Duke Cogema Stone & Webster

Mixed Oxide Fuel Fabrication Facility Environmental Report, Revision 1&2

Docket Number 070-03098

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Charlotte, NC 28202

Form PP7-4A
Revision 2

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REVISION DESCRIPTION SHEET

REVISION NUMBER	PAGES REVISED AND DESCRIPTION
0	Original Issue
1	Update to include responses to NRC Requests for Additional Information, minor editorial corrections.
2	Supplement to include information on alternate feedstock and solidification of liquid high alpha waste. Incorporates changes resulting from amended ROD for SPD FEIS and S&D PEIS. Incorporated any design changes since December 2000.

EXECUTIVE SUMMARY

This Environmental Report was prepared by Duke Cogema Stone & Webster, the applicant, for a 10 CFR Part 70 license to possess and use special nuclear material in a Mixed Oxide Fuel Fabrication Facility for the U.S. Department of Energy on the Savannah River Site near Aiken, South Carolina, in accordance with applicable regulations of the U.S. Nuclear Regulatory Commission. The Department of Energy will own the Mixed Oxide Fuel Fabrication Facility and has contracted with Duke Cogema Stone & Webster to design, construct, functionally test, operate, and ultimately deactivate the facility. Duke Cogema Stone & Webster (a Limited Liability Company owned by Duke Project Services Group; COGEMA, Inc.; and Stone & Webster, Inc., a Shaw Group Company) will be the license holder for the Mixed Oxide Fuel Fabrication Facility. The facility is an integral part of the overall U.S. Government's strategy for the disposition of surplus plutonium in accordance with the following: R2

- *Nonproliferation and Export Control Policy* (White House 1993)
- *Joint Statement by the President of the Russian Federation and the President of the United States on the Non-Proliferation of Weapons of Mass Destruction and the Means of Their Delivery* (White House 1994)
- *Joint Statement of Principles for Management and Disposition of Plutonium Designated as No Longer Required for Defense Purposes* (White House 1998).
- *Agreement Between the Government of the United States of America 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* (White House 2000) R1

R1

This Environmental Report will be used by the Nuclear Regulatory Commission in support of its effort to prepare an Environmental Impact Statement in connection with the licensing of the Mixed Oxide Fuel Fabrication Facility. Issuance of a Nuclear Regulatory Commission license to possess special nuclear material at the Mixed Oxide Fuel Fabrication Facility is an essential component of the United States Government's overall surplus plutonium disposition strategy.

This Environmental Report and the Nuclear Regulatory Commission's subsequent Environmental Impact Statement are not the first environmental evaluations performed in connection with the Government's surplus plutonium disposition strategy. The Department of Energy conducted extensive environmental evaluations of alternatives for implementing this overall strategy in the following documents: R1

- *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (DOE 1996b)
- *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement Record of Decision* (DOE 1997c)

- *Surplus Plutonium Disposition Final Environmental Impact Statement* (DOE 1999c)
- *Surplus Plutonium Disposition Final Environmental Impact Statement Record of Decision* (DOE 2000b)
- *Surplus Plutonium Disposition Final Environmental Impact Statement and Storage and Disposition Programmatic Environmental Impact Statement Amended Record of Decision* (DOE 2002). R2

These environmental evaluations considered numerous alternatives for storage and disposition of surplus plutonium and highly enriched uranium. This Environmental Report has adopted and utilizes, as appropriate, many of the results of the evaluations already performed by the Department of Energy.

In reviewing this Environmental Report, it is important to consider both the scope of the environmental determinations already made by the Department of Energy and the scope of the proposed action presently before the Nuclear Regulatory Commission for decision on the basis of environmental (as well as safety and security) considerations. The extensive evaluations previously performed by the Department of Energy have determined the following:

- There is a need for an effective national program for the disposition of surplus United States' plutonium.
- That need should be addressed through the irradiation of 37.5 tons (34 metric tons) of plutonium. R2
- A mixed oxide fuel fabrication facility designed to process and manufacture 37.5 tons (34 metric tons) of plutonium on a schedule consistent with the disposition strategy of the United States Government should be established. R2
- The fuel fabrication facility should be constructed on the Department of Energy's Savannah River Site in F Area.
- The surplus disposition program will not use immobilization. R2

These determinations were made based upon over five years of extensive environmental analysis. What the Department of Energy's analyses did not fully address were all of the site- and facility-specific impacts associated with the construction, and operation of the Mixed Oxide Fuel Fabrication Facility on the Savannah River Site. These impacts, along with the cumulative impacts of other activities that could affect the environment, are addressed in this Environmental Report. R1

The proposed action evaluated in this Environmental Report is the issuance of a 10 CFR Part 70 license to Duke Cogema Stone & Webster for the possession and use of special nuclear material at the Mixed Oxide Fuel Fabrication Facility on the Savannah River Site. The impacts of this proposed action are compared to the impacts from a reasonable range of alternatives. These alternatives include (1) a No Action Alternative (i.e., denial of the Part 70 license on the basis of environmental considerations); (2) certain siting alternatives within F Area at the Savannah River Site (the selection of F Area having already been decided by the Department of Energy); and (3) certain facility design alternatives.

The results of the analyses in this Environmental Report can be summarized as follows. The proposed action will satisfy the need for the establishment and operation of a Mixed Oxide Fuel Fabrication Facility in support of the Government's overall surplus plutonium disposition strategy. The No Action Alternative will not satisfy that need. Consideration of reasonable siting alternatives demonstrates that there is no other site that is obviously superior to the proposed site. Consideration of reasonable design alternatives demonstrates that none have substantial environmental advantages over the proposed design. After weighing the environmental, economic, technical, and other benefits against environmental costs associated with the proposed action, and considering available alternatives, this Environmental Report demonstrates that, subject to the completion of the Nuclear Regulatory Commission's review of safety and security considerations, the action called for is the issuance of the proposed license by the Nuclear Regulatory Commission.

The following discussion summarizes the analyses leading to the aforementioned results. The Mixed Oxide Fuel Fabrication Facility will be located in F Area of the Department of Energy-owned Savannah River Site. Other plutonium disposition facilities owned by the Department of Energy and operated by its Management and Operating Contractor will also be located in F Area near the fuel fabrication facility. The proposed facilities will use various existing sitewide infrastructure and services, such as security, emergency management, radiation monitoring, environmental monitoring, and waste management.

Related to the proposed action, the Department of Energy will construct and operate a facility for disassembling nuclear weapon pits and converting the recovered plutonium, as well as plutonium from other sources, into plutonium dioxide for disposition. The Pit Disassembly and Conversion Facility will be located near the Mixed Oxide Fuel Fabrication Facility and will provide plutonium dioxide feedstock for the fuel fabrication facility[1]. Although the Pit Disassembly and Conversion Facility is not part of this proposed action, its environmental impacts are addressed in this Environmental Report as part of the discussion on cumulative impacts. R2

As part of the Pit Disassembly and Conversion Facility, the Department of Energy is also constructing the Waste Processing Building. This facility will process, package, and ship for ultimate disposal certain liquid wastes from the Mixed Oxide Fuel Fabrication Facility and the Pit Disassembly and Conversion Facility. The Waste Processing Building is not part of the proposed action for this Environmental Report. Like the Pit Disassembly and Conversion Facility, the impacts of the Waste Processing Building are included in this Environmental Report as part of the discussion on cumulative impacts. Because the impacts of the Waste Processing R2 R2

[1] The Mixed Oxide Fuel Fabrication Facility will also obtain feedstock from material stored in the K-Area Material Storage Facility. Cancellation of the Plutonium Immobilization Plant created the option of using alternate feedstock for the Mixed Oxide Fuel Fabrication Facility. This supplement to the previous Environmental Report reflects changes in the facility design to accommodate alternate feedstock. R2

Building have not been addressed in a previous environmental document, a discussion of the specific impacts is included in an appendix to this Environmental Report. R2

The Mixed Oxide Fuel Fabrication Facility is designed to convert up to 37.5 tons (34 metric tons) of plutonium oxide to mixed oxide fuel. The mixed oxide fuel will be transported to and irradiated in commercial nuclear power reactors: two units at the Catawba Nuclear Station near York, South Carolina, and two units at the McGuire Nuclear Station near Huntersville, North Carolina. The addition of alternative feedstock will result in the need for increased irradiation capacity; DOE intends to make provisions for this capacity. For purposes of this environmental report, it is assumed that two generic mission reactors provide this increased capacity. The environmental impacts of depleted uranium feedstock and product transport are considered in this Environmental Report. The environmental impacts of transporting plutonium feedstock to the Savannah River Site were evaluated in *Surplus Plutonium Disposition Final Environmental Impact Statement,* issued in November 1999 (DOE 1999c). The environmental impacts of irradiating the mixed oxide fuel in six reactors were evaluated as part of the *Surplus Plutonium Disposition Final Environmental Impact Statement,* issued in November 1999 (DOE 1999c). The irradiation of the mixed oxide fuel is not part of this proposed licensing action but will be the subject of a separate Nuclear Regulatory Commission licensing action and environmental review. Nevertheless, the impacts of such irradiation are addressed as cumulative impacts in this Environmental Report. R2 R2 R2

The Mixed Oxide Fuel Fabrication Facility is designed for 20 years of operation beginning in 2007. Any significant delay in the schedule that will impact the projected operational date of the facility could jeopardize the availability of the mission reactors to irradiate the fuel. After the surplus plutonium is converted to mixed oxide fuel, the facility will be deactivated and turned over to the Department of Energy. R2

Construction of the Mixed Oxide Fuel Fabrication Facility will disturb 106 ac (43 ha), most of which will be returned to original use after construction. Once constructed, the Mixed Oxide Fuel Fabrication Facility will occupy 41 ac (16.6 ha). Approximately 17 ac (6.9 ha) of the 41-ac (16.6-ha) Mixed Oxide Fuel Fabrication Facility site will be developed with buildings, facilities, or paving. The remaining 24 ac (9.7 ha) will be landscaped in either grass or gravel. The protected area inside the double fence Perimeter Intrusion Detection and Assessment System occupies approximately 14 ac (5.7 ha) and is roughly square in shape. There are no wetlands or other critical habitat that will be affected by the construction or operation of the Mixed Oxide Fuel Fabrication Facility. R1

The mixed oxide fuel fabrication process and plant design are based on the COGEMA MELOX and La Hague Plutonium Finishing Facilities located in Marcoule and La Hague, France, respectively. The plant design has been modified to meet appropriate United States regulations and standards. The fuel fabrication subprocess is similar to what is operating in MELOX, while the aqueous polishing subprocess is similar to what is operating in La Hague.

The Mixed Oxide Fuel Fabrication Facility consists of an aqueous polishing and fuel fabrication building, secured warehouse, and various support buildings. Aqueous polishing is performed to remove impurities from the plutonium and produces most, but not all, of the liquid radioactive R1 waste that will be transferred to the Savannah River Site waste treatment facilities. Extensive reuse of reagents in the process results in a significant reduction of waste generated from the process. The mixed oxide fuel fabrication process blends plutonium and uranium oxides, converts the mixed oxide powder to fuel pellets, loads fuel pellets into rods, and bundles the rods into fuel assemblies. This process produces solid scrap material, which is recycled in the overall process. Airborne emissions are collected from process ventilation (gloveboxes and equipment) and from building ventilation in the fuel fabrication building. Those emissions are treated, filtered, monitored, and released. Small amounts of contaminated solid waste are produced during maintenance activities at the Mixed Oxide Fuel Fabrication Facility. R1

The radiation protection and waste management programs for the Mixed Oxide Fuel Fabrication Facility are guided by the principles of dose minimization through As Low As Reasonably Achievable (ALARA) design and administrative programs, waste minimization, and pollution prevention. Liquid and solid wastes will be transferred to the appropriate Savannah River Site waste management facilities and will meet applicable waste acceptance criteria for those facilities.

The principal benefit of the proposed action is to implement the joint United States and Russian Federation Agreement to convert [Text Deleted] surplus plutonium to mixed oxide fuel into a form that meets the *Spent Fuel Standard* recommended by the National Academy of Sciences. In addition to the benefit of implementing the United States and Russian Federation Agreement, the proposed action also results in the consumption of surplus depleted uranium from current stockpiles and additional benefits to the local community around the Savannah River Site by providing approximately 400 full-time jobs over the lifetime of the project. The jobs will have a definite, although somewhat non-quantifiable, economic benefit to these communities by counterbalancing current job losses in the area. R2

Because the Mixed Oxide Fuel Fabrication Facility does not use process storage or treatment ponds, there will not be any liquid effluent released to the environment, so there are no expected impacts on surface water or groundwater. The MFFF site will have a stormwater collection and routing system that will discharge through the existing Savannah River Site stormwater National Pollutant Discharge Elimination System outfall or new outfalls. There may be slight temporary impacts from construction runoff, but these impacts should disappear once construction is completed.

The Mixed Oxide Fuel Fabrication Facility will have emergency and standby diesel generators that will be tested periodically, which will result in criteria pollutant emissions during the testing periods. Incremental increases in ambient concentrations of these criteria pollutants will be well below the ambient air quality standards for southwestern South Carolina. The mixed oxide fuel fabrication process also will release small quantities of nitrogen oxides and chlorine. The annual releases are accounted for in the nitrogen dioxide projections for the facility. Chlorine releases are well below any applicable federal and state guidelines. Radiological dose to the public will be well below the criteria of the Nuclear Regulatory Commission and U.S. Environmental Protection Agency and below background radiation levels. R2

The construction and operation of the Mixed Oxide Fuel Fabrication Facility will have no impacts on sensitive ecological areas. The construction of the facility will require the excavation and recovery of two archaeological sites. Although the site is not expected to contain any human or sacred artifacts, the excavation and recovery of the artifacts would represent a benefit through the preservation of the artifacts. R2

The most notable impact of operations at the Mixed Oxide Fuel Fabrication Facility will be the amount of waste generated. The Mixed Oxide Fuel Fabrication Facility will generate a liquid high alpha activity waste, which is a transuranic waste form. With the exception of liquid high alpha activity waste, the amounts generated are a small fraction of annual waste generation at the Savannah River Site. The liquid high alpha activity waste generated by the Mixed Oxide Fuel Fabrication Facility will be transferred to the Waste Processing Building. The waste will be converted to a solid form for disposal at the Waste Isolation Pilot Plant in New Mexico. R1 R2 R2

Cumulative impacts in the geographic vicinity of the Mixed Oxide Fuel Fabrication Facility and the Savannah River Site are dominated by the impacts of existing activities at the Savannah River Site. The Savannah River Site is currently in substantial compliance with all federal, state, and local air quality regulations and would continue to remain well within compliance, even with the consideration of the cumulative effects of all surplus plutonium disposition activities. The surplus plutonium disposition facilities would cause the cumulative dose to the public from all Savannah River Site activities to increase by about 2.6%. All wastes, except transuranic waste, from the fuel fabrication facility represent very small (<10%) additions to the current Savannah River Site waste generation rates and should not represent any significant cumulative impact. R2

The cumulative impacts resulting from transport of feedstock and mixed oxide fuel are also low. Total dose to transportation workers associated with plutonium feedstock was addressed in the *Surplus Plutonium Disposition Final Environmental Impact Statement,* issued in November 1999 (DOE 1999c) and estimated as 7.8 person-rem. The total dose to the transportation workers associated with the uranium hexafluoride and uranium oxide shipments is estimated to be 1.06 and 0.78 person-rem, respectively. Total dose to the public associated with plutonium feedstock was also addressed in DOE 1999c and estimated at 4.1 person-rem. The dose to the public associated with the uranium hexafluoride and uranium oxide shipments is estimated to be 0.21 and 0.14 person-rem, respectively. The cumulative dose to the transportation workers associated with the mixed oxide fuel shipments is estimated to be 34.1 person-rem and the dose to the public is estimated to be 9.98 person-rem. R1 R2

[Text Deleted]

This Environmental Report relied on the mission reactor impacts analysis provided in the *Surplus Plutonium Disposition Final Environmental Impact Statement* (DOE 1999c). The Environmental Impact Statement determined that there should be no change in impacts to the environment during normal operations at the mission reactors resulting from the irradiation of mixed oxide fuel. This conclusion is reinforced by operating experience from Electricite de France, which operates mixed oxide fueled power plants in France.

Because the mixed oxide fuel that will be produced by the Mixed Oxide Fuel Fabrication Facility represents less than 1% of the domestic commercial nuclear fuel use, financial impacts to commercial fuel facilities should be minimal.

Although the proposed action does have environmental impacts, the impacts are small and consequently acceptable. The environmental impacts are outweighed by the benefit of enhancing nuclear weapons reductions.

The No Action Alternative is the denial of a license to possess and use special nuclear material in a Mixed Oxide Fuel Fabrication Facility at the Savannah River Site. Because of previous Department of Energy decisions in the *Surplus Plutonium Disposition Final Environmental Impact Statement Record of Decision* (DOE 2000b), the consequence of the No Action Alternative is continued storage of surplus plutonium [Text Deleted]. The No Action Alternative does not meet the need of implementing the joint United States and Russian Federation Agreement [Text Deleted]. The primary benefit of the No Action Alternative is the avoidance of impacts associated with the proposed action. This avoidance is most significant in the area of waste generation. R2 R1

In the *Surplus Plutonium Disposition Final Environmental Impact Statement* (DOE 1999c), the Department of Energy evaluated several combinations of facilities and sites. In the subsequent Record of Decision (DOE 2000b), the Department of Energy decided to locate the Mixed Oxide Fuel Fabrication Facility in F Area at the Savannah River Site. Subsequent to the Record of Decision, the Department of Energy investigated several sites within F Area for the fuel fabrication facility and other surplus plutonium disposition facilities.

Environmental impacts associated with facility operations (i.e., land use, water use, radiological and nonradiological emissions, and waste generation) are unaffected by the selection of any site within F Area. The selected site does not have wetlands or critical habitat; some alternative sites included wetlands. [Text Deleted] However, the selected site will require mitigation of an archaeological site, while some alternative sites would have avoided the archaeological site. In the final evaluation, none of the alternative sites were obviously superior to the selected site. R1

One of the bases for selection of Duke Cogema Stone & Webster as the contractor was that their proposal to use a proven design (the COGEMA process) based on actual operations of similar facilities in France. The COGEMA design represents the results of several iterations of process design and operating experience over 25 years of mixed oxide fuel production in France. This design optimizes both production and safety. The selection of Duke Cogema Stone & Webster and the contractual arrangements with the Department of Energy established the basic design of the facility and process. In the process of adapting the COGEMA design, based on the MELOX and La Hague facilities, to meet United States regulations, codes, and standards, Duke Cogema Stone & Webster considered several design alternatives. In each case, the design alternatives selected resulted in lower environmental impact. R1

The conclusion of the environmental analysis conducted in this Environmental Report is that the environmental impacts are outweighed by the reductions in weapons-grade plutonium stockpiles achieved in Russia and the United States through effective implementation of the national program for disposition of surplus plutonium.

