Includes 310 m^3 of solidified waste that is produced during treatment of 22,000 gal of TRU waste in the waste solidification building.

Source: DOE 1999:Table H-32; DCS 2002a:Table 5-12.

As previously discussed, the SPD EIS did not identify the amounts of liquid LLW and TRU that would be processed within the internal MOX facility liquid waste treatment system, only the resultant solid waste. The MOX ER indicates that these liquid wastes would be treated in the waste solidification building that will be built near the pit disassembly and conversion facility. The wastes would be piped from the MOX facility to the waste solidification building for volume reduction by evaporation. The evaporator residues would be solidified, and the liquid effluent would be sent to the F- and H-Area Effluent Treatment Facility for treatment prior to discharge. Approximately 170 m^3 of solidified LLW and 310 m^3 of solidified TRU waste are expected to result from treatment (DCS 2002a:5-87). The 170 m^3/yr of solidified LLW, plus an additional 100 m^3/yr of job control LLW (i.e., filters, protective clothing, contaminated equipment) would be processed along with other SRS LLW in the existing waste management infrastructure for disposal at DOE or commercial facilities. The additional 270 m^3/yr of solid LLW represents less than 4 percent of the approximately 8100 m^3 of solid LLW generated at SRS annually, and is well within the capacity of the SRS waste management infrastructure (DCS 2002a:5-86).

The 500 m^3/yr (5000 m^3 total) of solidified TRU waste and job control TRU waste generated from operation of the MOX facility would be packaged in standard waste boxes for disposal at WIPP. This additional TRU waste can be attributed primarily to design changes occurring since the SPD EIS was issued. TRU waste would be stored until cleared for shipment to WIPP. SRS has the capacity to store 34,400 m^3 of TRU waste (DOE 1999:3-133), and a TRU waste inventory of approximately 11,000 m^3 (WSRC 2002). Thus, this additional TRU waste is well within the storage capacity of SRS waste management facilities.

Programmatic Effects. Approximately 110,000 m^3 of nonhazardous liquid waste, 3,100 m^3 of nonhazardous solid waste, 94 m^3 of hazardous waste, 240 m^3 of LLW, and 180 m^3 of TRU waste were estimated to be generated annually by operation of the three surplus plutonium disposition facilities under the preferred alternative in the SPD EIS (DOE 1999:4-57). Nonradioactive waste generation estimates for the MOX facility described in the MOX ER (DCS 2002a:5-87) combined with the pit disassembly and conversion facility (DOE 1999:H-51) are less than estimated in the SPD EIS for the preferred alternative. LLW (330 m^3/yr solid and 1,500 m^3/yr liquid) and TRU waste (518 m^3/yr solid) estimates exceed those for the preferred alternative in the SPD EIS, but as demonstrated in this section, are well within the capabilities and capacities of the SRS waste management infrastructure.

The maximum waste disposal alternative evaluated in the WIPP SEIS included disposal of a total of 334,000 m^3 of TRU waste with 23,000 m^3 of the waste originating at SRS (DOE 1997a:A-22). The *National TRU Waste Management Plan* estimates that SRS would dispose of a total of 15,975 m^3 at WIPP (DOE 2000:42). Adding the 5180 m^3 of TRU waste estimated to be generated by surplus plutonium disposition facilities to the projected TRU waste from SRS increases the total SRS TRU waste disposal volume to 21,155 m^3. This is still below the 23,000 m^3 analyzed in the WIPP SEIS. The MOX facility TRU waste would meet the WIPP waste acceptance criteria for contact-handled TRU waste and the characterization of the waste would be bounded by the assumptions contained in the WIPP SEIS. Hence, the impacts of packaging, transporting, and disposing of the waste would be indistinguishable from the TRU waste analyzed in the WIPP SEIS.

Furthermore, the approximately 5,180 m^3 of TRU waste that would be generated during the life of the surplus plutonium disposition facilities is included in the WIPP SEIS, which indicated that up to 7,000 m^3 of TRU waste could be generated by surplus plutonium disposition activities for disposal at WIPP (DOE 1997a:1-13; 5-183). This 5,180 m^3 of TRU waste would be less than 3 percent of the 175,600 m^3 total disposal volume at WIPP (DOE 1997a:S-10), and less than 8 percent of the currently projected excess capacity of 68,000 m^3 based on a current projected disposal volume of 107,600 m^3 (DOE 2000:41). Therefore, the impacts of disposing of this material in WIPP are included in and bounded by the WIPP SEIS.

2.2.3 Human Health

The maximum annual processing rate of 3.5 MT of plutonium oxide is the same for both the SPD EIS and the MOX ER. However, additional impurities (e.g., salts, chlorides, or other metals) and larger particle sizes in the AFS have potential radiological and nonradiological impacts through airborne and liquid pathways. The MOX ER used a bounding estimate of release rate of radionuclides to the atmosphere but did not report estimates of release rate from individual process units such as those handling the AFS. This SA develops estimates of release rates to the environment and public health impacts due to changes in process design.

The particle size reduction step could potentially increase the radiological releases to the atmosphere from the MOX facility. However, release rates from other process steps remain the same as those estimated in the SPD EIS and the MOX ER. A total of 272 µCi/yr is estimated as the release to the atmosphere from the MOX facility during normal operations (DCS 2002a:Table D-7). The MOX ER states that the exhaust from each glovebox used for aqueous polishing has two high-efficiency particulate air (HEPA) filters and that an additional two stages of HEPA filtration are provided prior to release to the MOX facility stack (DCS 2002a:3-15 and Figure 3-9). The estimated atmospheric release rate attributable to the AFS particle size reduction step of 7.4×10^{-6} µCi/yr is a small fraction of the 272 µCi/yr, indicating that radiological impacts of normal operations for the AFS remain unchanged from those estimated in the SPD EIS. The SPD EIS estimates a dose to the maximally exposed individual through the combined atmospheric and liquid pathways of 3.7×10^{-3} mrem/yr (1.9×10^{-9}/yr risk of latent cancer fatality [LCF]) (DOE 1999:Table J-53). Using the same source term, DCS estimates a dose of 3.3×10^{-3} mrem/yr (1.6×10^{-9}/yr risk of LCF) (Birch 2003).[10] Analysis of the additional airborne release indicates negligible increase in airborne releases due to processing the AFS. Based on those considerations and the small magnitude of estimated dose relative to those associated with background radiation, it is concluded that releases to the atmosphere from the MOX facility pose small risk to human health.

The feedstock considered in the SPD EIS did not include chlorinated compounds. The MOX ER estimates that 15 kg/yr of chlorine will be emitted from the MOX facility stack during normal operations (DCS 2002a:Table 5-7). During a work year consisting of 7,056 hours, this equals 0.59 mg/sec. Using this release rate, the chlorine concentration at the location of the maximally exposed individual is estimated to be 1.4×10^{-5} µg/m^3. The South Carolina Department of Health and Environmental Control (SCDHEC) has established a limit at the site boundary of 75 µg/m^3 as determined by modeling. This estimated ambient air concentration of chlorine is nearly seven orders of magnitude less than the SCDHEC endpoint, indicating negligible impacts on human health.

Aqueous effluent release rates for the enhanced MOX facility have been estimated for both radiological and nonradiological constituents.[11] The SPD EIS, using an aqueous release rate of 7.4×10^{7} Bq/yr (0.002 Ci/yr) (DOE 1999, Table J-45), estimates a total dose (combined air and liquid pathways) to the maximally exposed individual of 3.7×10^{-3} mrem/yr (1.9×10^{-9}/yr risk of LCF) (DOE 1999:Table J-53). The MOX ER does not estimate a dose for the liquid pathway but does report estimates of distillate waste containing activity of 1.1×10^{8} Bq/yr (0.003 Ci/yr) and rinsing water containing alpha activity less than 2.4×10^{6} Bq/yr (6.5×10^{-5} Ci/yr) (DCS 2002a:Table 3-3). If the entirety of this activity (0.003 Ci/yr) were in the least favorable form (i.e., plutonium-239) and were released to Upper Three Runs, the estimated dose would be 0.02 mrem/yr (1.0×10^{-8}/yr risk of LCF). Because filtration, adsorption, reverse osmosis, and ion exchange are used to reduce the activity of effluents released to the environment (DOE 1995:C-67), this estimated dose is a conservative bound on potential impacts. Based on the small magnitude of estimated doses relative to those associated with background radiation, it is concluded that processing the AFS poses small risk to human health.