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LIST OF ACRONYMS AND ABBREVIATIONS

°C	degrees Celsius (Centigrade)
°F	degrees Fahrenheit
46°26'07"	46 degrees, 26 minutes, 7 seconds
ac	acre
AFS	alternate feedstock R2
ALARA	as low as reasonably achievable
ALOHA	Areal Locations of Hazardous Atmospheres
ANS	American Nuclear Society
ANSI	American National Standards Institute
APSF	Actinide Packaging and Storage Facility
ARF	airborne release fraction
ARR	airborne release rate
bgs	below ground surface
BMP	Best Management Practice
Bq	Becquerel
Btu	British thermal unit
CAA	Clean Air Act
CAR	Construction Authorization Request
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
Ci	Curie
CISAC	Committee on International Security and Arms Control
cm	centimeter
COE	U.S. Army Corps of Engineers
CPT	cone penetration test
CSWTF	Central Sanitary Waste Treatment Facility
CWA	Clean Water Act
D&D	decontamination and decommissioning
dB	decibel
dBA	decibels A-weighted
DCS	Duke Cogema Stone & Webster, LLC
DOE	U.S. Department of Energy
DOE-MD	U.S. Department of Energy Office of Fissile Materials Disposition
DOE-SR	U.S. Department of Energy Savannah River Operations Office
DOI	U.S. Department of Interior
DOT	U.S. Department of Transportation
DR	damage ratio
DWPF	Defense Waste Processing Facility
EF	efficiency factor

EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
ER	Environmental Report
ETF	Effluent Treatment Facility
FFCA	Federal Facility Compliance Act
FR	Federal Register
ft	foot
ft^2	square foot
ft^3	cubic foot
g	acceleration due to gravity
g	gram
gal	gallon
GDP	Gaseous Diffusion Plant
GE	General Electric
GPG	Good Practice Guide
GSAR	Generic Safety Analysis Report
ha	hectare
HEPA	high-efficiency particulate air
HEU	highly enriched uranium
HLW	high-level radioactive waste
hr	hour
HVAC	heating, ventilation, and air conditioning
ICRP	International Commission on Radiological Protection
in	inch
INEEL	Idaho National Engineering and Environmental Laboratory
IROFS	items relied on for safety
ISCST	Industrial Source Complex Short-Term
kg	kilogram
km	kilometer
km^2	square kilometer
kV	kilovolt
kW	kilowatt
L	liter
LANL	Los Alamos National Laboratory
lb	pound
LCF	latent cancer fatality
LDR	Land Disposal Restrictions
LLC	Limited Liability Company
LLNL	Lawrence Livermore National Laboratory
LLW	low-level radioactive waste
LPF	leak path factor
LWR	light water reactor
m	meter
M	molar

LIST OF ACRONYMS AND ABBREVIATIONS

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ALOHA	Areal Locations of Hazardous Atmospheres
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ANSI	American National Standards Institute
APSF	Actinide Packaging and Storage Facility
ARF	airborne release fraction
ARR	airborne release rate
bgs	below ground surface
BMP	Best Management Practice
Bq	Becquerel
Btu	British thermal unit
CAA	Clean Air Act
CAR	Construction Authorization Request
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
Ci	Curie
CISAC	Committee on International Security and Arms Control
cm	centimeter
COE	U.S. Army Corps of Engineers
CPT	cone penetration test
CSWTF	Central Sanitary Waste Treatment Facility
CWA	Clean Water Act
D&D	decontamination and decommissioning
dB	decibel
dBA	decibels A-weighted
DCS	Duke Cogema Stone & Webster, LLC
DOE	U.S. Department of Energy
DOE-MD	U.S. Department of Energy Office of Fissile Materials Disposition
DOE-SR	U.S. Department of Energy Savannah River Operations Office
DOI	U.S. Department of Interior
DOT	U.S. Department of Transportation
DR	damage ratio
DWPF	Defense Waste Processing Facility
EF	efficiency factor
EIS	Environmental Impact Statement

EPA	U.S. Environmental Protection Agency
ER	Environmental Report
ETF	Effluent Treatment Facility
FFCA	Federal Facility Compliance Act
FR	Federal Register
ft	foot
ft^2	square foot
ft^3	cubic foot
g	acceleration due to gravity
g	gram
gal	gallon
GDP	Gaseous Diffusion Plant
GE	General Electric
GPG	Good Practice Guide
GSAR	Generic Safety Analysis Report
ha	hectare
HEPA	high-efficiency particulate air
HEU	highly enriched uranium
HLW	high-level radioactive waste
hr	hour
HVAC	heating, ventilation, and air conditioning
ICRP	International Commission on Radiological Protection
in	inch
INEEL	Idaho National Engineering and Environmental Laboratory
IROFS	items relied on for safety
ISCST	Industrial Source Complex Short-Term
kg	kilogram
km	kilometer
km^2	square kilometer
kV	kilovolt
kW	kilowatt
L	liter
LANL	Los Alamos National Laboratory
lb	pound
LCF	latent cancer fatality
LDR	Land Disposal Restrictions
LLC	Limited Liability Company
LLNL	Lawrence Livermore National Laboratory
LLW	low-level radioactive waste
LPF	leak path factor
LWR	light water reactor
m	meter
M	molar
M&O	Management and Operating

m^2	square meter
m^3	cubic meter
MACCS2	MELCOR Accident Consequence Code System for the Calculation of the Health and Economic Consequences of Accidental Atmospheric Radiological Releases
MAR	material at risk
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual NUREG-1575
MEI	maximally exposed individual
MEPA	moderate-efficiency particulate air
MFFF	Mixed Oxide Fuel Fabrication Facility
MFFP	MOX Fresh Fuel Package
mg	milligram
mi	mile
mi^2	square mile
min	minute
MOX	mixed oxide
mph	miles per hour
mRad	milliRad
mrem	millirem
MSA	Metropolitan Statistical Area
msl	mean sea level
MW	megawatt
MWh	megawatt hour
MWMF	Mixed Waste Management Facility
N	normal
NAAQS	National Ambient Air Quality Standards
NAS	National Academy of Sciences
nCi	nanocurie
NEPA	National Environmental Policy Act
NESHAP	National Emissions Standards for Hazardous Air Pollutants
NMSS	Nuclear Materials Safety and Safeguards
NNSA	National Nuclear Security Administration | R2
NOI	Notice of Intent
NO_x	Nitric Oxide
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
NTS	Nevada Test Site
OFASB	Old F-Area Seepage Basin | R1
OML	Oxalic Mother Liquors
ORNL	Oak Ridge National Laboratory
ORR	Oak Ridge Reservation
OSHA	Occupational Safety and Health Administration
Pa	Pascal
pCi	picocurie

PCV	primary containment vessel
PDCF	Pit Disassembly and Conversion Facility
PEIS	Programmatic Environmental Impact Statement
pH	hydrogen ion concentration
PIDAS	Perimeter Intrusion Detection and Assessment System
PIP	Plutonium Immobilization Plant
PM_{10}	particulate matter less than or equal to 10 μm in diameter
PMF	probable maximum flood
PMOA	Programmatic Memorandum of Agreement
PMP	probable maximum precipitation
ppm	parts per million
PSD	prevention of significant deterioration
psf	pounds per square foot
PuO_2	plutonium dioxide
rad	radiation absorbed dose
RCRA	Resource Conservation and Recovery Act
rem	roentgen equivalent man
RF	respirable fraction
RFETS	Rocky Flats Environmental Technology Site
ROD	Record of Decision
ROI	region of influence
S&D	Storage and Disposition
SA	Safety Assessment
SAMS	secondary alarm monitoring station
SCAPA	Subcommittee on Consequence Assessment and Protective Action
SCDHEC	South Carolina Department of Health and Environmental Control
SCDNR	South Carolina Department of Natural Resources
SDWA	Safe Drinking Water Act
sec	second
SGT	SafeGuards Transporter
SHPO	State Historic Preservation Officer, State Historic Preservation Office
Sv	Sievert
SNM	special nuclear material
SPCC	Spill Prevention Control and Countermeasures
SPD	Surplus Plutonium Disposition
SRS	Savannah River Site
SSCs	structures, systems, and components
SST	safe secure transport
ST	source term
SWPPP	Stormwater Management Pollution Prevention Plan
TCE	trichloroethylene
TEEL	Temporary Emergency Exposure Limit
TIGR	Thermally induced gallium removal | R1
ton	short ton

TRU	transuranic
TSCA	Toxic Substances Control Act
UCNI	Unclassified Controlled Nuclear Information
UF_6	uranium hexafluoride
UO_2	uranium dioxide
UPS	uninterruptible power supply
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Services
USGS	United States Geological Service
USNRCS	U.S. Natural Resources Conservation Service
UST	underground storage tank
VOC	volatile organic compound
VRM	Visual Resource Management
WA	watt ampere
WAC	Waste Acceptance Criteria
WIPP	Waste Isolation Pilot Plant
WPB	Waste Processing Building R2
WSB	Waste Solidification Building
WSI	Wackenhut Services Inc.
WSRC	Westinghouse Savannah River Company
wt %	weight percent
yd	yard
yr	year
μg	microgram
μm	micrometer (micron)
μSv	microsievert

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Metric Conversion Chart

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

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1. PROPOSED ACTION AND ALTERNATIVES

An Environmental Report (ER) has been prepared to comply with Title 10 of the U.S. Code of Federal Regulations (CFR) Part 51, in support of the implementation of the U.S. Nuclear Regulatory Commission (NRC) responsibilities under the National Environmental Policy Act (NEPA). This ER describes the proposed action and various alternatives (Chapter 1), discusses the need and purpose of the proposed action (Chapter 2), describes the Mixed Oxide (MOX) Fuel Fabrication Facility (MFFF) and its operations (Chapter 3), describes the affected environment (Chapter 4), and identifies possible impacts of the proposed action and alternatives (Chapter 5). The potential impacts of the proposed action and alternatives are summarized in Chapter 6, while the status of Federal, State, and local permits applicable to the proposed action is summarized in Chapter 7. Appendix A provides correspondence with federal and state agencies. Impact methodology is discussed in Appendix B. The remaining appendices provide supporting information for the analyses presented in the ER.

1.1 DESCRIPTION OF THE PROPOSED ACTION

The action proposed in this ER is the issuance of an NRC license, under 10 CFR Part 70, to possess and use special nuclear material (SNM) in the MFFF at the U.S. Department of Energy's (DOE's) Savannah River Site (SRS) near Aiken, South Carolina.

DOE will own the MFFF. DOE has contracted with Duke Cogema Stone & Webster, LLC (DCS) to design, construct, operate, and deactivate the MFFF. DCS will be the license holder for the MFFF. DCS currently has a contract to convert up to 36.4 tons (33 metric tons)[1] of | R2 surplus plutonium to MOX fuel. After the contractual amount of the surplus plutonium has been converted to MOX fuel, DCS will deactivate[2] the facility and turn the facility over to DOE, and the license will be terminated. DOE is responsible for the ultimate disposition (e.g., reutilization, decommissioning) of the MFFF. Decommissioning is not part of the DCS contract with DOE and is not part of the proposed action.

DCS is a Limited Liability Company (LLC) owned by Duke Project Services Group, COGEMA, | R2 Inc., and Stone & Webster Inc. (a Shaw Group Company). These three companies are the equity owners of the LLC. The DCS corporate office is located in Charlotte, North Carolina, with a satellite office in Aiken, South Carolina, to serve the MFFF site.

Once constructed, the MFFF will be located on 41 ac (16.6 ha) in F Area of SRS. Located | R2 nearby will be the Pit Disassembly and Conversion Facility (PDCF), another proposed surplus

[1] DCS has been authorized to design the facility to accommodate the use of impure plutonium or alternative feedstock (AFS) and anticipates a contract change to accommodate 37.5 tons (34 metric tons) of feedstock. | R2

[2] Deactivation, rather than decommissioning, is required by the DOE contract with DCS. Deactivation is the process of removing a facility from operation and placing the facility in a safe-shutdown condition that is economical to monitor and maintain for an extended period until reuse or decommissioning.

plutonium disposition facility owned by DOE and to be operated by its Management and Operating (M&O) Contractor, but not licensed by the NRC. The PDCF will disassemble plutonium pits from weapons and convert the plutonium to plutonium oxide for use as MFFF feedstock. The PDCF also provides waste processing for both the MFFF and PDCF in a Waste Solidification Building (WSB) on the PDCF site. Each of the proposed surplus plutonium disposition facilities will use existing SRS sitewide infrastructure and services such as security, emergency management, radiation safety services, environmental monitoring, and waste management. R2

The MFFF consists of the MOX Fuel Fabrication Building (comprised of the aqueous polishing area, MOX processing area, and shipping and receiving area), and various support buildings.

The MFFF is designed to convert up to 37.5 tons (34 metric tons) of plutonium oxide, which will be supplied by the PDCF or from the K-Area Material Storage Facility, to MOX fuel. The fabricated MOX fuel assemblies will be transported to, and subsequently irradiated in, mission commercial nuclear power reactors: the Catawba Nuclear Station (Units 1 and 2) near York, South Carolina, and the McGuire Nuclear Station (Units 1 and 2) near Huntersville, North Carolina. The addition of alternative feedstock will result in the need for increased irradiation capacity to be named by DOE later. The MFFF is designed to operate for 20 years (including deactivation activities) with an annual design throughput of 3.8 tons (3.5 metric tons). The term of the contract is expected to be met in less than the 20-year design life. All information provided in this ER is based on the design throughput of 3.8 tons (3.5 metric tons). R2 R2 R′

About 95% of the MOX fuel matrix is uranium dioxide. The MOX fuel fabrication process has many of the same process elements that are used to produce low-enriched uranium fuel for commercial nuclear power reactors. With respect to the MOX process, the plutonium oxide and uranium dioxide powders are blended together into a mixed oxide. The processing of feed materials begins with the plutonium polishing (i.e., aqueous polishing) process to chemically remove gallium from the weapons-grade feedstock. The process also removes other impurities, including americium, aluminum, chlorides, and fluorides. This process includes three sub-processes: dissolution of the plutonium in nitric acid, removal of impurities by chemical separation (i.e., solvent extraction), and conversion of the plutonium back to an oxide powder by oxalate precipitation. Acid and solvent recovery steps, by which nearly all the nitric acid and extraction solvents would be recovered and reused in the process, are also included. This process is similar to the plutonium recovery and extraction process presently in use at the nearby F Canyon at SRS. The recovery steps are state-of-the-art due to the lessons learned from many years of European operating experience at COGEMA's La Hague Plutonium Finishing Facilities in northern France. R2

The polished plutonium dioxide, verified to meet fabrication requirements, is then transferred into reusable containers for storage until needed or transferred directly to the MOX fuel fabrication (i.e., MOX processing) process. MOX fuel fabrication begins with blending and milling of the plutonium dioxide powder to ensure general consistency in enrichment and isotopic concentration. The MOX powder is made into pellets by pressing the powder into shape, sintering (i.e., baking at high temperature) the formed pellets, and grinding the sintered pellets to the proper dimensions.

The finished pellets are moved to the fuel rod fabrication area where they are loaded into empty rods. The rods are sealed, inspected, decontaminated, and then bundled together to form fuel assemblies. Individual fuel assemblies can be stored for two years prior to shipment to the designated domestic commercial reactor, although production is anticipated to closely follow product need.

1.2 RELATED ACTIONS

1.2.1 F-Area Infrastructure Upgrades

As part of the implementation of the surplus plutonium disposition facilities, the U.S. Department of Energy Savannah River Operations Office (DOE-SR) will provide upgrades to F-Area infrastructure to support [Text Deleted] surplus plutonium disposition facilities. The environmental impacts resulting from this infrastructure project were considered in the DOE *Surplus Plutonium Disposition Final Environmental Impact Statement* (SPD EIS) issued November 1999 (DOE 1999c). Additional design for the MFFF has refined the information available concerning these infrastructure upgrades. Consequently, the environmental impacts of the upgrades that are necessary for MFFF construction and operation are considered in this document. R1 R1

1.2.2 Irradiation of MOX Fuel

The MOX fuel will be irradiated in mission commercial nuclear power reactors: two units at the Catawba Nuclear Station near York, South Carolina, and two units at the McGuire Nuclear Station near Huntersville, North Carolina. The addition of alternative feedstock will result in the need for increased irradiation capacity; DOE intends to make provisions for this capacity. For purposes of this environmental report, it is assumed that two generic mission reactors provide this increased capacity. The environmental impacts associated with irradiating the MOX fuel in six reactors (Catawba Nuclear Station, McGuire Nuclear Station, and North Anna Nuclear Station) were evaluated as part of the SPD EIS (DOE 1999c, 2000b). The environmental impact evaluations presented in the SPD EIS represent the range of impacts that would be anticipated at any mission reactors. In addition, fuel irradiation will require separate NRC licensing action. The NRC licensees for these commercial nuclear reactors will submit license amendment requests to gain NRC approval to irradiate MOX fuel. Any appropriate environmental impacts of irradiation will be considered at that time. Accordingly, the irradiation of the MOX fuel is not part of the proposed licensing action described in this ER. R2 R2

Although the irradiation of the MOX fuel is not part of this proposed licensing action and the environmental impacts of irradiation will not be reanalyzed in this ER, the conclusions presented in the SPD EIS regarding irradiation impacts are summarized in Section 5.6 of this ER as part of the cumulative impacts discussion. Refer to the SPD EIS and SPD EIS Record of Decision

(ROD) for detailed discussion of the environmental impacts related to the irradiation of the MOX fuel.

1.2.3 Pit Disassembly and Conversion

DOE will construct, operate, and ultimately decommission a facility (i.e., PDCF) for disassembling pits (a weapons component) and converting the recovered plutonium, as well as plutonium from other sources, into plutonium dioxide for ultimate disposition. The PDCF will be located near the MFFF and will provide most of the plutonium dioxide feedstock for the MFFF [Text Deleted].

The PDCF, in a separate WSB, will also convert the radioactive liquid wastes from the MFFF and PDCF into solid waste that will be disposed as transuranic waste or low-level radioactive waste. Because the environmental impacts of constructing and operating the WSB were not explicitly evaluated as part of the SPD EIS, the impacts are included in Appendix G of this ER. As with the PDCF, the impacts of the WSB are included in the cumulative impact discussion in Section 5.6 of this ER. R2

The PDCF is not part of this proposed action since the PDCF will not be licensed by the NRC. Accordingly, the discussion of the environmental impacts of the PDCF will not be reanalyzed in this ER; however, because PDCF is a connected action, its impacts are included in the cumulative impacts discussion in Section 5.6 of this ER. Refer to the SPD EIS and SPD EIS ROD (DOE 1999c, 2000b) for detailed discussion of the environmental impacts related to the PDCF. R2

1.2.4 Plutonium Immobilization

In April 2002, DOE issued the amended SPD EIS ROD (DOE 2002), which eliminated the immobilization facility. R2

[Text Deleted] R2

1.2.5 Lead Assemblies[3]

The environmental impacts resulting from the fabrication, irradiation, and examination of lead assemblies were discussed in the SPD EIS (DOE 1999c). In that EIS, five DOE sites were evaluated for the fabrication of lead assemblies: SRS, Los Alamos National Laboratory (LANL), Lawrence Livermore National Laboratory (LLNL), Hanford, and Idaho National Engineering and Environmental Laboratory (INEEL). Two DOE sites were evaluated for post-irradiation

[3] For the MOX program, lead assemblies are the first two to four assemblies manufactured using typical plutonium, depleted uranium, and hardware components and irradiated under the expected conditions for the production MOX fuel assemblies to obtain confirmatory data on the behavior of the fuel prior to manufacture and irradiation of batch quantities of MOX fuel. R2

examination: INEEL and Oak Ridge National Laboratory (ORNL). In the ROD associated with this EIS, DOE selected LANL as the site to fabricate lead assemblies and ORNL as the site to conduct post-irradiation examination. Subsequent to the issuance of the ROD, DOE has decided to revisit the decision regarding the fabrication of lead assemblies. The first option involves the fabrication occurring in Europe, while the second option involves fabrication at the MFFF.

Should DOE pursue the first option (European fabrication), DOE will evaluate the environmental impacts in NEPA documentation separate from this ER. The environmental impacts of the second option (fabrication at the MFFF) are bounded by the impacts discussed for full production of MOX fuel discussed in this ER. R2

1.2.6 Transportation

The environmental impacts associated with transportation of SNM to the plutonium disposition facilities, transportation of MOX fuel to the mission reactors, and transportation of wastes for ultimate disposal were discussed in the SPD EIS (DOE 1999c).

Because one mission reactor site was eliminated and the configuration of the transport package has changed since the publication of the SPD EIS, the environmental impacts of MOX fuel transport to the mission reactors are reevaluated in this ER. R1

1.2.7 Transport and Disposal of Spent MOX Fuel

The transportation and disposal of spent MOX fuel at a geologic repository are not part of this proposed licensing action. The environmental impacts associated with transport and disposal of spent MOX fuel were discussed in the S&D PEIS (DOE 1996b) and the *Draft Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada* (DOE 1999a). These impacts will not be addressed in this ER.

1.2.8 Decommissioning the Surplus Plutonium Disposition Facilities

As stated in Section 4.31.2 of the SPD EIS (DOE 1999c):

> The nature, extent and timing of future D&D [decontamination and decommissioning] activities are not known at this time. Although some choices currently exist, both technically and under environmental regulations for performing final D&D, DOE expects that there will be additional options available in the future.
>
> No meaningful alternatives or analysis of impacts can be formulated at this time. D&D is so remote in time that neither the means to conduct D&D, nor the impacts of the actions, are foreseeable in the sense of being susceptible to meaningful analysis now.

By contract, DCS is required to deactivate the MFFF, terminate the license, and turn the facility over to DOE. The impacts associated with deactivation are discussed in this ER.

1.3 ALTERNATIVES PREVIOUSLY EVALUATED BY DOE

To develop an appropriate range of alternatives to be considered and compared to the proposed action, it was necessary to consider the scope of the environmental determinations previously made by DOE. Sections 1.3.1 and 1.3.2 summarize DOE's prior environmental determinations related to the overall surplus plutonium disposition program.

In 1992, General Brent Scowcroft, then National Security Advisor to President George H.W. Bush, requested the National Academy of Sciences (NAS) Committee on International Security and Arms Control (CISAC) to perform a study of the management and disposition options for surplus weapons-usable plutonium. The results of the CISAC study were published in *Management and Disposition of Excess Weapons Plutonium* (NAS 1994). This study was followed by a series of agreements between the governments of the United States and the Russian Federation culminating in the most recent *Agreement Between the Government of the United States of America 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* (White House 2000). The agreement commits the United States to disposal of 28.2 tons (25.57 metric tons) of plutonium through conversion to MOX fuel and irradiation in power reactors. As the agency responsible for the management of surplus plutonium, DOE is charged with implementing these agreements.

The disposition of surplus weapons-usable plutonium was evaluated by DOE in two previous NEPA actions: the S&D PEIS (DOE 1996b) and the SPD EIS (DOE 1999c). Together, these comprehensive evaluations considered numerous alternatives for storage and disposition of surplus plutonium and highly enriched uranium (HEU). DOE has issued a ROD for each of these NEPA actions (DOE 1997c, 2000b), which supported the decision to construct the MFFF at SRS in F Area. In addition, the United States and the Russian Federation have entered into agreements based on the decisions in these RODs. The alternatives previously evaluated in the S&D PEIS and SPD EIS are briefly discussed in the following sections.

1.3.1 Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement (S&D PEIS)

In the S&D PEIS (DOE 1996b), DOE initially evaluated 37 potential disposition alternatives, as shown in Table 1-1. In addition to the 37 disposition alternatives, the S&D PEIS analyzed a No Action Alternative (i.e., all weapons-usable fissile materials would remain in storage at existing sites using proven nuclear material safeguards and security procedures) and the No Disposition Action Alternative (all weapons-usable fissile materials would remain in centralized storage).

Each of the alternatives was analyzed for the full range of natural resource, human resource, and issue areas pertinent to the sites considered for the long-term storage and disposition alternatives.

The resource/issue areas are land resources, site infrastructure, air quality and noise, water resources, geology and soils, biological resources, cultural and paleontological resources, socioeconomics, public and occupational health and safety, waste management, intersite transportation, and environmental justice.

The S&D PEIS also analyzed six candidate sites for the long-term storage of weapons-usable fissile materials: Hanford, Nevada Test Site (NTS), INEEL, Pantex, Oak Ridge Reservation (ORR), and SRS. These same sites were also used to evaluate the construction and operation of various facilities required for the disposition alternatives. These facilities include the pit disassembly/conversion and the plutonium conversion facilities common to all disposition alternatives, the MOX fuel fabrication facility common to all reactor alternatives, the ceramic immobilization facility for the deep borehole alternative, the glass vitrification and ceramic immobilization facilities, and the Evolutionary Light Water Reactor (LWR) Alternative.

In the S&D PEIS ROD (DOE 1997c), issued in January 1997, DOE concluded the following:

> The fundamental purpose of the program is to maintain a high standard of security and accounting for these materials while in storage, and to ensure that plutonium produced for nuclear weapons and declared excess to national security needs (now, or in the future) is never again used for nuclear weapons.
>
> DOE's strategy for disposition of surplus plutonium is to pursue an approach that allows immobilization of surplus plutonium in glass or ceramic material for disposal in a geologic repository pursuant to the Nuclear Waste Policy Act, and burning of some of the surplus plutonium as MOX fuel in existing, domestic, commercial reactors, with subsequent disposal of the spent fuel in a geologic repository pursuant to the Nuclear Waste Policy Act. ... 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 reviews, <u>as well as nonproliferation considerations, and agreements with Russia and other nations.</u> [Emphasis added]

In explaining the DOE decision, the S&D PEIS ROD noted the following:

> DOE has decided to pursue a strategy for plutonium disposition that allows for immobilization of surplus weapons plutonium in glass or ceramic forms and burning of the surplus plutonium as MOX in existing reactors. The decision to pursue disposition of the surplus plutonium using these approaches is supported by the analyses in the Disposition Technical Summary Report and the Nonproliferation Assessment, as well as the S&D Final PEIS. The results of additional technology development and demonstrations, site-specific environmental review, detailed cost proposals, nonproliferation considerations, and negotiations with Russia and other nations will ultimately determine the timing and extent to which MOX as well as immobilization is deployed. These efforts will provide the

> basis and flexibility for the United States to initiate disposition efforts either multilaterally or bilaterally through negotiations with other nations, or unilaterally as an example to Russia and other nations.

Therefore, in the S&D PEIS, DOE conducted the requisite environmental analyses and determined that MOX irradiation would be part of an overall hybrid strategy for surplus plutonium disposition.

1.3.2 Surplus Plutonium Disposition Final Environmental Impact Statement (SPD EIS)

Having determined that MOX irradiation should be part of the overall surplus plutonium disposition strategy, DOE next considered how best to implement that strategy, including how best to provide for MOX irradiation.

The SPD EIS (DOE 1999c) considered 14 alternatives including a No Action Alternative (i.e., all weapons-usable fissile materials would remain in storage at existing sites using proven nuclear material safeguards and security procedures) and several host sites. These alternatives are summarized in Table 1-2. The SPD EIS provided a general description of the MFFF facility and process, including the fact that the design would "… process up to 3.5 t [metric tons] (3.8 tons) of surplus plutonium … annually." For each potential host site, the SPD EIS considered specific locations at the host site.

The SPD EIS ROD (DOE 2000b), issued in January 2000, provided the DOE rationale for deciding to construct and operate the MFFF at SRS:

> The fundamental purpose of the program is to ensure that plutonium produced for nuclear weapons and declared excess to national security needs (now and in the future) is never again used for nuclear weapons. Specifically, the Department has decided to use a hybrid approach for the disposition of surplus plutonium. This approach allows for the immobilization of approximately 17 metric tons of surplus plutonium and the use of up to 33 metric tons of surplus plutonium as MOX fuel. The Department has selected the Savannah River Site in South Carolina as the location for all three disposition facilities. … SRS is preferred for the MOX facility because this activity would complement existing missions and take advantage of existing infrastructure and staff expertise.

In discussing the advantages and disadvantages of the hybrid approach, the SPD EIS ROD noted the following:

> Reactor technology will meet the *Spent Fuel Standard.* Reactor technology has some advantage over the immobilization technology with respect to perceived irreversibility, in that the plutonium would be converted from weapons-grade to reactor-grade, even though it is possible to produce nuclear weapons with both weapons and reactor-grade plutonium. However, the immobilization technology has some advantage over the reactor technology in avoiding the perception that the

> latter approach could potentially encourage additional separation and civilian use of plutonium, which itself poses proliferation risks.
>
> Pursuing this hybrid approach provides the best opportunity for U.S. leadership in working with Russia to implement similar options for reducing Russia's excess plutonium in parallel. Further, it sends the strongest possible signal to the world of U.S. determination to reduce stockpiles of surplus weapons-usable plutonium as quickly as possible and in an irreversible manner. Pursuing both immobilization and MOX fuel fabrication also provides important insurance against uncertainties of implementing either approach by itself.

In response to the foreign policy commitments in the *Agreement Between the Government of the United States of America 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* (White House 2000), DOE believed that only an approach involving MOX fuel can meet the need for the action to reduce the threat of nuclear weapons proliferation worldwide by disposing of surplus plutonium.

The initial 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 reviews, as well as nonproliferation considerations, and agreements with Russia and other nations. R2

In 2001, the schedule for design, construction and operation of the plutonium immobilization facility was delayed indefinitely due to budgetary constraints. DOE/National Nuclear Security Administration (NNSA) has evaluated its ability to continue implementing two disposition approaches and has determined that in order to make progress with available funds, only one approach can be supported. Russia does not consider immobilization alone to be an acceptable approach. In April 2002, DOE issued an amended ROD for the SPD EIS and S&D EIS canceling the immobilization program.

1.4 ALTERNATIVES CONSIDERED BUT NOT EVALUATED IN THIS ENVIRONMENTAL REPORT

1.4.1 Thermally Induced Gallium Removal

As noted in the DOE *Surplus Plutonium Disposition Final Environmental Impact Statement* (DOE 1999c), DOE originally considered the Thermally Induced Gallium Removal (TIGR) process, a dry process for gallium removal from plutonium oxide developed by Los Alamos National Laboratory. DOE concluded that the dry process would not meet the technical requirements for MOX fuel for the removal of gallium and other impurities from plutonium R1 oxide. The best reported gallium removal (Kolman et al. 2000) results in impurities still two orders of magnitude higher than that required in the plutonium oxide. Furthermore, the TIGR process remains an experimental process requiring further testing to scale the process to production while ensuring uniform plutonium oxide powder physical characteristics, such as particle size, surface area, chemical reactivity. Additionally, DOE is no longer providing funding for continued work on the TIGR process.

The aqueous polishing process, however, is a proven technology that is known to remove impurities that might have adverse impacts on fuel fabrication or performance. In addition to removing gallium and impurities, the aqueous polishing process produces uniform plutonium oxide powder with the appropriate physical characteristics. The aqueous polishing process also removes the existing americium from the plutonium to permit fuel fabrication and at-reactor fuel handling to proceed with much lower operational radiation exposures. The TIGR process would not reduce radiation exposures at mission reactors. R1

1.5 ALTERNATIVES CONSIDERED IN THIS ENVIRONMENTAL REPORT

Taking into consideration the above framework of determinations previously made by DOE and the nature of the proposed action before the NRC (see Section 1.1 above), DCS has developed the following range of alternatives for consideration in this ER.

This ER includes a No Action Alternative that is relevant to the proposed action. The No Action Alternative for this ER is a decision by the NRC to not grant a license to DCS to possess and use SNM at the MFFF. Because of previous DOE decisions, the consequences of the No Action Alternative are the same as those discussed in the SPD EIS (DOE 1999c); all weapons-usable fissile materials would remain in storage using proven nuclear material safeguards and security procedures. The No Action Alternative consequences, evaluated and discussed in the SPD EIS, are summarized in Section 5.7.1 of this ER but were not reanalyzed in this ER. The consequences of the No Action Alternative are discussed in more detail in the SPD EIS. R2

Within F Area at SRS, DCS considered various locations for the MFFF. This evaluation is discussed in Section 5.7.2 of this ER. Design alternatives that may impact the environment are addressed in Section 5.7.3 of this ER.

1.6 PROJECT SCHEDULE

The following timetable represents the anticipated schedule for licensing, construction, and operation of the MFFF.

Submit Application for Construction Authorization	Early 2001
Submit License Application	October 2003
Initiate Facility Construction	March 2004
Receive SNM	January 2006

R2

Commence Production of MOX Fuel	July 2007

R2

Any significant delay in the schedule of the MFFF could adversely affect the overall MFFF plutonium disposition mission.

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Tables

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Table 1-1. Description of Variants Analyzed in the S&D PEIS

Alternatives Analyzed	Possible Variants
Deep Borehole Direct Disposition	• Arrangement of plutonium in different types of emplacement
Deep Borehole Immobilized Disposition	• Emplacement of pellet-grout mix • Pumped emplacement of pellet-grout mix • Plutonium concentration loading; size and shape of ceramic pellets
New Vitrification Facilities	• Collocated pit disassembly/conversion, plutonium conversion, and immobilization facilities • Use of either Cs-137 from capsules or high-level waste (HLW) as a radiation barrier • Wet or dry feed preparation technologies • An adjunct melter adjacent to the DWPF at SRS, in which borosilicate glass frit with plutonium (without highly radioactive radionuclides) is added to borosilicate glass containing HLW from the DWPF • A can-in-canister approach at SRS in which cans of plutonium glass (without highly radioactive radionuclides) are placed in DWPF canisters, which are then filled with borosilicate glass containing HLW in the DWPF • A can-in-canister approach similar to the above but using new facilities at sites other than SRS
New Ceramic Immobilization Facilities	• Collocated pit disassembly/plutonium conversion, and immobilization facilities • Use of either Cs-137 from capsules or HLW as a radiation barrier • Wet or dry feed preparation technologies • A can-in-canister approach at SRS in which plutonium is immobilized, without highly radioactive radionuclides, in a ceramic matrix and then placed in the DWPF canisters that are then filled with borosilicate glass containing HLW • A can-in-canister approach similar to the above but using facilities at sites other than SRS
Electrometallurgical Treatment	• Immobilize plutonium into metal ingot form • Locate at DOE sites other than Argonne National Laboratory-West at INEEL
Existing LWR With New MOX Facilities	• Pressurized or boiling water reactors • Different numbers of reactors • European MOX fuel fabrication • Modification/completion of existing facilities for MOX fabrication • Collocated pit disassembly/conversion, plutonium conversion, and MOX facilities • Reactors with different core management schemes

Table 1-1. Description of Variants Analyzed in the S&D PEIS (continued)

Alternatives Analyzed	Possible Variants
Partially Completed LWR With New MOX Facilities	• Pressurized or boiling water reactors • Different numbers of reactors • Modification/completion of existing facilities for MOX fabrication • Collocated pit disassembly/conversion, plutonium conversion, and MOX facilities • Reactors with different core management schemes
New Evolutionary LWR With New MOX Facilities	• Pressurized or boiling water reactors • Different numbers of reactors • Modification/completion of existing facilities for MOX fabrication • Collocated pit disassembly/conversion, plutonium conversion, and MOX facilities • Reactors with different core management schemes
Existing CANDU Reactor With New MOX Facilities	• Different numbers of reactors • Modification/completion of existing facilities for MOX fabrication • Collocated pit disassembly/conversion, plutonium conversion, and MOX facilities • Reactors with different core management schemes

Table 1-2. Summary of Alternatives Considered in the Surplus Plutonium Disposition Environmental Impact Statement

Alternative	Pit Disassembly and Conversion (PDCF)	Plutonium Conversion and Immobilization (PIP)	MOX Fuel Fabrication (MFFF)	Disposition Amounts (metric tons of MOX)
1	No Action			
2	Hanford	Hanford	Hanford	33
3	SRS	SRS	SRS	33
4	Pantex	Hanford	Hanford	33
5	Pantex	SRS	SRS	33
6	Hanford	SRS	Hanford	33
7	INEEL	SRS	INEEL	33
8	INEEL	Hanford	INEEL	33
9	Pantex	SRS	Pantex	33
10	Pantex	Hanford	Pantex	33
11A	Hanford	Hanford	None	0
11B	Pantex	Hanford	None	0
12A	SRS	SRS	None	0
12B	Pantex	SRS	None	0

Note: This ER addresses the MFFF portion of Alternative 3. Section 5.6 discusses the cumulative impacts of all three SPD missions identified in Alternative 3.

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2. PURPOSE OF THE PROPOSED ACTION

This section provides background information (Section 2.1) and discusses the need for the MFFF (Section 2.2).

2.1 BACKGROUND INFORMATION

On September 27, 1991, President George H.W. Bush announced the end of the 42-year Cold War with the Soviet Union, soon after the Russian Federation suffered great political upheaval. R1
This event led to a determination that our nuclear weapons stockpile needed to be reduced, resulting in surplus plutonium and surplus HEU. In 1992, General Brent Scowcroft, then National Security Advisor to President George H.W. Bush, requested the NAS CISAC to R1
perform a study of the management and disposition options for surplus weapons-usable plutonium. The request was later confirmed by President William J. Clinton when he assumed R1
office in January 1993. The results of the CISAC study were published in *Management and Disposition of Excess Weapons Plutonium* (NAS 1994).

The CISAC recommended, among other actions, that the United States and Russia pursue a long-term plutonium disposition option that results in a form from which the plutonium would be as difficult to recover for weapons use as the larger and growing quantity of plutonium in commercial spent fuel. This recommendation became known as the Spent Fuel Standard. The CISAC report noted that two approaches could be used to achieve the Spent Fuel Standard. One approach is fabrication and use of MOX fuel in nuclear reactors. The plutonium in the MOX fuel would be irradiated and become part of the spent fuel that will be disposed in a geologic repository. The second approach is incorporation of plutonium in a vitrified HLW matrix (i.e., immobilization) with disposition in the same geologic repository. The study noted that there may be some public opposition to the proven MOX fuel option. The study also noted the existence of technical difficulties and longer implementation time with the immobilization option. Finally, the study noted that the immobilization option was not acceptable to Russian officials who view their surplus plutonium as a resource.

In December 1996, DOE published the S&D PEIS (DOE 1996b). The S&D PEIS analyzed the potential environmental consequences of alternative strategies for the long-term storage of weapons-usable plutonium and HEU and the disposition of weapons-usable plutonium that has been or may be declared surplus to national security needs. The ROD for the S&D PEIS, issued on January 21, 1997 (DOE 1997c), outlined DOE's decision to pursue a hybrid approach to plutonium disposition that would make surplus weapons-usable plutonium inaccessible and unattractive for weapons use. DOE's disposition strategy, consistent with the Preferred Alternative analyzed in the S&D PEIS, allowed for both the immobilization of some (and potentially all) of the surplus plutonium and use of some of the surplus plutonium as MOX fuel in existing domestic, commercial reactors.