[10] The MOX ER indicates a dose of 1.5×10^{-3} mrem/yr (DCS 2002a:5-18). However, the dose has been recalculated to 3.3×10^{-3} mrem/yr as a result of revised meteorological data.

[11] There is no direct release of radioactive liquid effluents to the environment from the MOX facility. All liquid radioactive effluents are transferred to SRS waste treatment facilities for treatment prior to release or disposal.

Chlorine in aqueous effluents from processing the AFS discharged to the F- and H-Area Effluent Treatment Facility has been estimated as 131 kg/yr based on flow and concentration data presented in the MOX ER (DCS 2002a:Table 3-3). This facility, located in F-Area, releases treated effluents to Upper Three Runs. The average annual flow rate of this stream is 6.9 m^3/sec (DCS 2002a:4-14). Using this flow rate and adjusting for time of operation implies a concentration of chlorine in surface water of 0.001 mg/l. Because this concentration is three orders of magnitude lower than values commonly found in surface water (Stumm and Morgan 1981), negligible impact on the environment is expected.

2.2.4 Facility Accidents

Comprehensive evaluations of the likelihood and consequence of facility accidents have been completed for both the SPD EIS (DOE 1999) and the MOX ER (DCS 2002a). Accident analysis completed for the MOX ER has been described in two documents, the MOX ER and the *Mixed Oxide Fuel Fabrication Facility Construction Authorization Request* (MOX CAR) (DCS 2001). The MOX ER and the MOX CAR evaluate accidents for the processing of feed produced at the pit disassembly and conversion facility. The current proposal involves processing of both the pit disassembly and conversion facility feedstock and an AFS that contains additional impurities. Because process design is at an early stage, the approach to accident analysis for both the SPD EIS and MOX ER was to identify a set of accidents that span the range of operations and are of a bounding nature. This section of the SA compares the MOX ER accident analysis to the SPD EIS accident analysis to determine whether changes in process design, including those related to processing an AFS, create new or different accident scenarios or increase the consequences of any accident scenarios evaluated in the SPD EIS.

Both the SPD EIS and MOX ER analyses group accident scenarios into categories and identify five accidents having the largest consequences. Results of bounding accident analyses from the SPD EIS and MOX ER are summarized in **Table 2–5**. The sets of scenarios analyzed are not the same. Even for scenarios that appear at first to be similar, such as internal fires, it is difficult to make direct comparisons because the SPD EIS considers generic scenarios, whereas the MOX ER uses facility-specific information that was not available when the SPD EIS was being prepared. Note that the MOX ER scenarios include both AFS and design changes effected since the SPD EIS was issued.

Fires. The MOX ER assumes that there is a beyond-design-basis fire in the fire area containing the Final Dosing Unit, with a material at risk (MAR) of 41 kg (DCS 2002a:F-7) and a source term of approximately 0.0024 g. This is smaller than the source term of 0.0094 g for the beyond-design-basis fire in the SPD EIS. (The SPD EIS does not specify the area in which the fire occurs, so the scenario is referred to generically as a beyond-design-basis fire.) Because processing the AFS does not increase the MAR in the final dosing unit, this scenario is not affected by the AFS.

Loss of Confinement/Load Drop. This accident evaluated in the MOX ER involves dropping a load onto the Jar Storage and Handling Unit, which contains about 337 kg of plutonium powder (DCS 2002a:F-8). There is no equivalent scenario presented in the SPD EIS. This scenario would not be affected by the AFS because the largest new potential MAR arising from the AFS is approximately 250 kg in the pretreatment buffer storage.

Table 2–5 Bounding Consequences for Events from the SPD EIS and MOX ER

Bounding Event	SPD EIS: Site Worker TEDE (rem) at 1,000 m[b]	SPD EIS: Public TEDE (rem)[b]	MOX ER[a]: Site Worker TEDE (rem) at 100 m[b]	MOX ER[a]: Public TEDE (rem)[b]
Loss of confinement[c]	NA	NA	0.15	1.0×10^{-3}
Load drop in the Jars Storage and Handling Unit	NA	NA	0.15	1.0×10^{-3}
Internal Fires				
Fire in the Final Dosing, Ball Milling Unit	NA	NA	0.1	5×10^{-4}
Beyond-design-basis fire	0.14	5.6×10^{-3}	NA	NA
Flammable solvent fire	8.4×10^{-6}	3.5×10^{-7}	NA	NA
Criticality	0.3	0.016	2.2	0.012
Explosions				
Explosion in a process cell in the Aqueous Polishing Unit	NA	NA	0.75	0.005
Explosion in a sintering furnace	0.0012	4.8×10^{-5}	NA	NA
Ion exchange column exotherm	5.1×10^{-5}	2.1×10^{-6}	NA	NA
Design-basis earthquake	1.7×10^{-4}	6.9×10^{-6}	NA	NA
Beyond-design-basis earthquake	230	8.8	NA	NA

[a] With the exception of the criticality accident where noble gases pass through the HEPA filters without attenuation, the consequences of these accidents are mitigated by an assumed leak path factor of 1×10^{-4} for the MOX facility's confinement and filtration systems.

[b] TEDEs calculated for 95th percentile meteorology. The SPD EIS also presents results for mean meteorology.

[c] Bounding loss of confinement event in the MOX ER is caused by load handling event. This means the first two events in the table are the same.

Key: NA, not analyzed; TEDE, Total Effective Dose Equivalent.

Source: DOE 1999:Table K-19; DCS 2002a:Table 5-13a, as updated by DCS 2002c.

Criticality. Both the SPD EIS and MOX ER assume a bounding criticality source term resulting from 1×10^{19} fissions in solution (DOE 1999:K-13; DCS 2002a:F-8). This is consistent with guidance given by both DOE (DOE 1994) and NRC (NRC 1998a, 1998b). These analyses are generic and are intended to be conservative and independent of the configuration of the facility. Therefore, the changes to the MOX facility, including those required to process the AFS, do not affect the criticality analysis. The public Total Effective Dose Equivalent predicted in the MOX ER and the SPD EIS are similar, at 0.012 rem and 0.016 rem, respectively.

Explosions. For the bounding scenario, the MOX ER evaluates a generic hypothetical explosion involving 75 kg of plutonium (DCS 2002c:F-9), the entire amount of radioactive material in a process cell in the aqueous polishing unit. This explosion causes a liquid containing plutonium to fragment and become airborne, with a predicted airborne source term of 0.08 g. Evaluation of the plutonium polishing unit for the SPD EIS indicated that no postulated explosion would be as severe as the design-basis accident scenario for the MOX facility (ORNL 1998:27).

The SPD EIS considers an explosion in a sintering furnace caused by the accidental introduction of oxygen into an atmosphere normally containing 6 percent hydrogen and 94 percent argon as the bounding scenario (DOE 1999:K-22). The assumed MAR is 5.6 kg and the accident results in a stack source term of 5.6×10^{-4} g, about two orders of magnitude less than the explosion source term identified in the MOX ER. The MOX ER explosion event has a larger source term and consequences than the explosions analyzed in the SPD EIS because DCS chose to be conservative and include a scenario that is "highly unlikely" (NRC terminology), but could in principle be screened out on the basis of low frequency. Thus, the difference in impacts is based solely on methodology and assumptions, and is not attributable to either AFS or design changes.