The ROD also noted, "The timing and extent to which either or both of these disposition approaches (i.e., immobilization or MOX fuel fabrication and irradiation) are ultimately deployed will depend upon the results of future technology development and demonstrations, follow-on (i.e., tiered) site-specific environmental review, contract negotiations, and detailed cost reviews, as well as non-proliferation considerations, and agreements with Russia and other nations." [Emphasis added]

The MOX decision is reinforced by the language in the *Joint Statement of Principles for Management and Disposition of Plutonium Designated as No Longer Required for Defense Purposes* (White House 1998), signed by Presidents Clinton and Yeltsen in September 1998, "In cooperation with others, the U.S. and Russia will, as soon as practically feasible, and according to a time frame to be negotiated by the two governments, develop and operate an initial set of industrial-scale facilities for the conversion of plutonium to fuel for the above-mentioned existing reactors." [Emphasis added]

In September 2000, the governments of the United States and the Russian Federation signed the *Agreement Between the Government of the United States of America 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* (White House 2000). The agreement commits the United States to disposal of 28.2 tons (25.57 metric tons) of plutonium through conversion to MOX fuel and irradiation in power reactors.

On May 22, 1997, DOE published a Notice of Intent (NOI) in the Federal Register (DOE 1997d) announcing its decision to prepare an EIS that would tier from the analysis and decisions reached in connection with the S&D PEIS. The SPD EIS (DOE 1999c) addressed the extent to which each of the two plutonium disposition approaches (i.e., immobilization and MOX) would be implemented and analyzed candidate sites for plutonium disposition facilities and activities.

In April 2002, DOE issued the amended ROD for both the S&D PEIS (DOE 1996b) and SPD EIS (DOE 2002), which contained the following decision: R2

> ...DOE/NNSA's current disposition strategy involves a MOX-only approach, under which DOE/NNSA would dispose of up to 34 t of surplus plutonium by converting it to MOX fuel and irradiating it in commercial power reactors. Implementation of this strategy is key to the successful completion of the agreement between the U.S. and the Russian Federation ... R2

2.2 NEED FOR THE FACILITY

The proposed action, issuing a license to possess and use SNM in an MFFF, is essential to the successful implementation of the joint United States-Russian nuclear disarmament policy.

DOE has previously determined that there is a clear need for the development of an MFFF at SRS. As stated in the SPD EIS (DOE 1999c):

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

As noted in 2.1, in the amended ROD for both the S&D PEIS (DOE 1996b) and SPD EIS (DOE 2002), DOE decided to convert up to 37.5 tons (34 metric tons) of surplus plutonium to MOX fuel. The DOE decision to construct and operate the MFFF is an essential component of the United States foreign policy as stipulated in the September 2000 agreement between the United States and Russian Federation (White House 2000). Accordingly, all of the aforementioned NEPA actions and foreign policy agreements strongly support the need for the MFFF. R2

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3. DESCRIPTION OF THE MOX FUEL FABRICATION FACILITY

This chapter describes the MFFF buildings and the major MFFF design and operating parameters. An overview of the buildings is provided in Section 3.1, including the general facility arrangements. The layout of the MFFF site is provided in Figure 3-1, and key design and operation parameters are listed in Table 3-1. A summary of facility processes and operations in sufficient detail to identify waste streams and effluent releases is provided in Section 3.2. The waste management systems and waste disposition are discussed in Section 3.3. The facility and process descriptions are based on the preliminary design and may be subject to change.

The MOX aqueous polishing and fuel fabrication processes and the basic plant design are based on the operational COGEMA MELOX Plant and La Hague Plutonium Finishing Facilities, located in Marcoule and La Hague, France, respectively. The proven COGEMA plant design is being adapted to meet appropriate United States codes and standards.

3.1 GENERAL FACILITY ARRANGEMENT

The MFFF site is located on the north-northwest side of F Area at SRS. When complete, the MFFF will occupy approximately 41 ac (16.6 ha). Approximately 17 ac (6.9 ha) will be developed with buildings, facilities, or pavement. The remaining 24 ac (9.7 ha) will be landscaped in either grass or gravel. R1

The buildings and facilities of the MFFF are arranged and oriented to ensure safe, secure, and efficient performance of all MFFF functions. The site layout provides the desired arrangement and physical site characteristics necessary to satisfy the very stringent security criteria for safeguarding SNM. The site layout also supports safe and efficient MFFF operations (e.g., receiving, handling, storing, and shipping feedstocks and product).

The protected area inside the double fence Perimeter Intrusion Detection and Assessment System (PIDAS) occupies approximately 14 ac (5.7 ha) and is roughly square in shape, as indicated on Figure 3-1. All deliveries are made to the MFFF protected area by truck shipment or underground piping. The plutonium oxide is transferred from the PDCF or K-Area Material Storage Facility by an approved means of transport. The Administration Building, Diesel Fuel Fill Station, Receiving Warehouse, and Gas Storage Facility are all located outside the PIDAS. R2

The MFFF consists of the following buildings:

- MOX Fuel Fabrication Building
- Reagents Processing Building
- Emergency Generator Building R1
- Standby Generator Building
- Secured Warehouse Building
- Administration Building
- Technical Support Building
- Receiving Warehouse Building. R1

In addition to the MFFF buildings, DOE is constructing a Waste Solidification Building (WSB) on the PDCF site to process waste from both the MFFF and PDCF. Although this building is not part of the MFFF licensed facility, the environmental impacts of constructing and operating this building are discussed in this ER (Appendix G). R2

These buildings and their operations are described in the following subsections.

3.1.1 MOX Fuel Fabrication Building

The MOX Fuel Fabrication Building is a multi-functional complex containing all of the plutonium handling, fuel processing, and fuel fabrication operations of the MFFF. The MOX Fuel Fabrication Building is located within the protected area and has the requisite security measures in place to adequately safeguard the facility and prevent any attempts to illicitly remove SNM from the facility. The MOX Fuel Fabrication Building is comprised of three major functional interrelated areas: the aqueous polishing area (contaminant removal), the fuel fabrication area (MOX processing), and the shipping and receiving area. Figures 3-2 and 3-3 provide a conceptual general arrangement of the aqueous polishing area and fuel fabrication area, respectively. Detailed drawings can be found in the Construction Authorization Request (CAR), Figures 7-1 through 7-8. R1 R1

The MOX Fuel Fabrication Building (i.e., aqueous polishing area, fuel fabrication area, and shipping and receiving area) is a multi-story, hardened, reinforced-concrete structure with a partial below-grade basement and an at-grade first floor. The MOX Fuel Fabrication Building has an overall height above grade of approximately 79 ft (24 m). The 40-ft (12-m) tall vent stack, mounted on top of the MOX Fuel Fabrication Building, has a top elevation of approximately 120 ft (37 m) above grade. This facility meets applicable requirements for processing SNM, as discussed in the CAR. The entire MOX Fuel Fabrication Building structure and the three component building areas are designed to withstand extreme natural phenomena, including design basis earthquakes, floods, severe winds, and tornadoes, as well as a spectrum of potential industrial accidents that could impact the fissile process materials. The lowest floor level of the MOX Fuel Fabrication Building, approximate elevation 256 ft (78 m) above mean sea level (msl), is well above the F-Area calculated design basis flood level with a 100,000-year return period (WSRC 1999a). Stormwater runoff from the MFFF site is directed to retention basins where it is released at rates equivalent to pre-construction stormwater runoff rates. Additional information on the MFFF design basis is provided in the CAR. R1, R2 R2

Functional areas and processes in the MOX Fuel Fabrication Building complex include the following:

- Shipping and receiving (i.e., truck bay) area
- Aqueous polishing area
- Blending and milling area
- Pelletizing area
- Sintering area

- Grinding area
- Fuel rod fabrication area
- Fuel bundle assembly area
- Storage areas for feed material, pellets, rods, and fuel assemblies
- A laboratory area
- Space for use by the International Atomic Energy Agency.

Support equipment (e.g., heating, ventilation, and air conditioning [HVAC] components; high-efficiency particulate air [HEPA] filter plenums; inverters; switchgear; pumps) is also present within the building complex. There are no convenience toilets, lockers, or break rooms for normal staff use within the radiation control areas of the MOX Fuel Fabrication Building. R1 Adequate space for waste packaging and its temporary storage is provided. The MFFF processes (i.e., plutonium polishing, powder processing, pellet processing, rod processing, building and glovebox ventilation systems, and offgas treatment) are described in Section 3.2.

The MOX Fuel Fabrication Building contains the SNM processing areas. This building complex is the source of any anticipated radiological releases to the environment. The MOX Fuel Fabrication Building produces solid and liquid wastes and airborne effluents. Solid wastes and liquid waste streams are transferred to the appropriate SRS waste management facilities in accordance with the applicable SRS Waste Acceptance Criteria (WAC) (WSRC 2000b). Anticipated airborne effluents are treated, as described in Sections 3.2 and 3.3, and monitored before being released to the environment. The management of the MFFF waste streams is described in Section 3.3.

3.1.2 Reagents Processing Building

The Reagents Processing Building, located inside the protected area adjacent to the aqueous polishing area of the MOX Fuel Fabrication Building, provides space for storage and mixing of the chemical reagents used in the aqueous polishing process. The Reagents Processing Building consists of a number of separate rooms/areas for the various chemicals. Liquid chemical containers are located inside curbed areas for containment of accidental spills. Safety showers and eyewash stations are located in each of the chemical rooms/areas. One end of the Reagents Processing Building has a loading dock for transfer of chemical drums in and out of the building. The Reagents Processing Building floor level is slightly above grade with a below-grade collection tank room that receives waste chemicals from the aqueous polishing area and the Reagents Processing Building. The Reagents Processing Building contains shower, restroom, and locker facilities. Chemicals are transferred to the aqueous polishing area from the Reagents Processing Building via piping located in a concrete, double-walled pipe between the two R1 buildings.

Table 3-2 summarizes the chemicals used at the MFFF site, many of which are stored in the Reagents Processing Building. The Reagents Processing Building has roof vents to allow for venting in emergency situations. No measurable gaseous emissions are expected from activities within this building. R1

The Liquid Solvent Area is located on the northwest side of the Reagents Processing Building. This area provides Resource Conservation and Recovery Act staging area for collection and transfer of liquid waste solvent. The area consists of a loading dock, monorail, two carboy tanks and curbed areas for containment of spills. R2

3.1.3 Emergency Generator Building

The Emergency Generator Building, located inside the protected area adjacent to the MOX Fuel Fabrication Building, contains the diesel generators that provide the emergency power for items relied on for safety (IROFS) in the MFFF. The building is a single-story, slab-on-grade, reinforced-concrete building. The design of the building structure is of sufficient strength and thickness to protect against the effects of extreme natural phenomena (e.g., severe wind and tornado) and associated generated missiles, as well as to resist the design basis earthquake. Natural disasters considered in the design of the Emergency Generator Building are the same as those considered for the MOX Fuel Fabrication Building. R1

The emergency onsite power is provided by seismically-mounted diesel generators that are approximately 2,000 kW [1]. Located adjacent to the diesel generator rooms, but separated from them by firewalls, are the switchgear, motor control centers, and uninterruptible power supplies (UPSs). The UPS equipment uses sealed, maintenance-free batteries. Transformers are provided with containment pits for potential leaks. R2

The Emergency Fuel Storage Vault is located inside the protected area adjacent to the Emergency Generator Building. The Emergency Diesel Fuel Storage Vault is a single story, in-ground, buried, reinforced concrete building that provides support and protection for the two fuel storage tanks. Each of the tanks and associated equipment is located within a missile resistant structure with roof and walls of sufficient strength and thickness to resist the design basis earthquake. R1

The diesel generator rooms contain a day tank that stores a maximum of 660 gal (2,498 L) of fuel oil. Each day tank is enclosed with a dike that can accommodate the full contents of the associated tank. These diesel generators also emit criteria pollutants during operation, and the diesel fuel tank emits a very small amount of VOCs due to evaporative losses. Unless there is a leak associated with the diesel fuel storage tanks, these tanks only provide fugitive emissions due to a very small evaporation (i.e., approximately 0.5 lb/yr [0.23 kg/yr]) of volatile organic compounds (VOCs).

3.1.4 Standby Generator Building

The Standby Generator Building is located inside the protected area and contains the normal operation electrical generators that provide the onsite power source for the major loads in the

[1] Further design refinement may reduce the size of the diesel generators. These are bounding values for NEPA purposes R2

event of a loss of offsite power. The building is a single-story, slab-on-grade structure with pre-engineered steel framing and insulated metal siding and roof.

The building contains four 2,000-kW standby diesel generators[2]. The normal switchgear, load centers, motor control centers, power panels, and dry type transformers are located adjacent to the diesel generator rooms and are separated from them by firewalls. R2

Fuel for the standby generators is provided by a 5,000-gal (18,925-L), double-walled tank buried adjacent to the building. This double-walled tank meets the design requirements of 40 CFR Part 280 for underground storage tanks. The diesel generator rooms contain a day tank that stores a maximum of 660 gal (2,498 L) of fuel oil. Each day tank is enclosed with a dike that can accommodate the full contents of the associated tank. These diesel generators also emit criteria pollutants during operation, and the diesel fuel tank emits a very small amount of VOCs due to evaporative losses.

3.1.5 Secured Warehouse Building

The Secured Warehouse Building is a single-story, slab-on-grade, pre-engineered, metal building located inside the protected area. The exterior walls and roof consist of insulated metal panels. The Secured Warehouse Building is comprised of several distinct areas: the General Storage Area; the MOX Fresh Fuel Package (MFFP) Storage and Maintenance Area; the Depleted Uranium Storage Area; the Small Parts Washing Facility; Offices; Electrical Equipment Room; and the Small Parts Storage Area. The walls are of reinforced concrete or reinforced masonry. Access to the General and Small Parts Storage Areas is provided by two receiving bays with roll-up doors and two secured entrance doors. The office area is constructed of light-gauge steel framing. The Depleted Uranium Storage Area has walls of reinforced concrete block or reinforced concrete and a concrete roof slab on metal decking. Access to this storage area is provided by one receiving bay with roll-up door and two secured entrance doors. Access to the MFFP Storage Area is provided by one receiving bay with a roll-up door and two secured doors. R1

The Secured Warehouse Building supports the MFFF operations by receiving and storing materials, equipment, and supplies inside the protected area near the MOX Fuel Fabrication Building, making them readily available when needed. Depleted uranium dioxide (UO_2), a MOX feedstock, is stored in drums in the Depleted Uranium Storage Area. R1

The Secured Warehouse Building also provides storage locations for 16 new-fuel shipping packages, components, and equipment for incidental periodic maintenance of these shipping packages in the MFFP Storage and Maintenance Area. R1

The two-story Parts Washing Facility is [Text Deleted] located in the Secured Warehouse Building. The Parts Washing Facility is where new fuel rod assembly parts are cleaned prior to

[2] Further design refinement may reduce the size of the diesel generators. These are bounding values for NEPA purposes R2

use in the MOX Fuel Fabrication Building. This facility has a separate ventilation/exhaust system and is equipped with a hood for worker protection. Wastes from parts washing are nonradioactive and will be managed as hazardous wastes and disposed of through the SRS waste management infrastructure[3].

3.1.6 Administration Building

The Administration Building, located outside of the protected area of the MFFF complex, provides space for administrative support functions to the MFFF and its operations. The Administration Building is accessed from the main facility personnel and public parking area. The Administration Building is a two-story, slab-on-grade, steel-framed structure. The first story is slab-on-grade and the second story is light-weight concrete on metal decking and bar joist framing. R1

The following functions are performed within the Administration Building:

- Facility management
- Facility operations
- Facilities engineering
- Material accountability administration
- Finance and administration
- Health and safety evaluations
- Quality assurance
- Personnel management
- Office space. R1

Also located in the Administration Building is the Programmable Logic Controller Software Simulation Laboratory where operations computer software maintenance and development are conducted.

The Administration Building does not emit any gaseous or liquid effluents, with the exception of sanitary waste that is routed to the Central Sanitary Waste Treatment Facility (CSWTF).

3.1.7 Technical Support Building

The Technical Support Building, located between the Administration Building and the MOX R1 Fuel Fabrication Building, provides personnel access control and support facilities for MOX Fuel Fabrication Building personnel. The Technical Support Building is a two-story, steel-framed structure. The first story is reinforced concrete, slab-on-grade. The exterior walls consist of modular panels with an integrated glazing system. The first level contains the Access Control R1 Facilities and personnel support facilities, such as the locker and change rooms, toilet facilities,

[3] The design of the Parts Washing Facility is not sufficiently developed to project waste quantities or emissions.

work and anti-contamination protective clothing storage and access, shops and laboratories, dosimeter and respirator issue, and first aid station.

The second level consists of office areas and related functions such as conference rooms, file storage areas, fax, copier, and printer areas. R1

Such activities as search and pass-through take place in the Personnel Access Portal. Security monitoring at the Personnel Access Portal includes metal detectors, explosive detectors, and radiation monitors. Also included in the Technical Support Building are the following:

- Security operations center and support facilities
- [Text Deleted] R1
- Safeguards vault
- Security response ready room
- Armory
- Emergency power room
- Computer and telecommunications room
- Building mechanical equipment room
- Uninterruptible power supply (UPS). R1

[Text Deleted]

The Technical Support Building is not directly involved in the principal processing functions of the MFFF. It is designed and shall be maintained as a contamination-free building.

3.1.8 Receiving Warehouse Building

The Receiving Warehouse Building is a single-story, slab-on-grade, pre-engineered metal building located outside of the PIDAS fence. The exterior walls and roof consist of insulated metal panels.

The building is comprised of the Unloading Dock, the Materials Receiving Area, the Inspected Warehouse Holding Area, the Material Transfer Dock, Offices, Vestibule and Inspection Guard Station. The Unloading Dock provides for the offloading and delivery of materials, supplies and equipment to the Warehouse. The Material Receiving Area provides for the receipt, unpacking and temporary storage and processing of items through the Material Access Portal (MAP) or distributed to the Administration Building. The MAP is equipped with screening equipment that allows identification and inspection of all materials prior to entering the Inspected Material Holding Area. The Inspected Material Holding Area provides for the receipt, temporary storage, and distribution of inspected materials, supplies, and equipment into the Protected Area. The Material Transfer Dock provides a loading area where items are transferred from the Inspected Material Holding Area through the PIDAS and enter the Protected Area. The office area provides a location for the processing, coordination, and distribution of items. The Vestibule and Inspection Guard Station provide a location for guard inspection and a secure area for guards during inspection of vehicles entering the Vehicle Access Portal, which is located to the south R1 and adjacent to the Receiving Warehouse Building. Items that are transported directly by vehicles through the PIDAS into the protected area include plutonium dioxide, bulk chemical reagents, depleted uranium, rods, and fuels shipping packages. R1

3.2 MOX FUEL FABRICATION PROCESS

The following process description is intended to support the discussion of environmental impacts from MFFF operations in Chapter 5. The SA and the CAR contain more detailed descriptions of the MOX fuel fabrication process.

The plutonium polishing (i.e., aqueous polishing) and fuel fabrication processes are based on similar processes used at the COGEMA MELOX Plant and La Hague Plutonium Finishing Facilities in France. The flow of plutonium compounds through the MOX fuel fabrication process is illustrated in Figure 3-4. The following brief discussion of the process focuses on process aspects of concern when addressing environmental impacts.

The MOX fuel fabrication process is divided into two major subprocesses:

- Aqueous polishing – Removes impurities from the weapons-grade plutonium oxide. For PDCF feeds, impurities are essentially gallium, americium and uranium. For AFS feeds, the diversity of impurities and the impurity levels are higher. R2

- Fuel fabrication – Blends plutonium and uranium oxides and recycled scraps to a mixed oxide, converts the MOX powder to a fuel pellet, loads the MOX fuel pellets into fuel rods, and bundles the rods into fuel assemblies.

The MFFF will receive and process alternate feedstock. Some of this feedstock was to have been processed by immobilization and does not meet the specifications of material normally produced by the PDCF. The alternate feedstock contains salt and chloride impurities at concentrations above what is expected for the remainder of the plutonium conversion campaign. Additional purification steps will be used to remove these impurities. For the purpose of calculating environmental impacts, this ER assumes that all alternate feedstock is processed in the first two to three years of MFFF operation. Actual scheduling of alternate feedstock has not yet been determined. R2

The aqueous polishing subprocess produces most of the liquid waste streams and employs extensive reuse of reagents to minimize plutonium losses and waste. The fuel fabrication subprocess produces solid scrap material, which is reused in the overall process. Both subprocesses generate small amounts of contaminated solid wastes related to maintenance activities. The building and glovebox ventilation systems are essential for contamination control. The associated airborne emissions are collected from the process ventilation (i.e., gloveboxes and equipment) and building ventilation in the controlled area.

3.2.1 Pretreatment for Alternative Feedstock

All feedstock will be received as plutonium oxide. Some of the alternative feedstock may contain higher than normal salt contaminants, some will contain chloride contaminants, and some will contain trace amounts of enriched uranium. All alternate feedstock will be milled to a uniform particle size to facilitate dissolution. The alternative feedstock will be analyzed for contaminants. R2

If chloride contaminants are above feedstock specifications they are removed as a chlorine gas waste steam. The chlorine gas is passed through a scrubber to convert the chlorine to a sodium chloride solution. R2

If the chloride contaminants are within feedstock specifications the feed stock is processed as described in 3.2.2.

3.2.2 Plutonium Polishing

Plutonium polishing is schematically represented in Figure 3-5. The polishing process can be divided into five discrete steps:

1. Plutonium oxide (PuO_2) is first electrochemically dissolved in nitric acid.
2. The plutonium nitrate solution is solvent extracted using tributyl phosphate in an aliphatic diluent (dodecane) to remove impurities. The solution containing plutonium nitrate is washed with nitric acid. The plutonium is removed from the solvent by an aqueous solution of hydroxylamine nitrate, hydrazine, and nitric acid.
3. The plutonium valence is oxidized back to Pu(IV) by driving nitrous fumes (NO_x) through the plutonium solution.
4. The plutonium is then precipitated with excess oxalic acid as plutonium oxalate that is collected on a filter.
5. The moist oxalate is dried and calcined to PuO_2 that is packaged in cans for use in the MOX fuel fabrication process.

The plutonium losses and liquid waste generation are maintained as low as technically and economically possible by specific solvent treatment and by reuse of nitric acid and silver in the polishing process. The MFFF design has a very stringent requirement imposed for plutonium loss in accordance with the DOE contract. The various liquid waste streams from the aqueous polishing process are illustrated in Figure 3-6, listed in Table 3-3, and described in the following paragraphs.

Plutonium oxide (PuO_2) is milled (only AFS feeds), analyzed, dechlorinated if necessary and electrochemically dissolved with silver (Ag^{2+}) in nitric acid. A solvent (tributyl phosphate) in an aliphatic diluent (dodecane) then extracts the plutonium nitrate from the nitrate solution. Nitrate R2 impurities (i.e., americium, gallium, and silver) remain in the aqueous (i.e., raffinate) phase. After diluent washing, the raffinate stream is routed to an acid recovery unit.

The extracted plutonium is washed with nitric acid. The plutonium is then reduced to trivalent plutonium by the introduction of hydroxylamine nitrate. The plutonium is removed from the solvent using a solution of nitric acid, hydrazine, and hydroxylamine nitrate. A silver recovery unit, based on electrolytic separation, recovers a large portion of the silver[4]. The organic solvent that has had the plutonium removed is mixed with an additional stripping solution in a plutonium barrier before being routed to the uranium removal process. Uranium impurities are removed from the organic solvent with dilute nitric acid. Criticality is an issue because of the high uranium-235 content of the stream. It is therefore necessary to perform an isotopic dilution through the addition of depleted uranium to reduce the uranium-235 concentration to below 30%. The solvent that has had the plutonium and uranium removed is routed to solvent recovery mixer-settlers to be recycled back into the process.

For uranium-rich feeds, a scrubbing column allows uranium to be removed to maintain the uranium content specification in the purified Pu stream. For batches with low uranium content, this column is by-passed. R2

After the extraction steps, the plutonium is oxidized back to quadravalent plutonium by driving nitrous fumes (NO_x) through the plutonium solution. Nitrous acid is removed in an air-stripping column. The NO_x-containing gas stream is demisted to limit plutonium loss, then treated through an NO_x scrubbing column, before being released to the process offgas treatment unit. Recombined acid is routed to acid recovery.

The oxidized plutonium is reacted with excess oxalic acid ($H_2C_2O_4$) to precipitate plutonium oxalate, which is collected on a filter, then dried in a screw calciner, to produce purified plutonium oxide powder (PuO_2), which is stored in cans. Offgas from the screw calciner is treated before discharge to the downstream Very High Negative Pressure main filters. The filtered oxalic mother liquors are concentrated, reacted with manganese to destroy the oxalic acid, and recycled to the beginning of the extraction cycle to minimize plutonium loss from the process.

3.2.3 Material Recovery and Recycling

3.2.3.1 Acid Recovery

Spent acid, consisting of oxalic mother liquor distillates, raffinates, calcination concentrates, and recombined acid, is mixed in a buffering tank and injected into an evaporator. The first evaporator of the acid recovery unit is a concentration step before treatment of the concentrates in the silver recovery unit. The evaporator bottom concentrates, which contain significant

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[4] DOE is evaluating eliminating the silver recovery step as a future design change. Silver recovery is retained in the ER to provide a bounding maximum for waste volumes.

Any nitric acid not reused is transferred to SRS for waste treatment as the excess acid component of the liquid high alpha waste. R2

3.2.3.2 Silver Recovery (see footnote 4 on previous page)

The concentrates from the first evaporator of the acid recovery unit are treated in the silver recovery unit. Silver recovery is a batch process that is based on electrolytic separation. After treatment, recovered silver is transferred back to the dissolution unit. Trace impurities removed in this process constitute the liquid americium stream of the high alpha waste. DOE is evaluating eliminating silver recovery as a future design modification. Silver recovery is retained in the ER to provide bounding maximum waste volumes. R1 R2

3.2.3.3 Stripped Uranium Collection

Before the commencement of the purification cycle, HEU impurities, which are present in the plutonium, are stripped from the plutonium and isotopically diluted to approximately 30% with depleted uranium. After the uranium stripping process, uranium removed from the plutonium stream is diluted with depleted uranium to approximately 1%. The diluted uranium is collected in storage vessels prior to subsequent processing within the SRS waste management infrastructure. R1

3.2.3.4 Solvent Regeneration

The regeneration of spent solvent from the plutonium separation step is accomplished by washing with sodium carbonate, sodium hydroxide, and nitric acid to remove degradation products from organic compounds, including trace amounts of plutonium and uranium. These degradation products are the alkaline wash component of the liquid high alpha waste (see Section 3.3.2.3). The regenerated solvent is adjusted with the addition of tributyl phosphate and reused in the purification process. R1

3.2.4 MOX Fuel Fabrication

The remaining steps in the MOX fuel fabrication process (i.e., powder, pellet, and rod processing) are dry subprocesses and are illustrated in Figure 3-7. The solid wastes produced from these steps are listed in Table 3-4.

Polished plutonium oxide is mixed with uranium oxide and recycled scraps to produce an initial MOX mixture that is 20% plutonium. This mixture is subjected to a micronized homogenization process in a ball mill and mixed with additional uranium oxide and recycled scraps to produce a final blend with the required plutonium content of 2.3% to 4.8%. The MFFF design is capable of producing MOX with a plutonium content of 6%. This final blend is further homogenized to meet the stringent plutonium distribution requirements. During the final homogenization process, lubricants and poreformers are added to control specific gravity.

Polished plutonium oxide is mixed with uranium oxide and recycled scraps to produce an initial MOX mixture that is 20% plutonium. This mixture is subjected to a micronized homogenization process in a ball mill and mixed with additional uranium oxide and recycled scraps to produce a final blend with the required plutonium content of 2.3% to 4.8%. The MFFF design is capable of producing MOX with a plutonium content of 6%. This final blend is further homogenized to meet the stringent plutonium distribution requirements. During the final homogenization process, lubricants and poreformers are added to control specific gravity.

Powder processing is performed in closed containers located in gloveboxes to contain any contamination. Gaseous exhaust points from the gloveboxes are equipped with HEPA filters to contain particulate emissions.

The homogenized powder is pneumatically transferred from the homogenizer to the press feeding hopper under negative pressure. The powder is then transferred by gravity to the press shoe.

The sintering process is performed in a furnace by heating the fuel pellets to a temperature of 3,092°F (1,700°C) under gas scavenging, using a nonexplosive mixture of argon and hydrogen. This specific furnace atmosphere controls sintering and pellet stoichiometry and is not subject to inadvertent detonations and deflagrations due to low hydrogen content. The pellet boats, which contain 22 lb (10 kg) of pellets each, are positioned on a molybdenum plate and then transferred to the furnace. An inlet and outlet furnace airlock is required for changes in atmospheric pressure. A pusher system provides continuous motion of the sets (i.e., boat on shoe) through the furnace. The last set introduced in the furnace pushes the preceding ones.

The sintered pellets are dry ground to meet the size and roughness of the fuel specifications for the specific reactor. The grinding process is performed in four dedicated gloveboxes. A dust removal system, composed of an extractor and a decloggable filter, is installed in the unit to minimize the spread of powder in the gloveboxes. This dust abatement technique minimizes waste production in the form of disposable filters and allows recovery and recycle of the captured dust. Grinding dust and pellet chips are routed back as feedstock to the scrap recycling process.

Pellet processing is performed in gloveboxes with HEPA filters on the vents to contain any dust. Glovebox exhausts are equipped with HEPA filters to contain any particulate emissions.

After the pellets are ground, they are automatically and visually inspected and sorted. Pellets that meet specifications are lined up and loaded into rods. Discarded pellets are routed to scrap processing and reintroduced to the blending feedstock (see Figure 3-7).

Within a glovebox environment, the rods are capped, welded, pressurized with helium, sealed, and then decontaminated. The decontaminated rods are removed from the gloveboxes and placed on trays for inspection and assembly.

Rods are inspected by testing for leaks and performing x-ray analysis of welds. The rods are then gamma-scanned to ensure that the plutonium content and length of the pellet column are correct. Bundles of three different plutonium content rods are assembled into the fuel assembly skeleton. The fuel assembly is subjected to a final inspection prior to shipment.

Rod processing, until the decontamination step, is performed in gloveboxes with HEPA filters on the vents to contain the minute amounts of particulates. Any air exhaust from the gloveboxes is equipped with HEPA filters to contain particulate emissions.

3.2.5 Process Ventilation Offgas Treatment System

The aqueous polishing process ventilation system, which is part of the process ventilation offgas treatment system, is used to:

- Remove plutonium from offgases released during dechlorination, dissolution and from the oxidation and degasing columns of the purification cycle | R2
- Decontaminate the offgas effluents from all of the aqueous polishing units
- Maintain negative pressure in the tanks and equipment connected to the process ventilation system (i.e., more than 500 Pa with respect to the cell or glovebox in which equipment is placed)
- Provide continuity of the first confinement barrier.

NO_X and air scrubbing columns generate most of the plutonium released to the ventilation. NO_X-containing exhausts are demisted through a cap impactor to maximize plutonium recycling to the process. The NO_X offgases are subsequently routed through a specific NO_X scrubbing column after demisting through a can impactor to maximize plutonium recycling to the process. Finally, the scrubbed exhaust gas is diluted with process ventilation air and cleaned through a final scrubbing column. The exhaust is filtered through two final HEPA filter stages prior to being released through the MFFF stack.

The exhaust from the air pulsation columns is passed through two final HEPA filters before being released through the MFFF stack. A continuous air monitor is used to monitor stack releases to the environment.

There is a separate ventilation system for the calcination furnace exhaust. Exhaust gas from the calcination furnace is filtered through a metallic filter to remove most of the dust, cooled, and filtered through two HEPA filter stages before extraction by the very high negative pressure duct.

3.2.6 Building and Glovebox Ventilation Systems

Areas within the facility with the highest potential for contamination are maintained at the lowest, or most negative, pressure compared to the adjacent room. Airflow cascades progressively from the areas of least potential contamination to the areas of highest potential contamination.

3.2.6.1 Confinement Zones

The MFFF ventilation systems maintain pressure gradients between the different confinement zones to ensure that leakage air flows from the zones of lowest contamination potential to zones of increasing contamination potential. Confinement zone classification is based on the fuel fabrication process, material handling, and the level of potential airborne and transferable contaminants generated in the various process areas. The confinement zone classification scheme is summarized as follows:

- Class C4 zones – Process equipment, containing radioactive materials where permanent contamination is allowed (e.g., gloveboxes in the MOX processing and Aqueous Polishing [AP] areas). R1
- Class PC zones – Process cells in the AP areas.
- Class C3 zones are divided into two sublevels:
  - Class C3a – Areas with low occasional contamination risk, such as airlocks to process rooms, filter rooms containing C3b room exhaust ventilation filters and some personnel and material access corridors.
  - Class C3b – Areas with moderate occasional contamination risk, such as laboratories, waste drum storage and areas enclosing gloveboxes that contain powder or pellets.
- Class C2 zones – Areas with very low occasional contamination potential, including zones within MOX and AP areas, such as the process rooms containing rods or assemblies, final filter rooms and corridors around the C3 areas. R1
- Class C1 zones – Areas with near zero contamination risk located within the shipping and receiving area and the area located in supply air handling units between air intake and high efficiency filter.

All C4, PC, C3, and C2 zones in the MOX Fuel Fabrication Building are maintained slightly below atmospheric pressure.

The MFFF has multiple static and dynamic confinement systems as shown in Figures 3-8 and 3-9. Figure 3-8 shows the typical ventilation confinement for the aqueous polishing process, while Figure 3-9 shows the typical ventilation confinement for the fuel fabrication process. R1 Confinement systems are used to confine dispersible radioactive contamination within specific controlled areas under all normal, abnormal, and accident conditions. The dynamic confinement systems supplement the static confinement systems by maintaining pressure gradients between R1 the different confinement zones.

Three confinement systems (primary, secondary, and tertiary) are used in the MFFF. Confinement systems consist of static confinement subsystems and dynamic confinement R1 subsystems. The static confinement systems include building walls, barriers, gloveboxes, enclosures, filters, hoods, piping, tanks, ductwork, plenums, and vessels. The dynamic confinement systems consist of the HVAC exhaust subsystems and equipment. R1

Ventilation systems and components have features that provide for alarm indication. HVAC dynamic confinement systems are designed to assure the confinement of hazardous material and airborne contaminants during normal, abnormal, and accident conditions, including natural phenomeha and fires, without the loss of confinement. The HVAC dynamic confinement systems operate continuously to protect personnel from exposure to airborne and transferable contamination. R1

R1

3.2.6.2 Very High Negative Pressure Ventilation System

The primary confinement system consists of barriers, gloveboxes, hoods, piping, vessels, tanks, glovebox exhaust ductwork, primary confinement HEPA filter plenums, class C4 zones, and their associated ventilation systems. The dynamic confinement of class C4 zones is ensured by a Very High Negative Pressure Ventilation System, which maintains a negative pressure in C4 enclosures relative to the C3b rooms in which they are installed. Each process glovebox supply and exhaust is fitted with two HEPA filter stages within the process rooms. Inside the grinding gloveboxes, contamination is collected with an additional decloggable pre-filter to reduce the airborne concentration. The exhaust from the C4 enclosures prior to exhausting through the MFFF stack is routed through two additional final HEPA filters. R1

3.2.6.3 High Negative Pressure Ventilation System

The secondary confinement system consists of walls, floors, roofs, and associated ventilation exhaust system's components that confine any potential release of hazardous materials from the primary confinement. Dynamic confinement of C3a and C3b zones within the secondary confinement system is provided by the High Negative Pressure Ventilation System, which maintains a negative pressure in the zones relative to the atmosphere. This room ventilation air is normally not contaminated. The exhaust from these zones is routed through two final HEPA filters before exhausting through the MFFF stack. R1

The process cell confinements in the aqueous polishing area are also served by a High Negative Pressure Ventilation System. The system maintains process cells at the required negative pressure with respect to atmosphere. The exhaust from the process cells is routed through two stages of HEPA filters for the final level of filtration before release. R1

3.2.6.4 Medium Negative Pressure Ventilation System

Dynamic confinement of class C2 rooms within the tertiary confinement system in both MOX and the Aqueous Polishing building is provided by the Medium Negative Pressure Ventilation System. The system maintains the required negative pressure relative to the atmosphere. The R1 exhaust from the Class C2 zones is passed through two final HEPA filter stages before being released through the MFFF stack. R

3.3 WASTE MANAGEMENT SYSTEMS

MFFF waste management is guided by the principles of as low as reasonably achievable (ALARA), waste minimization, and pollution prevention. Liquid and solid wastes produced in the MFFF will be transferred to the appropriate SRS facility for waste processing. Consequently, there are no process liquid effluents discharged directly to the environment. The MFFF site does discharge uncontaminated HVAC condensate and stormwater to an NPDES permitted outfall. R1 All wastes transferred to SRS meet the waste acceptance criteria (WAC) for the respective waste management facility. Processes related to waste management are discussed in the following subsections. Tables 3-3 and 3-4 summarize waste volumes and characteristics for the MFFF. Figure 3-6 illustrates the primary sources of liquid wastes generated by the aqueous polishing process. Treatment of airborne wastes is illustrated in Figure 3-10. Figures 3-11 and 3-12 provide the waste management flow diagrams for liquid and solid wastes, respectively.

The MOX fuel fabrication process employs reuse of reagent feedstocks and plutonium to the maximum extent possible. This approach results in a very small amount of generated waste that is transferred from the facility. The various waste streams are discussed in the following sections. No HLW will be generated by any of the facility operations.

3.3.1 Airborne Emissions Management

Airborne emissions are controlled by the building and glovebox ventilation systems, the process ventilation offgas system, and MFFF stack HEPA filters. The expected plutonium, americium, and uranium emissions are projected to be significantly smaller than those reported in the SPD EIS (DOE 1999c). Accordingly, the SPD EIS values may be considered conservative bounding limits for airborne emissions from the MFFF.

3.3.2 Liquid Waste Management

The aqueous polishing process is the primary source of liquid waste, although it is not the only source. Liquid feedstocks are recycled in the process to the maximum extent practical to minimize waste generation and plutonium losses. The various steps in the aqueous polishing process generating liquid waste streams are described below. Additional liquid wastes are also discussed. Figure 3-6 provides a flow diagram of the aqueous polishing waste streams, while Table 3-3 presents the annual volume and concentrations of stream isotopes.

3.3.2.1 Chloride Removal Waste

A dechlorination step is necessary before dissolution for chlorinated feeds (AFS). The extracted chlorine is filtered and washed in a scrubbing column. Chlorinated liquid wastes are collected in R2 buffer storage tanks, sampled and analyzed to verify their compatibility with SRS site requirements. They will be then directed to the SRS Effluent Treatment Facility (ETF). R2

3.3.2.2 Liquid Americium Stream

The regenerated concentrates stream from the silver recovery process[5] contains unwanted impurities, trace amounts of silver, plutonium and uranium, and possibly some excess acid. This stream is a liquid high alpha activity waste[6]. The stream is collected in a storage tank, and the contents of the tank are sampled and analyzed.