The SPD EIS also considers an ion exchange column exotherm, a thermal excursion within an ion exchange column inside a glovebox resulting from off-normal operations, degraded resin, or a glovebox fire. The MOX facility as designed has no ion exchange columns in gloveboxes, so this event is no longer relevant.

Design Basis Earthquake. The SPD EIS assumes that the design basis earthquake has a frequency of 5×10^{-4}/yr and that the MOX facility is designed to seismic performance category 3 (DOE 1999:K-14). The SPD EIS then assumes that the vibratory motion of the design basis earthquake would cause the resuspension of loose plutonium powder and some minor spills, which would be picked up by the ventilation system and filtered by the HEPA filters, leading to a release of 7.9×10^{-5} g from the stack (DOE 1999:Table K-19). This is very small relative to the source terms from the explosion and internal fire scenarios. As previously noted, only a very small fraction of the AFS would be in the respirable range. There will be some pre-dissolution milling operations to ensure that all particles are less than 200 µm in diameter. This could generate some loose particles, but not enough to affect the SPD EIS conclusion that the stack source term for this event would be very small.

As to the MOX ER: in practice, the MOX facility is being designed to a standard based on a somewhat more severe earthquake with a peak horizontal ground acceleration of 0.20g (as compared to 0.16g for Performance Category 3) that occurs with a frequency of 1×10^{-4}/yr (DCS 2001:5.5-35). Therefore the MOX CAR essentially screens out this accident on the basis that the "principal systems, structures and components" (precursors of NRC's "items relied on for safety") will be designed to withstand its effects.

Beyond-Design-Basis Earthquake. In the SPD EIS, an earthquake in the frequency range of 1×10^{-5}/yr to 1×10^{-7}/yr is assumed to cause total collapse of the building (DOE 1999:K-22). Even in such a case, materials in vault storage are assumed to be adequately protected from the scenario energetics. Events that could compromise the vault integrity are assessed as being beyond extremely unlikely. An assessment of the amount of plutonium in each of the process areas leads to a MAR of 410 kg and a predicted release of 0.124 kg of plutonium powder (DOE 1999:K-22).

The MOX CAR lists the radioactive materials inventory in the MOX facility by location (DCS 2001:Table 5.5-2). The total amount of plutonium oxide powder that is elsewhere than in vault storage is approximately 740 kg. That is, the MOX facility as currently designed has about 1.8 times the MAR available for this scenario than assumed in the SPD EIS. However, the MOX ER analysis screens out the beyond-design-basis earthquake on the basis of low frequency. The MOX ER states that "The [MOX facility] is designed to withstand the effects of the design basis earthquake. The design and the associated design margin reduce the likelihood of significant damage to the [MOX facility] to Highly Unlikely. Thus, no significant radioactive or hazardous material release or loss of subcritical conditions at the [MOX facility] is postulated to occur for earthquakes" (DCS 2002a:5-37). The reasoning is that the MOX facility design basis earthquake already has a relatively low frequency of 1×10^{-4}/yr, and there is sufficient margin in the design to ensure that the MOX facility will withstand earthquakes that are at least ten times less likely (i.e., with a frequency of less than 1×10^{-5}/yr) without significant damage. A frequency of less than 1×10^{-5}/yr is in NRC's "Highly Unlikely" frequency category, and in accordance with the performance requirements of 10 CFR 70, needs no further prevention or mitigation measures.

Note that in any case, the consequences predicted in the SPD EIS for the beyond-design-basis earthquake continue to bound the predicted consequences for all accident scenarios from both the MOX ER and MOX CAR.

Miscellaneous Small Spills. The SPD EIS assumes that a liquid organic solvent containing the maximum plutonium concentration leaks as a spray into a glovebox, builds to a flammable concentration, and is contacted by an ignition source. The predicted stack source term is very small, approximately 4.0×10^{-6} g of plutonium (DOE 1999:Table K-19). There is no equivalent scenario in the MOX ER. However, neither design changes nor the presence of AFS increases the concentration of plutonium in the solvent, so they would not affect the predicted source term.

The SPD EIS also considers a spill of 50 l of concentrated aqueous plutonium solution into a process room with a MAR of 5 kg (DOE 1999:K-23). There is no equivalent scenario in the MOX ER, and neither the presence of the AFS nor design changes would increase the plutonium concentration or the MAR, so they would not affect this scenario.

Aircraft Crash. The SPD EIS considers the accidental crash of a large, heavy commercial or military aircraft directly into a reinforced-concrete structure such as the MOX facility at SRS and concluded that the predicted frequency of less than 1×10^{-7}/yr is extremely unlikely (DOE 1999:K-22). This analysis was conducted in accordance with DOE's aircraft crash risk assessment methodology (DOE 1996), in which the frequency is proportional to the area of the footprint of the facility. The physical dimensions of the MOX facility as currently designed are different from that analyzed in the SPD EIS such that the effective area of the building and the related aircraft crash probabilities have increased by a factor of approximately two. However, the aircraft crash probabilities for large aircraft remain at or below 1×10^{-7}/yr.

The MOX CAR also screened out aircraft crashes based on criteria given in NUREG-0800 (NRC 1981), which states that the probability of aircraft accidents resulting in unacceptable radiological consequences is less than 1×10^{-7}/yr if a number of requirements related to the location of a given facility relative to distances to airports, airways, holding patterns, and military training routes; and numbers of operations are met. The NRC's criteria do not include the area of the footprint of the facility, or any details about the facility. The MOX CAR analysis was submitted in February 2001 and can be regarded as up-to-date with respect to the information used for nearby airports and other assumptions, so it can be concluded that the aircraft crash analysis remains valid even with the proposed design changes.

In the aftermath of September 11, 2001, DOE is continuing to consider measures to minimize the risk and consequences of a potential terrorist attack. The MOX facility would offer certain unique features from a safeguards perspective: a remote location, restricted access afforded by Federal land ownership, restricted airspace above the site, and access to a highly effective rapid-response security force. DOE expects that the safeguards applied to the MOX facility will involve a dynamic process of enhancement to meet threats, and that those safeguards will evolve over time.

Chemical Releases. The MOX ER indicates that based on the results of preliminary evaluations, the chemical consequences both to the noninvolved worker and at the site boundary are low as defined in 10 CFR 70.61 and discussed in the following paragraph (DCS 2002a:F-10). The SPD EIS did not identify chemical accidents for the MOX facility because no hazardous chemicals were estimated to be present in quantities that would result in consequences at levels of concern for the either the noninvolved worker or at the site boundary.

The AFS does not introduce any new hazardous chemicals to the MOX facility. However, the AFS contains chlorides that must be removed during the polishing process, and the chloride removal process involves generation of chlorine gas. Chlorine gas would be generated, passed through a scrubber, and released into the atmosphere at a rate of 15 kg/yr (DCS 2002a:Table 5-7), or 0.59 mg/sec. A worst-case, though highly unlikely, accident scenario is that a leak path develops so that the chlorine bypasses the scrubber and is released to the environment, in which case the release rate would be about 12 mg/sec. The MOX ER presents the methodology for calculating the potential effects of chemical releases on the noninvolved workers (DCS 2002a:F-9, F-10). For the noninvolved worker, the MOX ER compares predicted concentrations with Emergency Response Planning Guideline (ERPG) values or equivalently DOE's Temporary Emergency Exposure Limits (TEELs). For workers, the consequences are low when the predicted concentrations are below the ERPG-2/TEEL-2, which for chlorine is 3 ppm (approximately 8 mg/m^3). Using the essentially worst-case atmospheric dispersion factor from the MOX ER and the release rate of 12 mg/sec gives a predicted concentration of approximately 0.007 mg/m^3, about a factor of 1,000 smaller than the ERPG-2. A similar calculation for the offsite public shows that predicted concentrations at the site boundary are nearly five orders of magnitude lower than the ERPG-1/TEEL-1 of 1 ppm, the lowest consequence concentration for the public.