Liquid high alpha activity waste (i.e., americium) will be transferred through a dedicated pipeline to the Waste Solidification Building. R2

3.3.2.3 Excess Acid Stream

The acid recovery process produces a condensate stream and excess acid or evaporator bottoms. The acid recovery distillates stream also will be collected in buffer storage tanks and subsequently sampled and analyzed. Depending on the process requirements, the distillate stream may be either recycled into the process through rinsing and scrubbing of the columns or discharged to the SRS process sewer. The evaporator bottoms are expected to contain significant levels of alpha-emitting isotopes and will be managed with the liquid high alpha activity waste. The waste will be transferred to the Waste Solidification Building. R2

3.3.2.4 Excess Low-Level Radioactive Solvent Waste

The alkaline treatment process generates a small excess solvent stream and an alkaline waste stream. After these washings, the alkaline liquid waste stream is transferred to the liquid high alpha activity waste storage tanks and managed with the liquid alpha waste stream. The tanks are sampled and analyzed before transfer to the Waste Solidification Building. R2

The slightly contaminated excess solvent is a LLW. It is collected and, when a sufficient quantity of solvent has been accumulated, packaged in a container. The container of spent solvent is transferred by truck to an appropriate SRS for disposal at an approved facility. R1

3.3.2.5 Stripped Uranium Stream

After the uranium stripping process, the uranium is isotopically diluted (uranium-235 < 1%) for criticality considerations and is collected in a storage vessel. The uranium stream will be transferred to the Waste Solidification Building for management by SRS as LLW. R1 R2

[5] If DOE eliminates the silver recovery, the liquid americium stream will be a waste from the acid recovery process.

[6] Liquid high alpha activity waste contains alpha-emitting isotopes in excess of the low-level radioactive waste (LLW) limit (>100 nCi/g). Classification of the waste is deferred until further processing by SRS.

3.3.2.6 Rinsing Water

Potentially contaminated wastewater is collected in the controlled area. This wastewater consists of laboratory rinse water, mop water from washing, and condensate from room air conditioners. The rinse water stream is discharged to the process sewer for treatment at the SRS ETF. R1

3.3.2.7 Contaminated Drains

The MFFF building contaminated drains system consists of drains, piping, and necessary tanks, which collect all contaminated and potentially contaminated fluids from within the process areas and other potentially contaminated areas. There are not any personnel sinks or toilets in potentially contaminated areas. Janitor sinks and floor drains in potentially contaminated areas drain to the contaminated drain system. All drains lead to central collection tanks in the MFFF building radioactive waste area for monitoring and discharge to the appropriate SRS facility for processing. Drains from rooms that contain criticality-safe equipment and collection tanks must have a critically-safe geometry aligned to criticality-safe tanks. Drains in rooms that contain conventional equipment will be aligned to conventional tanks. R1 R1 R1

The design of the contaminated drains system considers the collection system guidelines in Regulatory Guide 3.10 (NRC 1973).

Additional liquid containment features include the following engineered systems:

- Tanks containing contaminated liquids are located in diked rooms/areas that are of sufficient size to contain the contents of a single tank.
- Concrete vaults and dikes are used for spill protection of diesel fuel oil storage tanks.
- Stainless steel-lined floors and portions of walls creating containment basins in tank rooms of the aqueous polishing building are used.
- Double-walled pipes are used for transport of contaminated liquids between or outside of the buildings.
- Stormwater collection and monitoring basins and oil separators are employed.

3.3.2.8 Nonhazardous Liquid Waste

Nonhazardous liquid waste includes uncontaminated HVAC condensate, boiler blowdown, and the sanitary waste from sinks, showers, urinals, and water closets from outside the radiological control area. The Radiation Protection Contamination Monitoring and Control Program ensures that showers and sinks outside of the restricted radiation zones will not be contaminated. This program requires personnel and equipment leaving contaminated areas to be monitored to ensure that they are not contaminated. The uncontaminated HVAC condensate is discharged to the stormwater system in accordance with SCDHEC standard stormwater permit conditions. The R1 R1 remaining nonhazardous wastewater is discharged to the SRS F-Area sanitary sewer system that connects to the CSWTF.

3.3.2.9 Processing of Liquid High Alpha Activity Waste at the Waste Solidification Building

The Waste Solidification Building will receive waste from the MFFF and PDCF. Appendix G provides a characterization of these waste streams. As noted in Table 3-3, three of the MFFF liquid waste streams (liquid americium, excess acid, and solvent regeneration alkaline wash) are combined into the high alpha waste. The stripped uranium waste stream is transferred as a separate waste to the Waste Solidification Building. The two wastes are batch transferred through separate double-walled stainless steel lines to the Waste Solidification Building. R2
Following each transfer, the line is rinsed twice, adding the first rinse to the WSB waste tanks, and allowed to gravity drain to the MFFF waste tank. The collected rinse water becomes part of the waste stream. The transfer line is maintained in a drained state between waste transfers. Waste from the PDCF is also transferred through double-walled stainless steel lines to the Waste Solidification Building.

The wastes are collected in the waste receipt area of the WSB. The waste receipt area is equipped with separate collection tanks for each waste type. Each collection tank is sized to hold six weeks worth of waste.

The waste is transferred by pump from the waste receipt tanks to the pretreatment tanks on the ground level. Following receipt, provisions have been made to volume reduce the high alpha waste stream (but not required). The high alpha waste volume is reduced by evaporation and the still bottoms neutralized with sodium hydroxide. The distillate is sent to the SRS ETF as LLW. The neutralized bottoms are blended with cement to produce a solid TRU waste matrix suitable for disposal at the Waste Isolation Pilot Plant (WIPP). R2

The volume of stripped uranium waste will be reduced using evaporation with the distillate sent to SRS ETF as LLW and the uranium blended with cement to produce a solid LLW matrix suitable for disposal at SRS or an approved outside facility.

3.3.3 Facility Solid Waste Management

The management of solid waste for the MFFF is discussed in the SPD EIS, Appendix H, Section H.4.2.3.2 (DOE 1999c). No HLW will be generated by the facility. Solid waste includes transuranic (TRU) waste, mixed TRU waste, LLW, mixed LLW, hazardous waste, and nonhazardous solid waste. Waste that is potentially contaminated with plutonium is collected, drummed, and then analyzed to determine the waste category. The drums are then separated by waste category and stored as TRU waste, mixed TRU waste, LLW, and mixed LLW. All solid waste will comply with SRS WAC and certification requirements. The methods and materials

[7] These volumes are based on no reduction from evaporation. Use of evaporation would reduce these volumes to 125 yd^3 (100 m^3)

used in the management of these various waste streams are often similar and are noted in the following discussion.

3.3.3.1 Solid Transuranic Waste

TRU waste is radioactive waste containing more than 100 nCi (3,700 Bq) of alpha-emitting TRU isotopes per gram of waste, with half-lives greater than 20 years. Contact-handled TRU waste is TRU waste with a surface dose rate not greater than 200 mrem/hr. The container itself provides sufficient protection, and no extra shielding is required.

TRU solid waste generation is related to the normal process operations, maintenance operations, and replacement of faulty equipment. TRU solid waste includes disposable materials and replaced equipment. TRU solid waste may be both compactible and non-compactible.

TRU solid waste streams are separated at the source of generation and packaged in standard metallic 55-gal (208-L) drums.

Waste containers are marked at the point of generation. The containers are processed sequentially. Each drum is checked for plutonium mass, labeled, and registered, if within the plutonium mass limits. The drums are uniquely labeled, and the drums are tracked through the storage and shipping cycles in the waste management computer system.

3.3.3.2 Solid Mixed Transuranic Waste

The only solid mixed TRU waste produced at the MFFF may consist of the lead-lined gloves that may be used in the gloveboxes. Removal of this potential waste source is under consideration.

3.3.3.3 Solid Low-Level Waste

LLW is defined as radioactive waste that is not HLW, spent nuclear fuel, TRU waste, uranium or thorium mill tailing, byproduct material, or naturally occurring radioactive material.

LLW will be generated as a result of normal MFFF process operations and maintenance activities. LLW is waste contaminated with radioactivity. It includes alpha-emitting radionuclides with half-lives greater than 20 years but in concentrations less than 100 nCi/g of the waste matrix without regard to source or form. Solid LLW will include both disposable materials and replaced equipment. Solid LLW will be compactible and non-compactible.

Acceptable containers for LLW are Department of Transportation (DOT) Type A Spec 7A drums or containers specified in the SRS WAC.

3.3.3.4 Solid Mixed Low-Level Radioactive Waste

Mixed LLW is LLW determined to contain both a hazardous component subject to the Resource Conservation and Recovery Act (RCRA), as amended, and source, special nuclear, or byproduct material subject to the Atomic Energy Act of 1954, as amended.

Mixed LLW includes solidified solvents contaminated with plutonium, and scintillation vials from the laboratory.

Mixed LLW is packaged and stored onsite for processing in a manner consistent with the Site Treatment Plan for SRS. To the extent possible, commingling of waste from streams requiring different treatment technologies will be prevented. Packaging of mixed LLW will meet SRS requirements. For mixed LLW destined for an offsite facility, packaging, labeling, and marking will comply with DOT transportation regulations.

3.3.3.5 Potentially Contaminated Waste

Wastes that are believed to be non-contaminated or potentially contaminated, as well as drums contaminated with plutonium, are collected, drummed, and then analyzed to determine the waste category. Drums may be categorized as LLW or nonradioactive waste.

3.3.3.6 Hazardous Solid Waste

Hazardous solid waste is waste that is, or contains, listed hazardous waste or that exhibits one of the four EPA hazardous waste characteristics (i.e., ignitability, corrosivity, reactivity, and toxicity).

Hazardous waste includes spent solvents and reagents from the analytical laboratory that are not contaminated with radioactive material. Hazardous waste is packaged and stored onsite for treatment and/or offsite disposal in a manner consistent with the SRS WAC. Hazardous waste from the MFFF will be managed at SRS facilities, at other DOE sites, or by commercial services.

Hazardous wastes will be certified as meeting the WSRC WAC before being transferred. Hazardous waste that has been certified as meeting the WAC for transfer will be managed in a manner that maintains the certification status.

3.3.3.7 Nonhazardous Solid Waste

Nonhazardous waste is waste that is not or does not contain listed hazardous waste, that does not exhibit one of the four EPA hazardous waste characteristics (i.e., ignitability, corrosivity, reactivity, and toxicity), and that does not contain radioactive material.

Nonhazardous solid waste includes office garbage, machine shop waste, and other industrial wastes from utility and maintenance operations. Nonhazardous solid waste is packaged in conformance with standard industrial practice. Recyclable solid wastes (e.g., office paper, metal cans, and plastic and glass bottles) are sent offsite for recycling. The remaining solid sanitary waste is sent to the Three Rivers Landfill, which is located at SRS just southwest of B Area.

Figures

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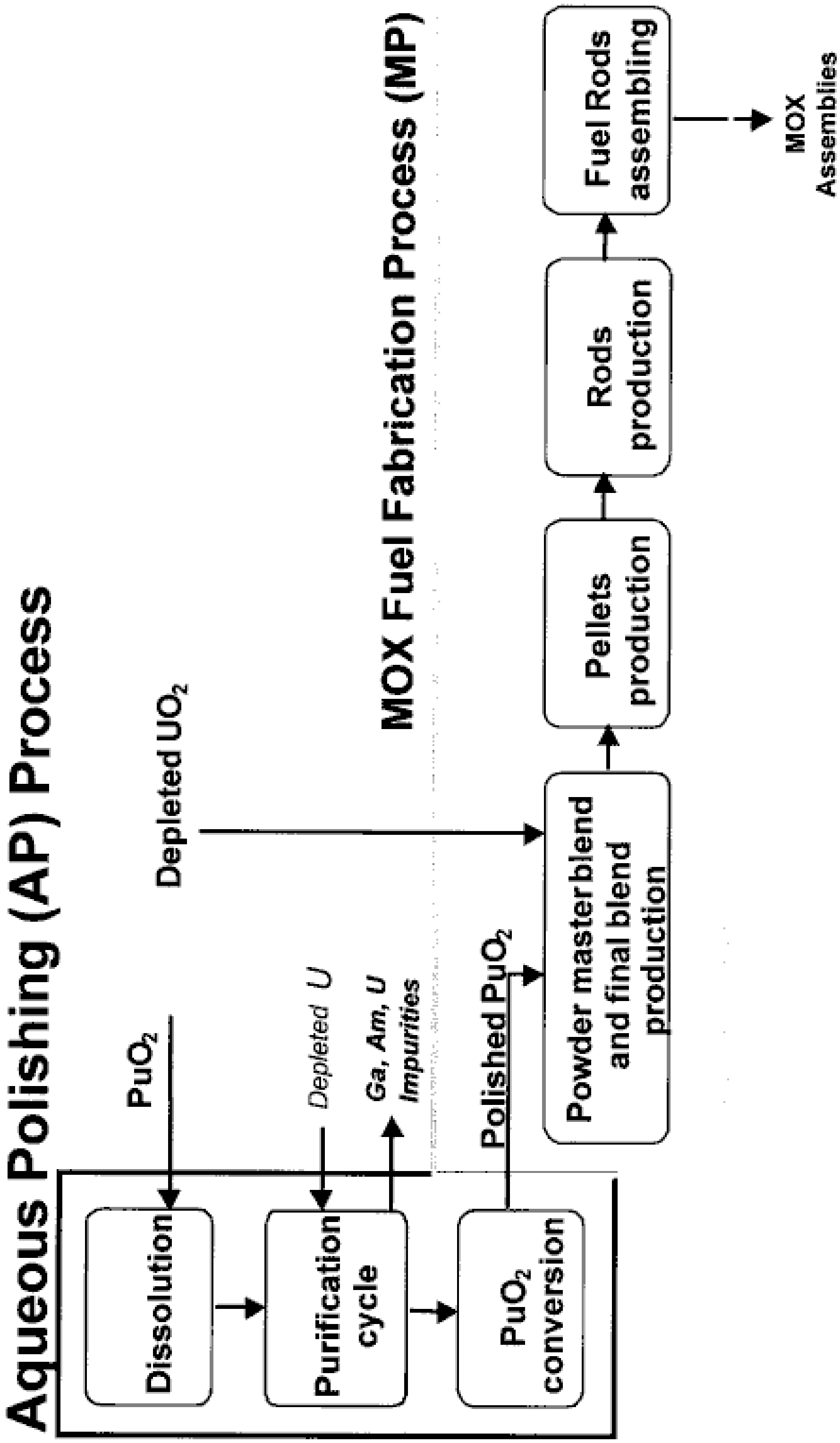

Figure 3-4. MOX Fuel Fabrication Production Process Flow

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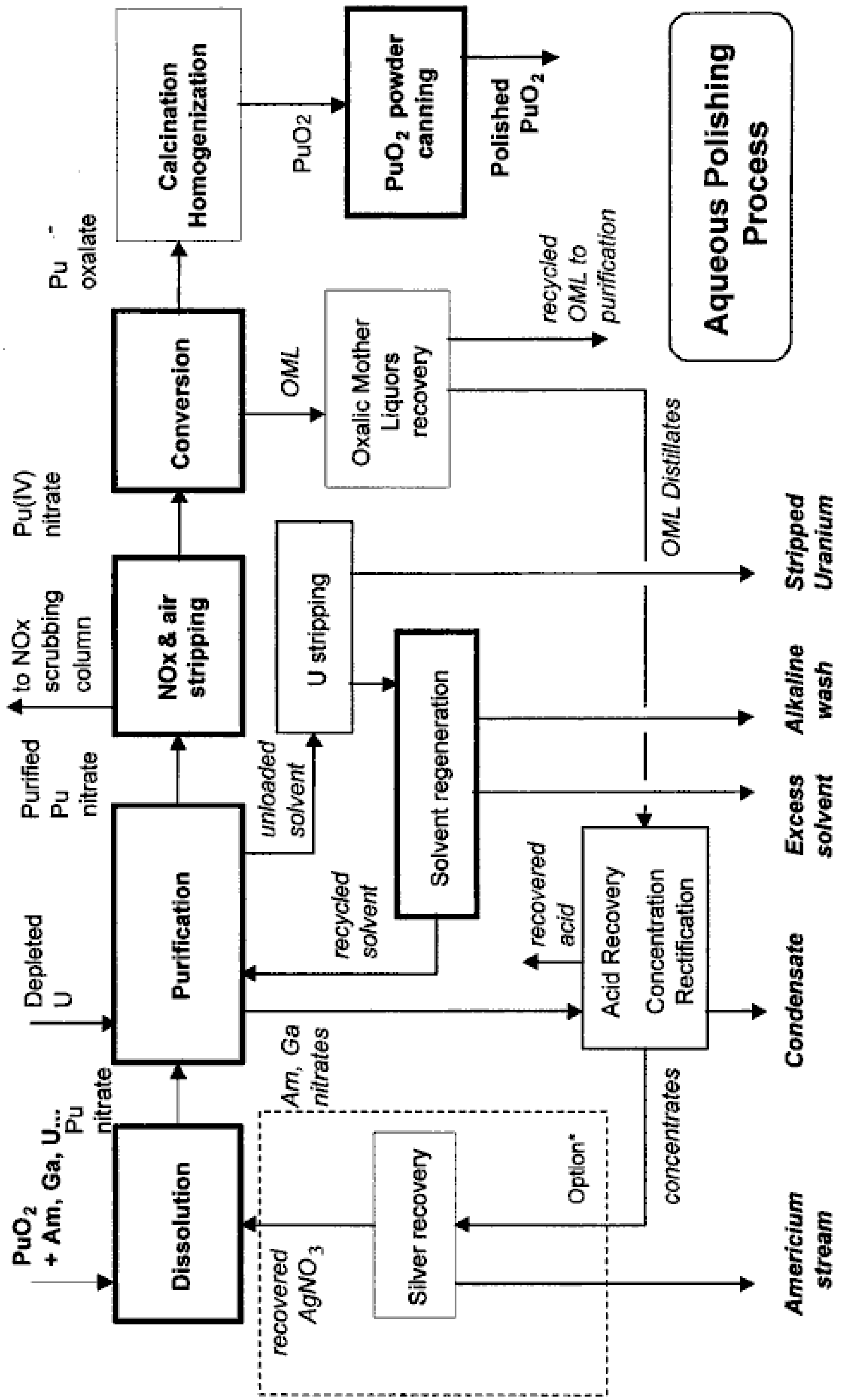

* DOE is evaluating elimination of silver recovery.

Figure 3-5. Plutonium Polishing Block Diagram

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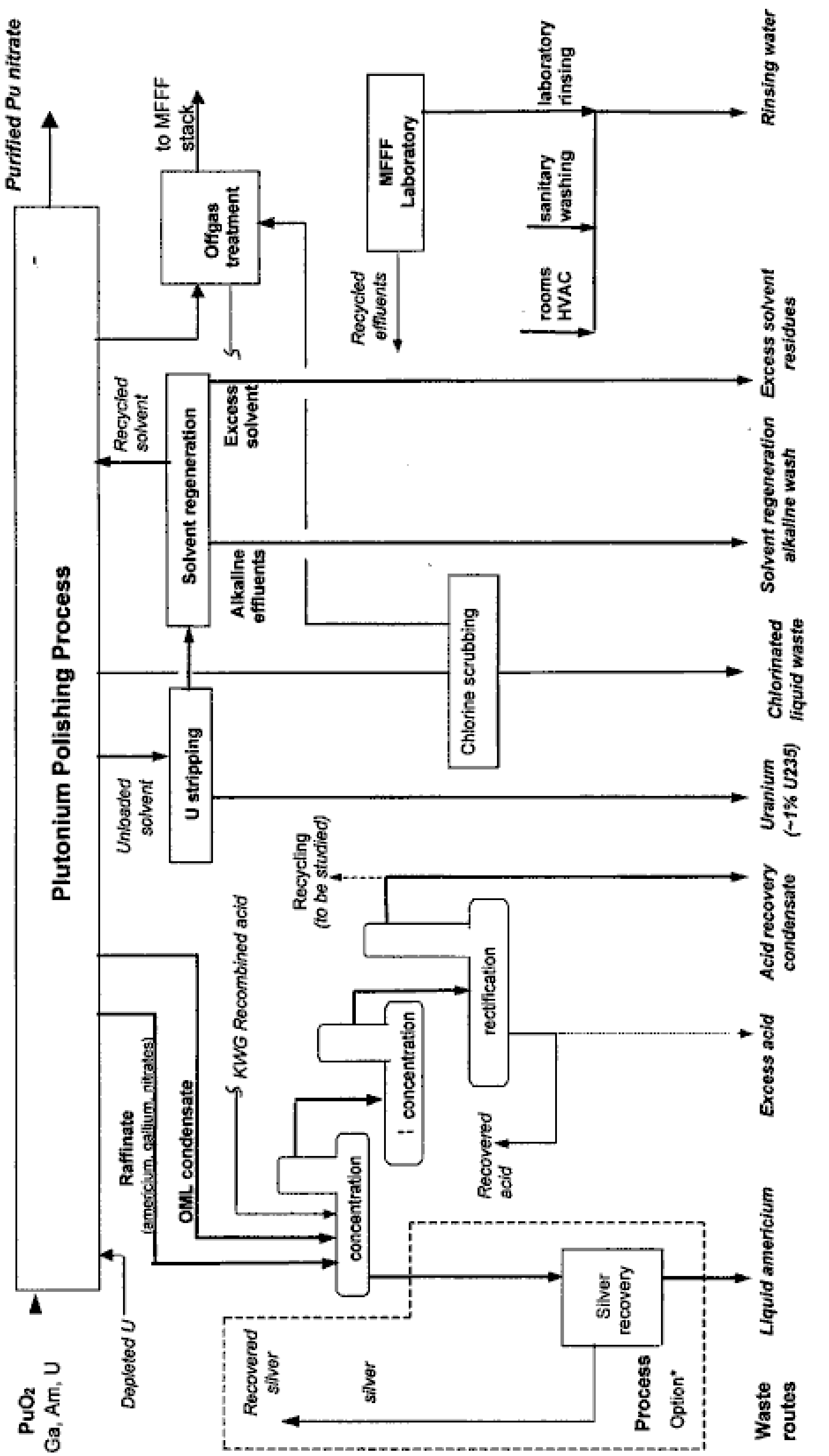

* DOE is evaluating elimination of silver recovery

Figure 3-6. Aqueous Polishing Waste Streams

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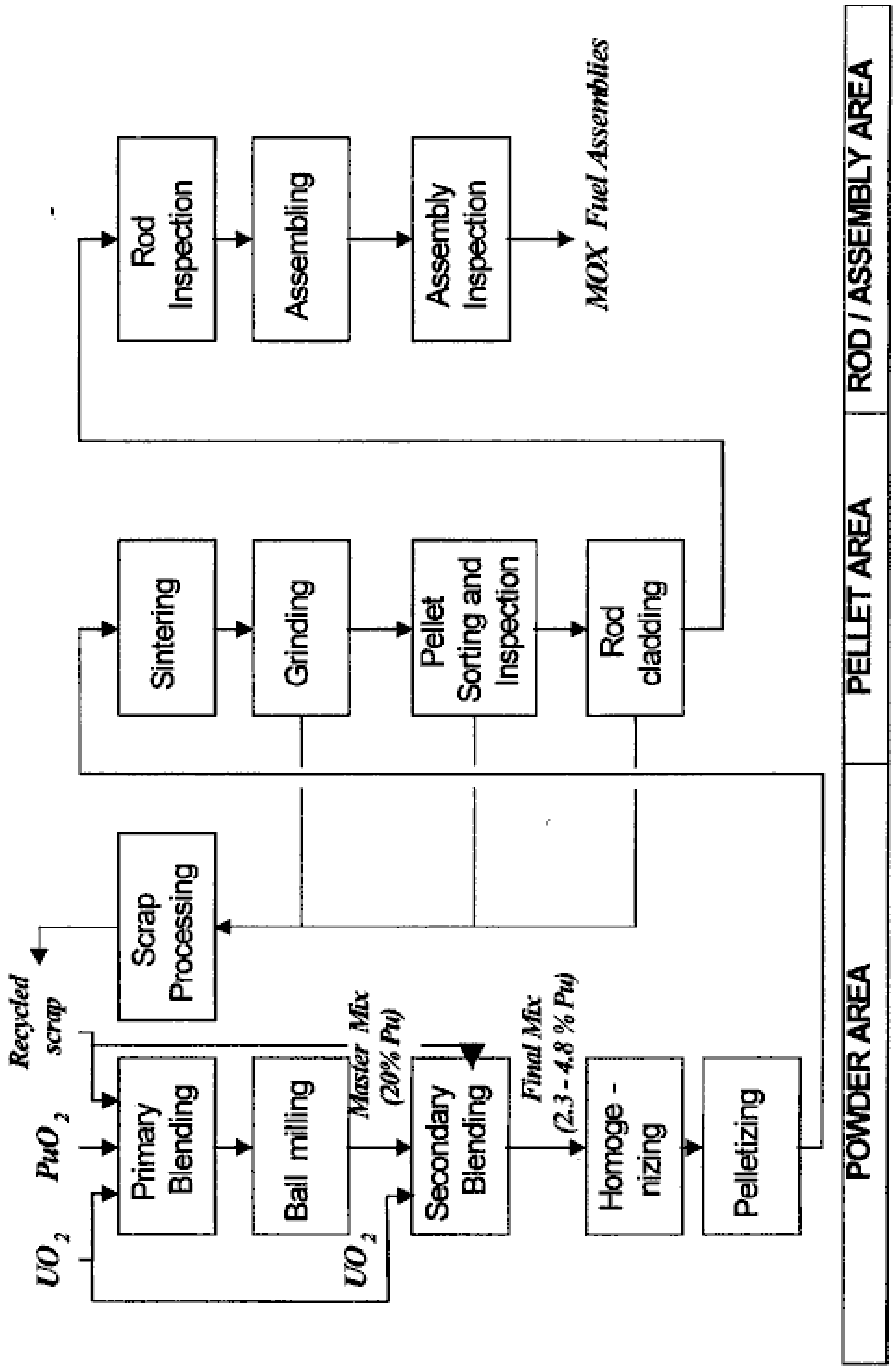

Figure 3-7. MOX Fuel Fabrication Processes

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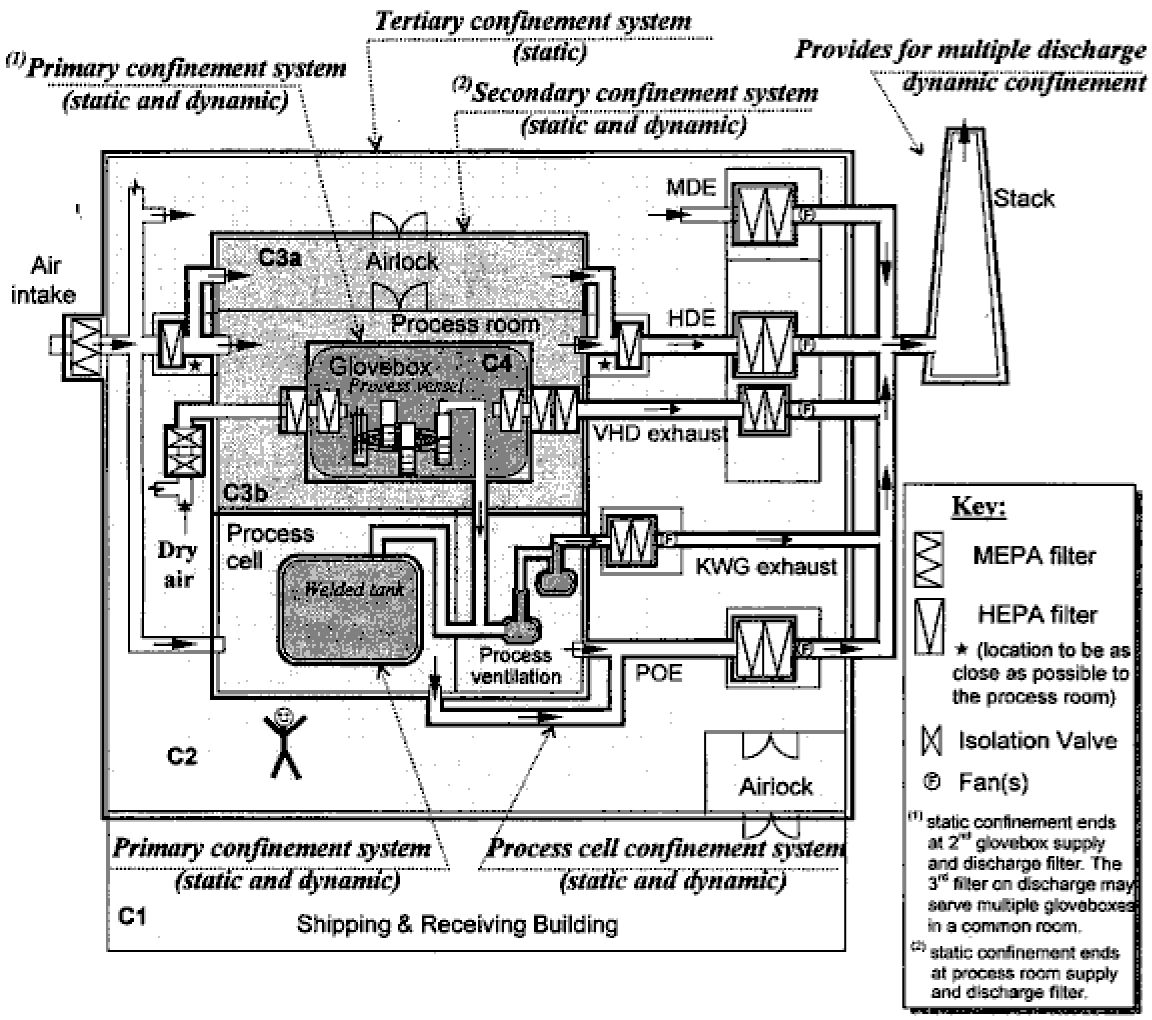

Figure 3-8. Ventilation Confinement for Aqueous Polishing

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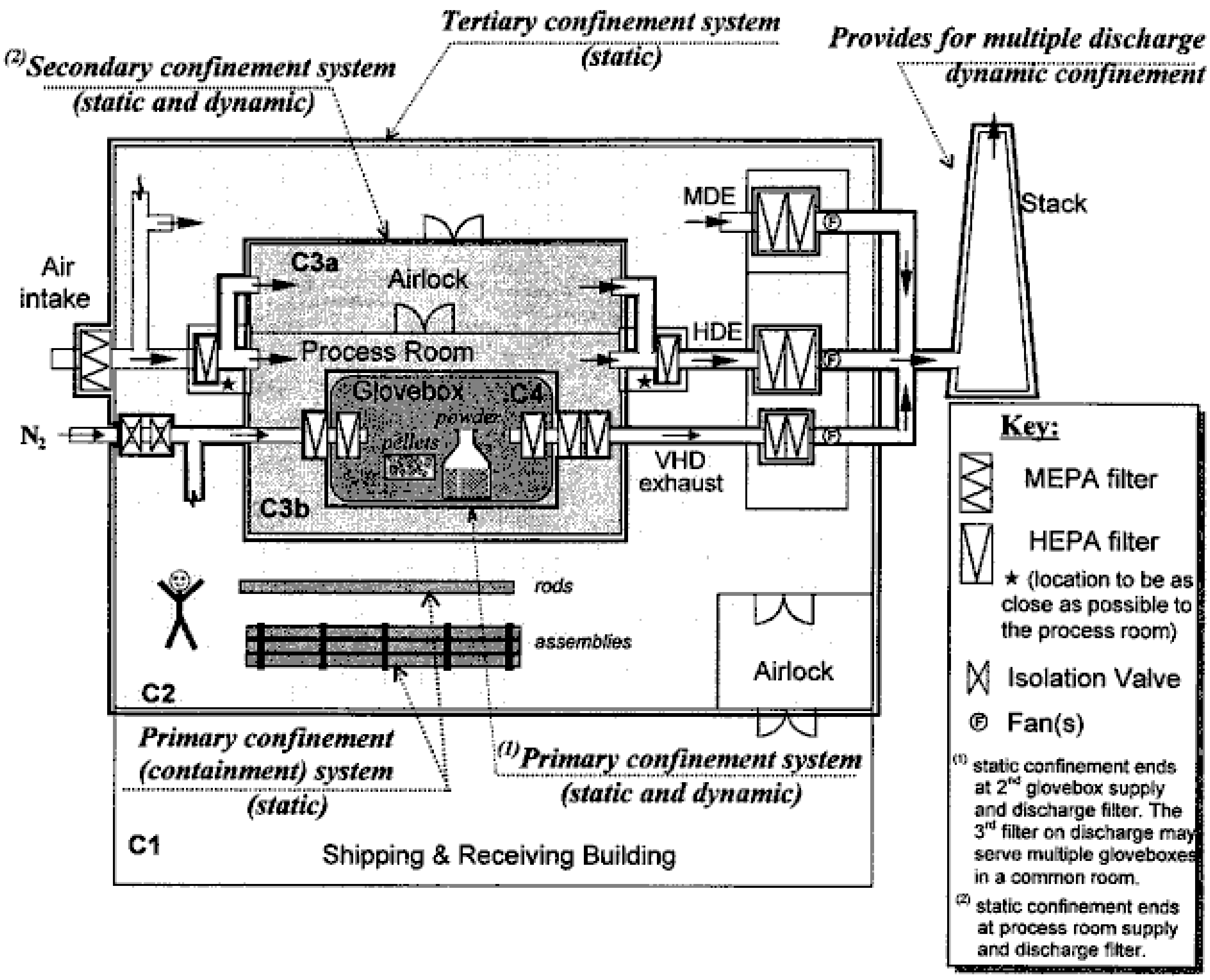

Figure 3-9. Ventilation Confinement for Fuel Fabrication

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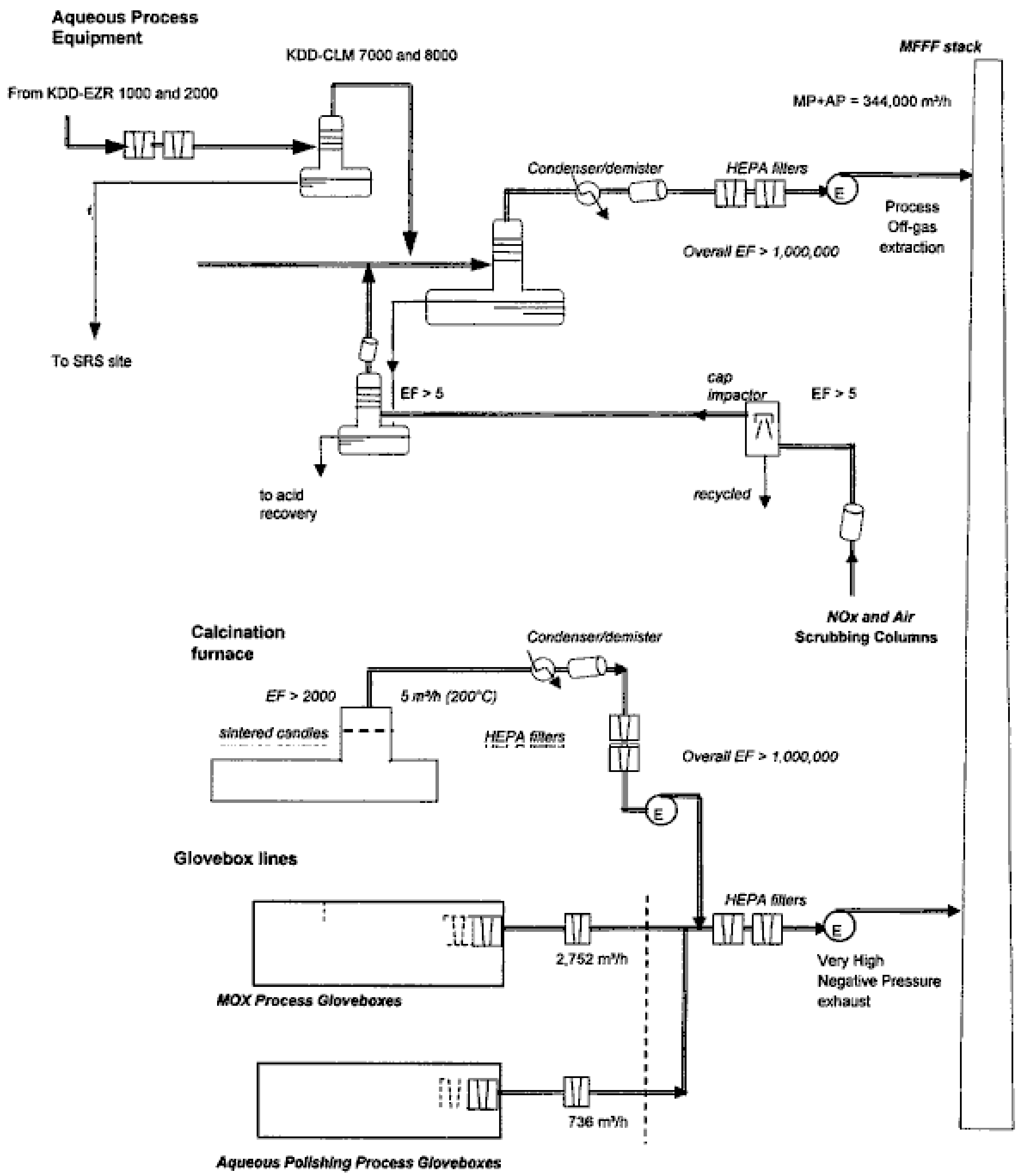