In summary, the SPD EIS and the MOX ER each analyze a set of accident scenarios intended to span the range of potential impacts of operation of the MOX facility. Because additional design information was available for the MOX ER analysis, the specific accident scenarios analyzed in the MOX ER differ from those analyzed in the SPD EIS. In addition, availability of more detailed information supported reduction of conservatism in the selection of scenarios for the MOX ER relative to the SPD EIS.

The SPD EIS and MOX ER did, however, use the same approach to accident analysis and similar assumptions and parameter values. Examples include use of the same method for calculation of release rates, the same guidance for airborne and respirable release fractions, the same atmospheric dispersion code, and the same dose conversion factors. In addition, values of most parameters used in the analyses are identical and suitably conservative. However, differences in assumptions between the two documents include:

- The MOX ER uses a more conservative onsite worker distance of 100 m, as compared to the SPD EIS distance of 1,000 m. This results in higher calculated doses to onsite workers in the MOX ER.

- For all accident scenarios, the MOX ER uses a HEPA leakpath factor of 1×10^{-4}, an order of magnitude higher than that used in nearly all the scenarios the SPD EIS (1×10^{-5}). This results in higher calculated releases and doses for accidents in the MOX ER. The only exception is for major fires, for which the SPD EIS uses a leakpath factor of approximately 1×10^{-2}.

- The SPD EIS is more conservative than the MOX ER for duration of release. The SPD EIS uses 10 minutes while the MOX ER uses 1 hour. The shorter release time, for the same source term, results in a slightly higher dose.

Accounting for these various factors, the additional information in the MOX ER does not indicate that the design changes or other additional information lead to accident impacts from the MOX facility significantly different from or greater than those analyzed in the SPD EIS.

Review of the MOX ER accident analysis indicates that processing of the AFS has minor impact on the bounding accidents. The radiological, chemical, and physical properties of the AFS are, for the most part, similar to the feedstock that will be received from the pit conversion facility. Although certain chemical impurities, most notably chlorine, and the presence of larger particles in the AFS are differences that could potentially affect certain parameters in the calculation of accident consequences, because of similarities in the two feed materials and the conservative assumptions used in the accident calculations, the AFS does not affect the consequences of any of the bounding accidents for the MOX facility.

Some of the AFS will have particle diameters of 1 mm or greater. This material will be milled to reduce the particle diameter to less than 200 μm before processing. Because respirable particles of plutonium oxide have diameters less than 5 μm, existing respirable fractions used in the analysis in the MOX CAR, MOX ER, and SPD EIS should be conservative with respect to the AFS.

The accident analysis described in the MOX ER does not identify hazards in addition to those identified in the SPD EIS, and reports estimates of impacts of accidents that indicate small risk to public health and safety due to operation of the MOX facility. This SA review concluded that analyses of beyond-design-basis events performed for the SPD EIS remain bounding for events anticipated for the MOX facility.

2.2.5 Water Resources

The SPD EIS concluded that the use of proven construction techniques would mitigate potential impacts from stormwater runoff (i.e., impacts of soil erosion on receiving streams) resulting from construction of the MOX facility (DOE 1999:4-284). As discussed in Section 2.2.6, the construction area described in the MOX ER is larger than that estimated in the SPD EIS. Although the construction area is larger, the MOX ER reaches the same conclusion as the SPD EIS: no long-term impacts due to construction would be expected (DCS 2002a:5-3).

Water for use in F-Area is drawn from wells that tap local groundwater. As shown in **Table 2–6**, water requirements estimated in the MOX ER for construction are greater than those estimated in the SPD EIS. Although the total water use for the 3-year construction period in the MOX ER is more than that estimated in the SPD EIS, it is well within the available capacity at F-Area. Operations water use in the MOX ER is less than that in the SPD EIS and would be less than 1 percent of the available water. Therefore, water use would not be expected to result in more than minor impacts on groundwater resources.

Table 2–6 Water Resource Requirements for the MOX Facility (million gal/yr)

	SPD EIS	MOX ER	Availability/ Capacity
Water use			
Construction	6.1	33	730
Operation	18	2.4	730
Nonhazardous wastewater generation			
Construction	5.3	9.5	400
Operation	6.9	4.4[a]	400

[a] Of the total nonhazardous wastewater generated during operation, 2.4 million gal are condensate from the heating, ventilation, and air conditioning system (Bowling 2002b). Condensate is condensed from the air and is not a component of water usage.

Source: DOE 1999:4-289, H-57, H-58; DCS 2002a:4-41, 5-3, 5-22, 5-79, 5-80, 5-87.

Although more water is estimated to be used during the 3-year construction period in the MOX ER than in the SPD EIS, estimated water use during the total operating period has decreased. Total water use for construction and operation of the MOX facility (123 million gal) is about two-thirds of that estimated in the SPD EIS (198 million gal).

Nonhazardous wastewater generation estimates have decreased from estimates in the SPD EIS. Total wastewater generation for the construction and operation of the MOX facility has decreased from 85 million gal to 72 million gal. Although wastewater generation during the 3-year construction period would almost double, annual wastewater generation during the operating period would be about one-third less than that estimated in the SPD EIS. Even during the construction period, when wastewater generation would be highest, there is sufficient capacity (400 million gal/yr) for treatment at the Central Sanitary Wastewater Treatment Facility (DCS 2002a:4-41).

Effluent from treatment of wastewater during construction and operation would ultimately be discharged from the Central Sanitary Wastewater Treatment Facility to Fourmile Branch (DCS 2002a:4-15). The average and 7-day, 10-year low flow in Fourmile Branch are 1.8 m^3/sec and 0.23 m^3/sec, respectively (DCS 2002a:4-14, 4-15). Assuming that the effluent discharge from the Central Sanitary Wastewater Treatment Facility would increase by the amount of MOX facility wastewater being treated, little impact on surface water quality and flow would be expected in Fourmile Branch. (It should be noted that these estimates conservatively assume that all water used during construction results in a like amount of wastewater generation and a like amount of effluent from the treatment facility.)

Process and other facility wastewater would be treated by SRS facilities before being released to onsite surface water. As discussed in Section 2.2.2, liquid TRU waste and liquid LLW would be generated from the MOX facility. Effluent from treatment of these waste streams would be treated at and ultimately discharged from the F- and H-Area Effluent Treatment Facility to Upper Three Runs (WSRC 2001:85). The average and 7-day, 10-year low flow in Upper Three Runs are 6.9 m^3/sec and 2.8 m^3/sec, respectively (DCS 2002a:4-14). Conservatively, assuming that effluent discharge from the F- and H-Area Effluent Treatment Facility would be equal to the amount of MOX facility wastewater being treated, little impact on surface water quality or flow would be expected in Upper Three Runs.

Stormwater runoff and uncontaminated heating, ventilation, and air conditioning system condensate would be the only direct liquid discharges to the environment from the MOX facility. These would be discharged through an approved NPDES outfall (DCS 2002a:5-12). These discharges are expected to result in only minor impacts on either surface water or groundwater.

Programmatic Effects. Construction and operation of the MOX facility and the pit disassembly and conversion facility would require a total of approximately 260 million gal of water (DOE 1999:E-2, E-3; DCS 2002a:5-3, 5-22). This amount is about one-third the requirement for the preferred alternative in the SPD EIS of approximately 712 million gal (DOE 1999:E-2, E-3, E-6, E-10, E-12, E-13). Construction and operation of the MOX facility and the pit disassembly and conversion facility would generate a total of approximately 143 million gal of nonhazardous wastewater (DOE 1999:H-71, H-72; DCS 2002a: 5-80, 5-87). This amount is about one-half the preferred alternative in the SPD EIS of approximately 317 million gal (DOE 1999: H-71, H-72).

2.2.6 Land Use

Land uses at SRS include forest/undeveloped, water/wetlands, and developed facilities. SRS occupies about 310 mi^2. Approximately 226 mi^2 are undeveloped; wetlands and water bodies account for 70 mi^2, and developed areas, road, and utility corridors account for 15 mi^2 (DOE 1999:3-161–3-163).

The SPD EIS concluded that there was sufficient available land for the new facilities in F-Area. F-Area is an existing heavy industrial area surrounded by forest and undeveloped areas. The new area required for the MOX facility is shown in **Table 2–7**. In addition to the area shown for construction, additional temporary construction laydown, storage, and parking areas were considered. The disposition facilities were to be located in and around F-Area and conform to existing industrial land use. Since these facilities would be in and around developed areas, other land uses or special-status lands would not be affected (DOE 1999:4-288).

Table 2–7 Maximum New Facility and Construction Area Requirements for the MOX Facility (acres)

Land Requirement	SPD EIS [a]	MOX ER
Construction area	29[b]	106[c]
New operational area	15	41

[a] Newly disturbed area.
[b] Includes uses such as construction laydown, construction worker parking, construction waste storage, and facility operating area.
[c] Including facility operational area; graded areas; ponds; and transmission, utility and waste lines.
Source: DOE 1999:4-287; DCS 2002a:5-102.

The MOX ER indicates that construction of the MOX facility would require approximately 41 acres of land for the operating area. In addition, the waste solidification building would be constructed near the pit disassembly and conversion facility in F-Area. The land that would be used for the MOX facility is mostly evergreen plantation. Construction on this site is consistent with other SRS uses and with the industrial land use in the surrounding area (DCS 2002a:5-1, 5-2). In addition to the 41 acres for the facility operating area, there would be additional acreage disturbed for grading and ponds; relocation of a power transmission line; installation of various utility lines and a waste pipeline; and for road widening. The total disturbed area would be about 106 acres, including 17 acres of the pit disassembly and conversion facility site that would be used to store excess soil during MOX facility construction (DCS 2002a:5-1, 5-2, 5-11, 5-12). The increase in disturbed area results from a number of changes, including the increase in operating area for the MOX facility, grading, and transmission line relocation.

Programmatic Effects. Land requirements for construction of the MOX facility analyzed in the MOX ER and the pit disassembly and conversion facility are greater than the 79 acres needed for construction of the three facilities in the SPD EIS preferred alternative. This results from a number of changes, including the increase in the operating area for the MOX facility, grading, and transmission line relocation. The 106 acres that would be disturbed during construction of the MOX facility analyzed in the MOX ER includes 17 acres of the pit disassembly and conversion facility site, where prior to facility construction, excess soil associated with MOX facility construction would be stored. Since the SPD EIS estimates that 12 acres would be needed for the pit disassembly and conversion facility, the 106 acres identified in the MOX ER represents the amount of land that would be disturbed to construct both the MOX and pit disassembly and conversion facilities.

Land required for operating areas for the MOX and pit disassembly and conversion facilities is about 48 acres as compared to 29 acres for the preferred alternative in the SPD EIS. This results from the increased operating area for the MOX facility identified in the MOX ER. Although the amount of land required for construction and operation has increased from that estimated in the

SPD EIS for the MOX facility, there is adequate land available that is consistent with the land use category.

2.2.7 Infrastructure

The SPD EIS summarizes the infrastructure available for F-Area activities and concludes that these resources are adequate for construction and operation of the MOX facility and other disposition facilities. The infrastructure requirements for MOX facility construction and operation are presented in **Tables 2–8** and **2–9**, respectively, and are compared to the available SRS infrastructure (DOE 1999:4-288, 4-289). The electricity use estimate for construction is higher in the MOX ER than in the SPD EIS, but as can be seen in Table 2–8, is well within the available site capacity. Diesel fuel use for construction is higher in the MOX ER than in the SPD EIS. This can be attributed to increased use of diesel equipment because the construction activity has increased with the increased amount of disturbed area.

Table 2–8 Maximum Site Infrastructure Requirements for MOX Facility Construction

Resource	SPD EIS		MOX ER	
	MOX Facility Requirement	Availability	MOX Facility Requirement	Availability
Transportation				
Roads (mi)	1.2	143	2	142
Railroads (mi)	0	64	0	NA
Electricity				
Energy consumption (MWh/yr)	1,900	482,700	8,000[a]	482,700
Peak load (MW)	2.1	49.5	NR	NR
Fuel				
Natural gas (m^3/yr)	NA	NA	0	NA
Diesel fuel (gal/yr)	92,000	NA	330,000	NA
Coal (t/yr)	NA	NA	NA	NA
Water (million gal/yr)	6.1	321	33	730

[a] From Jackson 2003.

Key: NA, not applicable; NR, not reported.

Source: DOE 1999:Table 4-177; DCS 2002a:Table 5-5, Jackson 2003.

Estimates of construction water use in the MOX ER increased from that shown in the SPD EIS. For further discussion of water use, see Section 2.2.5.

Table 2–9 shows changes to infrastructure requirements for operation of the MOX facility. Water use is within the availability shown in the MOX ER and SPD EIS and has decreased from that shown in the SPD EIS. Diesel fuel use has increased over that shown in the SPD EIS as a result of the use of larger diesel generators. The increased use of diesel fuel is not expected to be limiting due to the ability to procure additional resources. The increase in electrical requirements over that shown in the SPD EIS is in part due to the use of electric rather than oil-fired boilers and reflects more recent design information.

Table 2–9 Maximum Site Infrastructure Requirements for MOX Facility Operation

Resource	SPD EIS		MOX ER	
	MOX Facility Requirement	Availability	MOX Facility Requirement	Availability
Transportation				
Roads (mi)	0	143	0	142
Railroads (mi)	0	64	0	NA
Electricity				
Energy consumption (MWh/yr)	30,000	482,700	130,000	482,700
Peak load (MW)	5.2	49.5	NR	NR
Fuel				
Natural gas (m^3/yr)	NA	NA	0	NA
Diesel fuel (gal/yr)	17,000	NA[a]	111,000	NA[a]
Coal (t/yr)	890	NA	0	NA
Water (million gal/yr)	18	321	2.4	730

[a] Not applicable due to ability to p rocure additional resources.
Key: NA, not applicable; NR, not reported.
Source: DOE 1999:Table 4-178; DCS 2002a:Table 5-21.

Programmatic Effects. Infrastructure requirements for construction of the surplus plutonium disposition program based on the MOX facility as analyzed in the MOX ER with the pit disassembly and conversion facility vary compared to the preferred alternative in the SPD EIS. There is a small increase in the amount of roads and water required for construction. The amount of electricity and diesel fuel required for construction for the overall program would decrease somewhat.

Infrastructure requirements for operation of the MOX facility as analyzed in the MOX ER with the pit disassembly and conversion facility vary compared to the preferred alternative in the SPD EIS. There is no change in the amount of permanent roads required. The amount of water required would decrease. However, the amount of electricity and diesel fuel required for operation for the overall program would increase somewhat. This increase is due primarily to the use of electric boilers and the increased operation and testing of emergency and standby generators. However, there is adequate capacity available to provide the electricity, and diesel fuel would be replenished as needed.

2.2.8 Other Resource Areas

Impacts on socioeconomics, environmental justice, geology and soils, ecological resources (including threatened and endangered species and wetlands), and cultural and paleontological resources are primarily related to construction of new facilities or the number of persons employed to support the activities, and as such can be determined to be minimally affected by the proposed changes to the MOX facility. Therefore, little or no impacts beyond those discussed in the SPD EIS would be expected. Based on the description of the proposed action, DOE expects little or no adverse impact to the visual environment, or from noise generated by MOX facility construction and operation.

Noise. The SPD EIS indicates that traffic is the primary source of noise at the SRS site boundary. Major noise sources onsite are limited to developed or active areas, except for transportation noise. Most noise sources are far enough from the site boundary that noise from these sources at the boundary would not be measurable or would be barely distinguishable from background levels. Noise levels at nearby residences would be expected to be below the day/night average sound level guideline of 65 dBA for compatibility with residential land uses as defined by the Federal Aviation Administration and the Federal Interagency Committee on Urban Noise (14 CFR 150), except along major roadways.

During construction of the MOX facility, onsite noise levels could be high enough to disturb some wildlife, but no federally listed threatened or endangered species or their critical habitats would be expected to be affected. Except for temporary increases in offsite traffic noise levels from construction of the MOX facilities, construction activities and operation of the facility were not expected to cause any detectable change in noise levels offsite (DOE 1999:4-52, 4-56).

The MOX ER reached the same conclusions as the SPD EIS regarding noise. Changes proposed in the MOX facility would result in some changes in construction activity from that analyzed in the SPD EIS, for example, a larger construction area and increased duration of construction, but there would be little or no change in traffic noise levels or noise levels off the site as a result of construction activity. There would be no change in operational noise impacts from those discussed in the SPD EIS (DCS 2002a: 5-6, 5-15).

Environmental Justice. There are no anticipated environmental justice issues associated with construction of the MOX facility at SRS. MOX facility operation would pose no significant health risks to the public regardless of racial or ethnic composition, or economic status (DCS 2002a:5-9, 5-15).

Socioeconomics. Construction of the MOX facility at SRS would have minor beneficial socioeconomic impacts on the region with the addition of approximately 1,050 craft workers during the peak construction year in 2005 (DCS 2002a:5-8). The average number of construction workers during the peak year increased from approximately 772 in the SPD EIS to 950 in the MOX ER (DOE 1999:4-53; DCS 2002a:5-77). Operation of MOX facility would create 400 permanent jobs, slightly higher than the 385 projected in the SPD EIS (DOE 1999:E-12; DCS 2002a:5-16). Assuming that both temporary and permanent staff move into the area to fill the MOX facility employment needs and choose to live in one of the five counties in the region of influence (Aiken, Barnwell, and Edgefield, South Carolina; and Columbia and Richmond, Georgia), they would represent 0.28 percent of the total 2000 region of influence population (DCS 2002a:4-36; DOC 2002). Given the size of the population of the region, and the rate of growth it is currently experiencing, no appreciable socioeconomic impacts are anticipated.

Geology and Soils. Actual creation of foundations and building of structures on the proposed site would be limited to upper geologic layers, thus minimizing impacts on geology and groundwater. The soils at SRS are considered suitable for standard construction techniques and no economically viable geologic resources have been identified. Operation of the MOX facility is not expected to impact site geology (DCS 2002a:5-3, 5-12). There is therefore no change in impacts from those described in the SPD EIS (DOE 1999:4-283).

Ecological Resources. Animal populations in the areas disturbed by MOX facility construction would be affected by habitat destruction. Some of the less mobile or established animals within the construction zone could perish during land-clearing activities and from increased vehicular traffic. Activities and noise associated with construction could cause larger mammals and birds to relocate to similar habitat in the area. Likewise, animal species inhabiting areas surrounding F-Area could be disturbed by the increased noise associated with construction activities and the additional vehicular traffic could result in higher mortality for individual members of local animal populations. Although a survey conducted in 2000 did not reveal any nests of migratory birds, prior to construction the proposed site would be resurveyed. Surveys conducted in 1998 and 2000 confirmed that there were no federally listed threatened, endangered, proposed, or sensitive plant or animal species in the area designated for MOX facility construction. In June 2001, the U.S. Fish and Wildlife Service confirmed that the MOX facility project would not affect protected species or habitats. There would be no impacts on aquatic habitat from surface water consumption because water required for construction would be withdrawn from groundwater. Lastly, wetlands are not expected to be affected because erosion and sedimentation controls would be used during construction (DCS 2002a:5-5, 5-6). There is therefore little change in construction impacts from those described in the SPD EIS (DOE 1999:4-285).

The MOX ER states that noise disturbance would likely be the most significant impact of routine operation of the MOX facility on local wildlife populations. Disturbed individual members of local populations could migrate to adjacent areas of similar habitat. Impacts associated with airborne releases of criteria pollutants, hazardous and toxic air pollutants, and radionuclides would be unlikely because scrubbers and filters would be used. Impacts on aquatic habitats would be limited because all liquid would be transferred to SRS for disposal in accordance with approved permits and procedures. Furthermore, operational impacts on wetlands and other sensitive habitats and species would be unlikely because airborne and aqueous effluents would be controlled through state permits (DCS 2002a:5-14). There is therefore little change in the operational impacts from those described in the SPD EIS (DOE 1999:4-285, 4-286).

Cultural and Paleontological Resources. Archaeological surveys of F-Area in the vicinity of the proposed MOX facility site have identified four prehistoric sites that could be affected by construction. Two of the sites, 38AK546/547 and 38AK757, have the potential to yield significant information about prehistoric periods in the Aiken Plateau and have been determined to be eligible for inclusion in the National Register of Historic Places. The SPD EIS indicated that DOE would mitigate potential impacts by avoiding these sites (DOE 1999:4-286). However, the revised siting of the MOX facility makes it impossible to avoid affecting these two eligible sites, so a data recovery plan for impact mitigation was developed, approved by the South Carolina State Historic Preservation Office, and implemented. Any discoveries of cultural resources will be handled in accordance with 36 CFR 800.11 (historic properties) or 43 CFR 10.4 (Native American human remains, funerary objects, objects of cultural patrimony, and sacred objects) as well as with the terms of the SRS Programmatic Memorandum of Agreement (DCS 2002a:5-7). The mitigation field work has been completed (King 2002).

Operation of the MOX facility is not anticipated to have any impact on site or regional historic or cultural resources (DCS 2002a:5-15).

Visual Resources. The SPD EIS indicates that the only areas visually impacted by SRS facilities are those along State Highway 125 and SRS Road 1. Facilities in the F-Area cannot be seen from these roads or from the Savannah River because of the terrain and heavy vegetation. Construction and operation of the MOX facility would not result in a major change in any natural features of visual interest in the area (DOE 1999:4-287, 4-288).

The MOX ER is consistent with the discussion of visual resources in the SPD EIS. Construction and operation of the MOX facility would not effect a major change in any natural features of visual interest in the area (DCS 2002a:5-7).

Chapter 3
Transportation Impact Analysis

The SPD EIS analyzes transportation of most of the 17 MT of impure surplus plutonium metal and oxide from around the DOE complex to the proposed immobilization facility at SRS. (Some of this material was generated at SRS, and is in storage there.) Because the approximately 6.5 MT of impure plutonium metal and oxide originally intended for immobilization is part of this 17 MT of plutonium, the impacts of transporting this material are included in those presented in the SPD EIS.

Table 3–1 presents the impacts associated with transporting material for this proposed activity based on calculations performed to support the SPD EIS. The 6.5 MT of material would be moved to SRS independent of this change in disposition pathway. Since this material represents approximately 38 percent of the 17 MT that would have been transported under the immobilization option in the SPD EIS, transportation impacts would be reduced accordingly. All shipping routes were included in the total transportation impacts shown in Section 4.4.2.6 and Appendix L of the SPD EIS. All shipments would be packaged as described in Section L.3.1 and transported in safe, secure transports/safe-guarded transports as described in Section L.3.2 of the SPD EIS. Section L.6.5 of the SPD EIS discusses the consequences of sabotage or terrorist attack during transportation, and indicates that because of the Transportation Safeguards System described in its Section L.3.2, DOE considers sabotage or terrorist attack on a safe, secure transport/safe-guarded transport to be unlikely enough that no further risk analysis is needed.

Table 3–1 Transportation Impacts for Shipping Impure Plutonium Metal and Oxide

Amount of Material Shipped	Origin–Destination	Estimated Number of Shipments	Routine Transportation Impacts			Accident Impacts	
			Radiological		Nonradiological	Radiological	Nonradiological
			Crew	Public	Emission	Accident	Traffic
6.5 MT	From the DOE complex–SRS	158	1.5×10^{-3}	7.5×10^{-4}	2.9×10^{-3}	1.7×10^{-4}	4.0×10^{-3}

Note: All impacts are expressed as latent cancer fatalities during the implementation of the action, except for the nonradiological accident impacts, which is number of fatalities.

As discussed in the SPD EIS, onsite transportation of radioactive materials would be accomplished using closed roads, DOE-approved packages, and other local safety and security procedures, which minimize the risk to the public. The MOX ER indicates that since onsite transportation of plutonium feedstock would not utilize public roads, there is no need to consider additional environmental impacts of this transportation (DCS 2002a:5-30).

Programmatic Effects. Table 3–2 compares the transportation impacts presented in the SPD EIS to those estimated for the current surplus plutonium disposition program. The total shipments of radioactive materials would decrease from approximately 2,500 shipments to approximately 1,800 shipments. This decrease is due to the smaller amount of plutonium dispositioned under the current program, and the elimination of shipments of depleted uranium, uranium oxide and high-level waste for the immobilization process. Incident-free transportation of radioactive materials under the current program would be expected to result in reduced LCFs among transportation workers (2.1×10^{-3}) and in the total affected population (6.1×10^{-3}) over the duration of the transportation activities. The estimated number of nonradiological fatalities from vehicular emissions would also be lowered to 1.1×10^{-2}. In addition, the total transportation accident risk to the affected population from all hypothetical accidents under the current program would be expected to result in reduced total population risk (3.4×10^{-3} LCF) and reduced traffic accident fatalities (2.3×10^{-2}).

Table 3–2 Surplus Plutonium Disposition Program Transportation Impacts

	Amount of Material Shipped	Estimated Number of Shipments	Routine Transportation Impacts			Accident Impacts	
			Radiological		Nonradiological	Radiological	Nonradiological
			Crew	Public	Emission	Accident	Traffic
SPD EIS	50 MT	2,500	2.4×10^{-2}	3.4×10^{-2}	1.9×10^{-2}	3.7×10^{-3}	5.3×10^{-2}
Current Program	34 MT	1,800	2.1×10^{-3}	6.1×10^{-3}	1.1×10^{-2}	3.4×10^{-3}	2.3×10^{-2}

Note: All impacts are expressed as latent cancer fatalities during the implementation of the action, except for the nonradiological accident impacts, which is number of fatalities.
Source: DOE 1999:4-66.

Waste Transport. All of the proposed activities considered in this SA involve generation of waste. As discussed in the SPD EIS (DOE 1999:L-24), all DOE sites have plans and procedures for handling and transporting waste. This transportation would be handled in the same manner as other site waste shipments and would not generally represent any additional risks beyond the ordinary waste shipments at these sites as analyzed in the *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (DOE 1997b).

With respect to TRU waste, it is estimated that approximately 57 shipments per year,[12] for a total of 570 shipments, would be required to transport MOX facility TRU waste from SRS to WIPP. The WIPP SEIS evaluated, depending on the specific alternative, the transport of between 2,238 and 3,591 shipments of TRU waste from SRS to WIPP (DOE 1997a:E-15, E-16). In addition, *DOE's National TRU Waste Management Plan* identifies that 1,829 shipments of TRU waste are currently scheduled to be transported from SRS to WIPP through 2035 (DOE 2000:132). Because shipments of TRU waste from the MOX program are not included as part of the scheduled shipments, their addition would increase the total estimated shipments of TRU waste from SRS to WIPP to 2,399. However, this material would be packaged and shipped to meet the WIPP waste acceptance criteria, using the same types of vehicles, packaging, and payload configuration as other TRU waste being transported to WIPP (DOE 1997a:A-5). Therefore, the total transportation impacts of TRU waste shipments from SRS to WIPP, even with this increase, would still remain within the range of the transportation impacts of shipments analyzed in the WIPP SEIS. Moreover, shipments from SRS would represent only a small fraction of the 29,766 total DOE complex-wide shipments evaluated as part of the WIPP SEIS proposed action (DOE 1997a:E-15). Finally, the overall impact of these 570 additional TRU waste shipments from SRS to WIPP would be somewhat offset by the elimination of the 145 shipments of immobilized plutonium that would have been transported from SRS to a geologic high-level

[12] The MOX ER (DCS 2002a:G-31) estimates that 35 shipments of TRU waste per year would be required to transport solidified high-alpha and job control wastes associated with the solidification process. In addition, 190 m^3 (DCS 2002a:3-54) of job control waste would be generated by the MOX facility and managed as part of the SRS TRU waste inventory. This job control waste is estimated to result in 22 additional TRU waste shipments from SRS to WIPP each year, resulting in a total of 57 TRU waste shipments annually.

waste repository as part of the immobilization portion of the surplus plutonium disposition program (DOE 1999:L-15).

Chapter 4
Conclusions

In accordance with Council on Environmental Quality regulations at 40 CFR 1502.9(c) and DOE regulations at 10 CFR 1021.314(c), this SA evaluates proposed changes in the surplus plutonium disposition program to determine whether the SPD EIS should be supplemented, a new EIS should be prepared, or no further NEPA documentation is necessary.

Based on the analyses in this SA, proposed changes to the MOX facility resulting from the detailed design process and information gained during that process, the processing of an additional 1 MT of surplus plutonium into MOX fuel, and the proposed fabrication into MOX fuel of certain impure plutonium originally destined for immobilization would not result in impacts significantly different from or greater than those described in the SPD EIS. Where there are differences in impacts, they are small changes to impacts that are themselves small and result only in environmental concerns that are well within DOE's capacity to manage. Therefore, the activities and information evaluated in the SA do not represent substantial changes in any proposed actions or result in any new circumstances relevant to environmental concerns.

Although LLW, TRU waste, and nonradioactive, nonhazardous wastewater generation from the MOX facility would increase over levels identified in the SPD EIS, there is sufficient capacity within the waste management infrastructure at SRS, and available disposal capacity within the DOE complex to accommodate the additional waste. Further, from a programmatic perspective, nonradioactive, nonhazardous wastewater generation would decrease. Including shipments of TRU waste generated by MOX facility operations, the total number of shipments of TRU waste from SRS to WIPP remains within the number of shipments evaluated in the WIPP SEIS. The amount of land estimated to be temporarily and permanently disturbed for construction of the MOX facility has increased. However, construction of the MOX facility in F-Area is consistent with other SRS uses and with the surrounding industrial land use. Changes to the MOX facility and associated operations would result in only minor additional impacts on other resource areas, including an overall decrease in water use and a small positive socioeconomic benefit from the need for a slightly larger workforce. No new or different bounding accident scenarios or impacts have been identified, and operation of the MOX facility continues to pose no more than a small risk to human health.

Chapter 5
Determination

The analyses in this SA indicate that the activities and potential environmental impacts associated with the proposed processing of 6.5 MT of surplus plutonium originally intended for immobilization and the increase in the total amount of surplus plutonium to be fabricated into MOX fuel from 33 MT to 34 MT are not different in kind, and only slightly in degree, from those described in the SPD EIS. Processing this material in the MOX facility at SRS would not constitute significant new circumstances or information relevant to environmental concerns and bearing on the previously analyzed action or its impacts. In addition, the design changes and other information obtained during the detailed design process also have not resulted in impacts that are significantly different from or greater than those analyzed in the SPD EIS. Therefore, pursuant to 10 CFR 1021.314(c), no additional NEPA analyses are required in order to determine whether to fabricate the additional material into MOX fuel.[13]

Issued in Washington, D.C., this 17th day of April, 2003.

Linton F. Brooks
Acting Administrator
National Nuclear Security Administration

[13] This conclusion is intended solely to address DOE/NNSA's NEPA responsibilities in connection with its determination regarding the method for disposing of these materials. It is not intended to address any other DOE/NNSA responsibilities in connection with the MOX facility, or any matters within the authority of the NRC.

Chapter 6
References

Birch, M.L., 2003, Duke Cogema Stone & Webster, Charlotte, NC, personal communication (email) to C. Groome, Science Applications International Corporation, Germantown, MD, “Met Data Impact on Normal Dose Calcs in ER,” April 2.

Bowling, T.J., 2002a, Duke Cogema Stone & Webster, Charlotte, NC, personal communication (email) to C. Groome, Science Applications International Corporation, Germantown, MD, “Questions for MOX Supplement Analysis,” April 3.

Bowling, T.J., 2002b, Duke Cogema Stone & Webster, Charlotte, NC, personal communication (email) to C. Groome, Science Applications International Corporation, Germantown, MD, “MFFF Water Balance,” July 9.

DCS (Duke Cogema Stone & Webster), 2001, *The Mixed Oxide Fuel Fabrication Facility Construction Authorization Request*, Docket Number 070-03098, rev. 2/28/01, Charlotte, NC.

DCS (Duke Cogema Stone & Webster), 2002a, *Mixed Oxide Fuel Fabrication Facility Environmental Report,* Revisions 1 and 2, Charlotte, NC, July.

DCS (Duke Cogema Stone & Webster), 2002b, Letter Number DCS-NRC-000116 from Peter S. Hastings to Document Control Desk, U.S. Nuclear Regulatory Commission, “Docket Number 070-03098, Duke Cogema Stone & Webster, Mixed Oxide Fuel Fabrication Facility, Responses to the Request for Additional Information on the Environmental Report, Revisions 1 & 2,” October 29.

DCS (Duke Cogema Stone & Webster), 2002c, Letter Number DCS-NRC-000121 from Peter S. Hastings to Document Control Desk, U.S. Nuclear Regulatory Commission, “Docket Number 070-03098, Duke Cogema Stone & Webster, Mixed Oxide Fuel Fabrication Facility, Update to Mixed Oxide Fuel Fabrication Facility Environmental Report Revisions 1 & 2,” December 10.

DOC (U.S. Department of Commerce), 2002, *Profile of General Demographic Characteristics: 2000*, DP-1, http://factfinder.census.gov, April 11.

DOE (U.S. Department of Energy), 1994, *Airborne Release Fractions/Rates and Respirable Fractions for Nonreactor Nuclear Facilities*, DOE Handbook DOE-HDBK-3010-94, Washington, DC, October.

DOE (U.S. Department of Energy), 1995, *Final Environmental Impact Statement Interim Management of Nuclear Materials*, DOE/EIS-0220, Savannah River Site, Aiken, SC, October.

DOE (U.S. Department of Energy), 1996, *Accident Analysis for Aircraft Crash Into Hazardous Facilities*, DOE-STD-3014-96, Washington, DC, October.

DOE (U.S. Department of Energy), 1997a, *Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement*, DOE/EIS-0026-S-2, Carlsbad Area Office, Carlsbad, NM, September.

DOE (U.S. Department of Energy), 1997b, *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), 1999, *Surplus Plutonium Disposition Final Environmental Impact Statement*, DOE/EIS-0283, Office of Fissile Materials Disposition, Washington, DC, November.

DOE (U.S. Department of Energy), 2000, *The National TRU Waste Management Plan*, DOE/NTB-96-1204, Rev. 2, Carlsbad Field Office, Carlsbad, NM.

DOE (U.S. Department of Energy), 2002, *Transuranic Waste Performance Management Plan*, Carlsbad Field Office, Carlsbad, NM, August.

Jackson, Ronald J., 2003, Duke Cogema Stone & Webster, Charlotte, NC, personal communication (memorandum) to Mary L. Birch, Duke Cogema Stone & Webster, Charlotte, NC, "Construction Power Requirements," January 13.

King, Adam, 2002, Savannah River Archaeological Research Program, personal communication (email) to C. Groome, Science Applications International Corporation, "Archaeological Mitigation," May 15.

NRC (U.S. Nuclear Regulatory Commission), 1981, *Standard Review Plan*, NUREG-0800, Washington, DC, July.

NRC (U.S. Nuclear Regulatory Commission), 1998a, *Nuclear Fuel Cycle Facility Accident Analysis Handbook*, NUREG/CR-6410, Washington, DC, March.

NRC (U.S. Nuclear Regulatory Commission), 1998b, *Nuclear Criticality Safety Standards for Fuels and Material Facilities*, Regulatory Guide 3.71, Washington, DC.

NRC (U.S. Nuclear Regulatory Commission), 2003, *Environmental Impact Statement on the Construction and Operation of a Mixed Oxide Fuel Fabrication Facility at the Savannah River Site, South Carolina*, Draft NUREG-1767, February.

ORNL (Oak Ridge National Laboratory), 1998, *Final Data Report Response to the Draft Surplus Plutonium Disposition Environmental Impact Statement Data Call for Generic Site Add-On Facility for Plutonium Polishing*, ORNL/TM-13669, Oak Ridge, TN, June.

St. Pierre, J., 2002, Duke Cogema Stone & Webster, personal communication (interoffice memorandum) to Distribution, "MFFF Building Square Footage," May 14.

Stumm, W., and J.J. Morgan, 1981, *Aquatic Chemistry*, John Wiley and Sons, Inc., New York, NY.

WSRC (Westinghouse Savannah River Company), 2001, *Savannah River Site Environmental Report for 2000*, WSRC-TR-2000-00328, Aiken, SC.

WSRC (Westinghouse Savannah River Company), 2002, *Transuranic Waste Disposition Plan*, WSRC-RP-2001-00916, Aiken, SC, March.

Code of Federal Regulations

10 CFR 70, U.S. Nuclear Regulatory Commission, "Domestic Licensing of Special Nuclear Material," *Code of Federal Regulations*, Washington, DC.

10 CFR 1021, U.S. Department of Energy, "National Environmental Policy Act Implementing Procedures," *Code of Federal Regulations*, Washington, DC.

14 CFR 150, U.S. Department of Transportation, Federal Aviation Administration, "Airport Noise Compatibility Planning," *Code of Federal Regulations*, Washington, DC.

36 CFR 800, Advisory Council on Historic Preservation, "Protection of Historic Properties," *Code of Federal Regulations*, Washington, DC.

40 CFR 1502, Council on Environmental Quality, "Environmental Impact Statement," *Code of Federal Regulations*, Washington, DC.

43 CFR 10.4, U.S. Department of the Interior, "Native American Graves Protection and Repatriation Regulations, Inadvertent Discoveries" *Code of Federal Regulations*, Washington, DC.

Federal Register

65 FR 1608, U.S. Department of Energy, "Record of Decision for the Surplus Plutonium Disposition Final Environmental Impact Statement," *Federal Register*, Washington, DC, January 11, 2000.

67 FR 19432, U.S. Department of Energy, "Surplus Plutonium Disposition Program, Amended Record of Decision," *Federal Register*, Washington, DC, April 19, 2002.

68 FR 9728, U.S. Nuclear regulatory Commission, "Notice of Availability of Draft Environmental Impact Statement for the Construction and Operation of the Proposed Mixed Oxide Fuel Fabrication Facility at the Savannah River Site, South Carolina, and Notice of Public Meetings," *Federal Register*, Washington, D.C., February 28, 2003.