Figure 3-10. MFFF Airborne Waste Treatment Flowsheet

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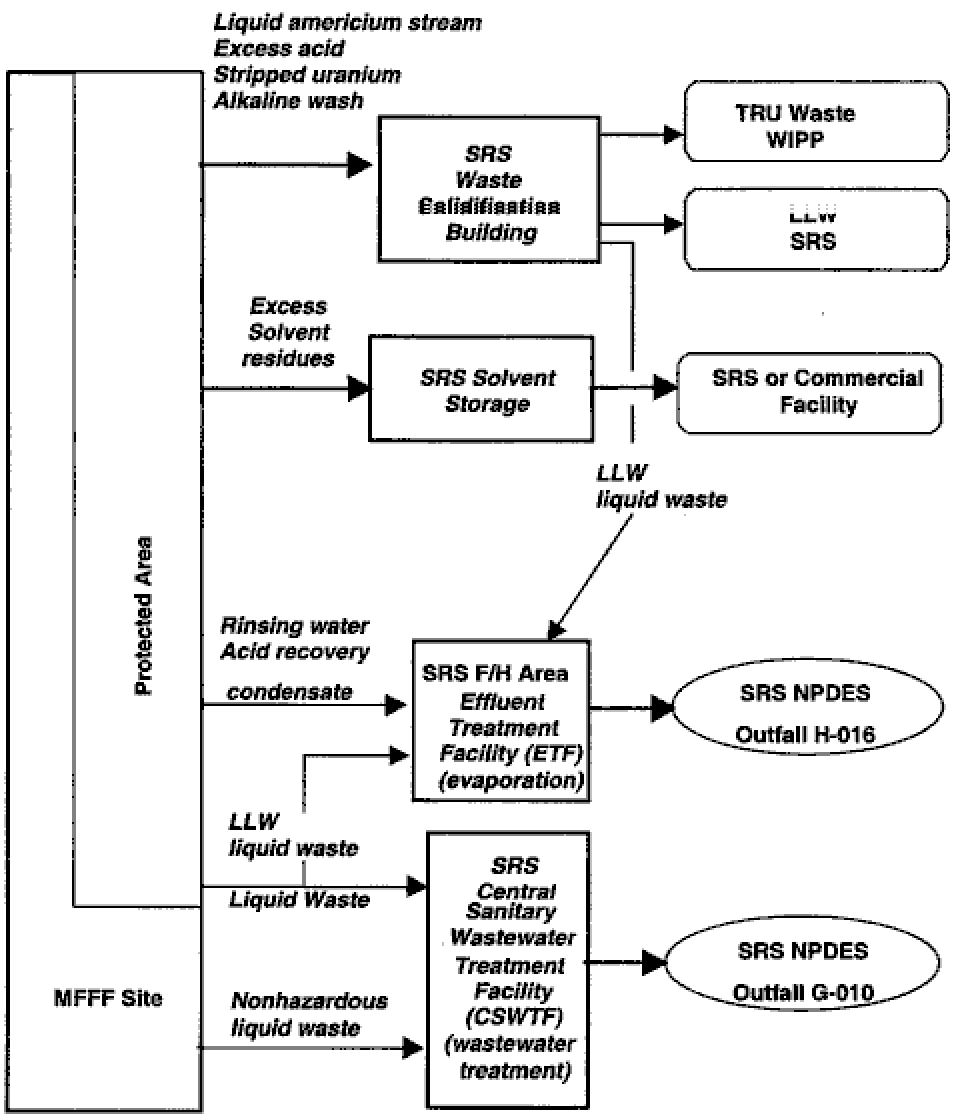

Figure 3-11. MFFF Liquid Waste Management Flow Diagram

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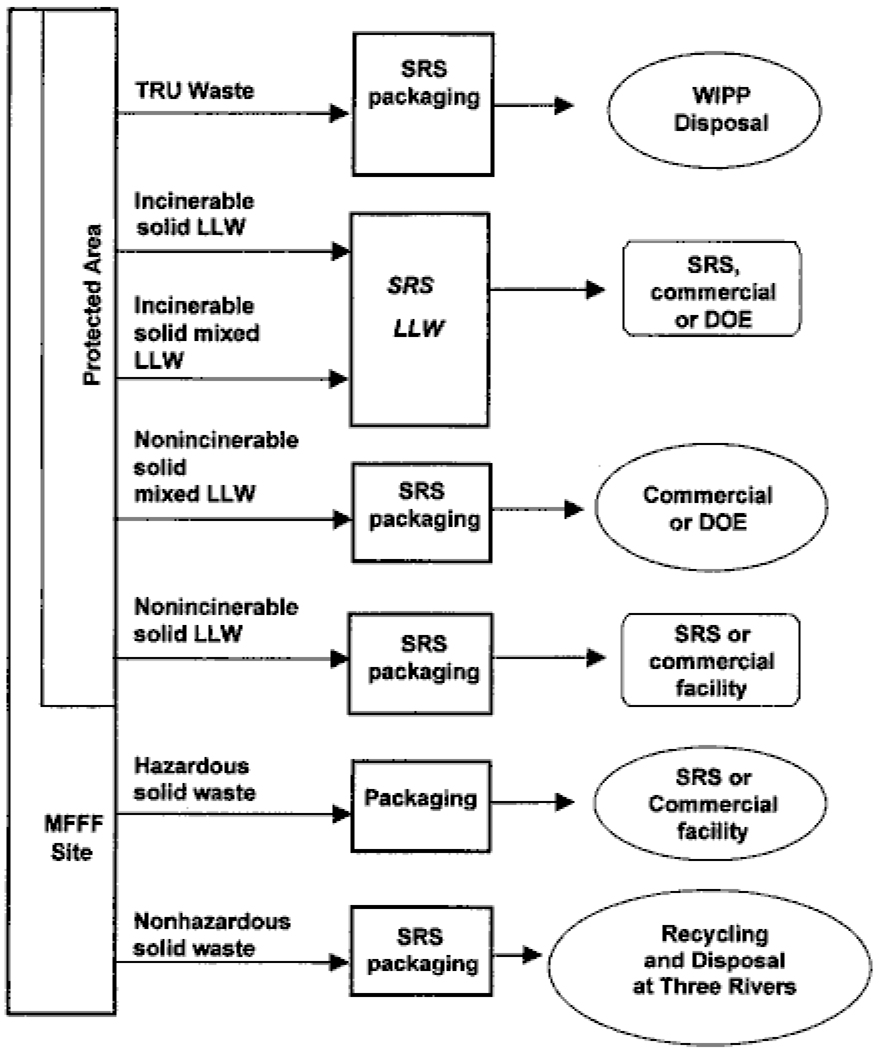

Figure 3-12. Solid Waste Management Flow Diagram

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Tables

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Table 3-1. Key MFFF Design and Operation Parameters

Parameter	Projected Value
Site area (ac)	41
Building total floor area (ft^2)	441,000
Building footprint (ft^2)	145,000
Stack height (ft)	120
Electricity (MWh/yr)	130,000
Fuel oil (gal /yr)	111,000
Maximum projected water consumption (gal /yr)	2,438,410
Total employees	400

R2

Table 3-2. MFFF Chemical Usage

Chemical	Annual Consumption	Anticipated Onsite Inventory[a]
Argon	14,411,000 ft^3	not available
Argon-Methane	367,000 ft^3	not available
Dodecane	1800 gal	400 gal
Helium	341,000 ft^3	not available
Hydrazine (35%)	700 gal	160 gal
Hydrogen	371,000 ft^3	not available
Hydrogen peroxide (35%)	700 gal	115 gal
Hydroxylamine nitrate	10,300 lb	1,220 lb
Manganese nitrate	10 lb	1 lb
Nitric acid (4.5N)	Included in 13.6N consumption	9,250 gal
Nitric acid (13.6N)	1,300 gal	925 gal
Nitrogen	160,000,000 ft^3	not available
Nitrogen tetroxide	132,000 ft^3	not available
Oxalic acid	8,900 lb	1,050 lb
Oxygen	71,000 ft^3	not available
Porogen	210 lb	not available
Silver nitrate	45 lb	240 lb
Sodium carbonate	590 lb	66 lb
Sodium hydroxide (10M)	800 gal	15 gal
Tributyl phosphate	854 gal	320 gal
Zinc stearate	680 lb	not available

[a] Onsite inventory of pressurized gases is not finalized.

R2

Table 3-3. Aqueous Polishing Waste Streams

Waste Stream	Annual Volume (gal)	Main Chemical or Isotope Concentration or Annual Quantity	Disposition (gal)	
Liquid americium stream Concentrated stream from acid recovery after silver recovery[a]	10,000 16,520 (max)	Am-241: < 24.5 kg/yr (84,000 Ci) Pu: < 205 g/yr Hydrogen ions: 180,000 moles [H$^+$]/yr Nitrate salts: 1,500 kg/yr+ nitrates from silver Silver: < 300 kg/yr Trace quantities of thallium, lead and mercury	**High Alpha Waste to WSB** 14,301 21,841 (max)	R1
Excess acid stream	1,321 2,378 (max)	Am: < 14 mg/y (rectification step after two evaporation steps) Hydrogen ions: 13.6 N		
Alkaline stream	2,980 4,000 (max)	Pu: < 16 g/yr U: < 13 g/yr Na: < 147 kg/yr		R2
Stripped uranium stream	42,530 46,000 (max)	Plutonium: < 0.1 mg/L Stripped U quantity: < 5,000 kg/yr [~1% U-235] Hydrogen ions: 26,000 moles [H$^+$]/yr	**Stripped Uranium to WSB** 42,530 46,000 (max)	
Excess low-level radioactive solvent wastes	2,700 3,075 (max)	Solvent: 30% tributyl phosphate in dodecane Pu: < 17.2 mg/yr	**SRS Solvent Recovery** 2,700 3,075 (max)	R1
Distillate waste[b]	109,000 111,000 (max)	Am-241: < 0.85 mg/yr Activity 1. 12 x 10^8 Bq/yr [H+] = <6,240 moles [H$^+$]/yr	**Liquid LLW to ETF** 338,230 385,800 (max)	
Chloride removal waste	46,230 76,000 (max)	This waste is produced only when alternate feedstock with chlorides is used. < 0.75 g/L (will be diluted with distillate and rinse water to <0.15 g/L to meet ETF WAC)		R2
Rinsing water[b]	158,000 173,800 (max)	Alpha activity: < 4 Bq α/L		
Internal HVAC condensate	25,000 (max)	Trace contamination		

(max) Represents maximum expected annual volume due to unplanned rinses and change-overs.

[a] DOE may eliminate silver recovery, silver quantity represents that expected if silver recovery is eliminated, volumes include silver recovery for bounding purposes.

[b] DCS may use distillate and rinse water to dilute the chloride waste to lower chloride concentrations more acceptable to ETF.

Table 3-4. Solid Waste Generated by MFFF Fuel Fabrication Processes

Waste Stream	Annual Volume (Mass)[a]	Contamination[b] (mg Pu/kg)	Disposition[c]
Uncontaminated, nonhazardous solid waste	575 yd^3 1,150 yd^3 (max)		**Solid Nonhazardous Waste** 877 yd^3 1,754 yd^3 (max)
Potentially contaminated solid waste[c]	302 yd^3 604 yd^3 (max)	Under detection limit Free of contamination waste collected in controlled area	
UO_2 area LLW	9 yd^3 18 yd^3 (max)	Uranium contamination	**Solid LLW** 122 yd^3 134 yd^3 (max)
Zirconium swarfs and samples	2 yd^3 4 yd^3 (max)	< 0.2	
Stainless Steel Inner and Outer Cans	10 yd^3	< 0.2	
Building and U area ventilation filters	100 yd^3	< 0.3	
Miscellaneous LLW	< 1 yd^3 2 yd^3 (max)	< 0.2	
Cladding area TRU	9 yd^3 11yd^3 (max)	< 2.8	**Solid TRU Waste** 205 yd^3 248 yd^3 (max)
Low contamination TRU waste	60 yd^3 72 yd^3 (max)	< 10	
High contamination TRU waste	83 yd^3 100 yd^3 (max)	approximately 250	
PuO_2 convenience cans	7.9 yd^3	approximately 1670	
Filters	43.3 yd^3 50 yd^3 (max)	approximately 600	
Miscellaneous TRU waste	1.6 yd^3 6.6 yd^3 (max)	approximately 600	

R2

R1

[a] Values are approximate based on preliminary design

[b] Estimates for plutonium mass collected in solid waste is about 7 kg.

[c] Potentially contaminated waste will be surveyed and released as nonradioactive if determined to be below release limits.

(max) Represents maximum expected annual volume due to unplanned change-overs. R1

4. DESCRIPTION OF THE AFFECTED ENVIRONMENT

The SPD EIS (DOE 1999c) provided an extensive discussion of the affected environment for SRS, including F Area. That discussion is included in this chapter with appropriate updated information. SRS developed the *Generic Safety Analysis Report* (GSAR) (WSRC 1999a) for all facilities located at SRS. The GSAR provides key site information including (but not limited to) geology, hydrology, meteorology, land use, and demographics for SRS. The GSAR is updated on a periodic basis. The GSAR is used in this ER to supplement the information provided in the SPD EIS. This ER also uses the SRS Environmental Reports for 1998 and 1999 (Arnett and Mamatey 1999, 2000a) to update information provided in the SPD EIS. Where more recent information is not available, the data provided in the SPD EIS were used. In some instances, more recent data were investigated, and it was determined that data presented in the SPD EIS provided a more conservative basis for projecting impacts on the affected environment.

4.1 SITE LOCATION AND LAYOUT

The site location is summarized in Section 4.1.1, and the site layout is described in Section 4.1.2.

4.1.1 Site Location

The MFFF is located in the Separations Area (F Area) of SRS in South Carolina (Figure 4-1). SRS, which is owned by the U.S. Government, was set aside in 1950 for the production of nuclear materials for national defense. SRS, as shown in Figure 4-1, is an approximately circular tract of land occupying 310 mi^2 (803 km^2) or 198,400 ac (80,292 ha) within Aiken, Barnwell, and Allendale Counties in southwestern South Carolina. Because public access to the SRS area is limited by DOE security regulations, DCS plans to use the DOE site boundary as the controlled area boundary for the MFFF (Figure 4-2). F Area and the MFFF are located in Aiken County near the center of SRS, east of SRS Road C and north of SRS Road E. F Area comprises approximately 395 ac (160 ha) of SRS. The nearest site boundary to F Area is approximately 5.8 mi (9.3 km) to the west. The center of F Area is approximately 25 mi (40 km) southeast of the city limits of Augusta, Georgia; 100 mi (161 km) from the Atlantic Coast; 6 mi (9.7 km) east of the Georgia border; and about 110 mi (177 km) south-southwest of the North Carolina border. The MFFF site is located adjacent to the north-northwest corner of F Area (Figure 4-3).

The location of SRS and F Area relative to towns, cities, and other political subdivisions within a 50-mi (80-km) radius is shown in Figure 4-4. The largest nearby population centers are Aiken, South Carolina, and Augusta, Georgia. The only towns within 15 mi (24 km) of the center of F Area are New Ellenton, Jackson, Barnwell, Snelling, and Williston, South Carolina.

Prominent geographical features within 50 mi (80 km) of SRS are Thurmond Lake (formerly called Clarks Hill Reservoir) and the Savannah River. Thurmond Lake is an impoundment of the Savannah River approximately 40 mi (64 km) northwest of the center of SRS. The Savannah River bounds 17 mi (27 km) of the southwest border of SRS.

Six principal tributaries to the Savannah River are located on SRS: Upper Three Runs, Beaver Dam Creek, Fourmile Branch, Pen Branch, Steel Creek, and Lower Three Runs. F Area is drained by several tributaries of Upper Three Runs and by Fourmile Branch as shown in Figure 4-1.

The PDCF and the Waste Solidification Building (WSB) are part of the DOE's surplus plutonium disposition program in addition to the MFFF. The PDCF and WPB will be located in F Area at SRS near the MFFF. The PDCF will supply plutonium feedstock to the MFFF, while the WPB will solidify the MFFF stripped uranium and high alpha waste streams and PDCF waste. R2

The main processing facility in F Area is F Canyon, which is composed of a chemical separations plant and associated waste storage facilities. During the SRS production years, F Canyon was used to chemically separate uranium, plutonium, and fission products from irradiated fuel and target assemblies. The separated uranium and plutonium were transferred to other DOE facilities for further processing and final use. F Canyon is presently used to process the remaining transplutonium solutions and other material onsite for eventual disposal in a geologic repository. F-Canyon waste is transferred to HLW tanks in the area for storage. The F-Area Tank Farm consists of 22 underground storage tanks that store aqueous radioactive HLW and saltcake.

Five reactor facilities are located within a 10-mi (16-km) radius of F Area; however, all five of these reactors have been placed in cold shutdown with no plans for restart.

Facilities in Z Area, which is located about 2.5 mi (4 km) from F Area, are used to process and dispose of decontaminated salt solution supernatants from waste tanks. The DWPF in nearby S Area vitrifies the F-Area waste tank HLW into borosilicate glass for disposal offsite.

H Area is located 2 mi (3.2 km) to the east of F Area. The H-Canyon Facility in H Area is used to convert highly enriched weapons-grade uranium to a low enriched form not usable for weapons production and to stabilize plutonium-242 solutions. In July 2000, work commenced R1
on the Tritium Extraction Facility, which will extract tritium from irradiated fuel rods from the Tennessee Valley Authority Sequoyah and Watts Bar nuclear plants.

Reactor material fabrication facilities in M Area are located approximately 5 mi (8 km) from F Area.

4.1.2 Site Layout

The MFFF is located adjacent to the north-northwest corner of F Area, as shown in Figure 4-3. The buildings and facilities of the MFFF, shown in Figure 4-5, are arranged to ensure safe, secure, and efficient performance of all MFFF functions. The site layout provides the characteristics necessary to satisfy the stringent security criteria for safeguarding the SNM and to support safe and efficient MFFF operations. The entire facility comprises an area of approximately 41 ac (16.6 ha). No highways, railroads, or waterways traverse the MFFF site, and the movement of material and personnel to and from the MFFF site takes place via the SRS internal road system.

A conventional PIDAS fence surrounds the protected area of the MFFF. The specific functions of the MFFF buildings and facilities are described in Section 3.1. The MOX Fuel Fabrication Building is located within the protected area and is comprised of three major functional areas: the MOX Processing Area, the Aqueous Polishing Area, and the Shipping and Receiving Area. The Diesel Generator Buildings, the Technical Support Building, and the Secured Warehouse Building are also located inside the protected area. The Administration Building and the Gas Storage Facility are located outside the PIDAS. The Secured Warehouse Building, which is located adjacent to the site access road, is an integral part of the outer PIDAS security barrier. The Technical Support Building, which serves as the sole personnel access point to the protected area, is located near the Administration Building and is accessed by a walkway between the two buildings.

4.2 LAND USE

Information in this section was previously discussed in Section 3.5.10.1 of the SPD EIS (DOE 1999c). Land may be characterized by its potential for the location of human activities (i.e., land use). Natural resource attributes and other environmental characteristics could make a site more suitable for some land uses than for others. Changes in land use may have both beneficial and adverse effects on other resources (i.e., biological, cultural, geological, aquatic, and atmospheric).

4.2.1 General Site Description

The general site description was provided previously in Section 3.5.10.1.1 of the SPD EIS (DOE 1999c). Forest and agricultural land predominate in the areas bordering SRS. There are also significant open water and non-forested wetlands along the Savannah River Valley. Incorporated and industrial areas are the only other significant land uses. There is limited urban and residential development bordering SRS. The three counties in which SRS is located have not zoned any of the site land. The only adjacent area with any zoning is the town of New Ellenton, which has lands bordering SRS in two zoning categories: urban development and residential development. The closest residences are to the west, north, and northeast, within 200 ft (61 m) of the SRS boundary (DOE 1996b).

Various industrial, manufacturing, medical, and farming operations are conducted in areas around the site. Major industrial and manufacturing facilities in the area include textile mills, plants producing polystyrene foam and paper products, chemical processing plants, and a commercial nuclear power plant. Farming is diversified in the region; it includes such crops as peaches, watermelon, cotton, soybeans, corn, and small grains (DOE 1995a).

Outdoor public recreation facilities are plentiful and varied in the SRS region. Included are the Sumter National Forest, 47 mi (76 km) to the northwest; Santee National Wildlife Refuge, 50 mi

(80 km) to the east; and Clarks Hill/Strom Thurmond Reservoir, 43 mi (69 km) to the northwest. There are also a number of state, county, and local parks in the region, most notably Redcliffe Plantation, Rivers Bridge, Barnwell and Aiken County State Parks in South Carolina, and Mistletoe State Park in Georgia (DOE 1995a). The Crackerneck Wildlife Management Area, which extends over 4,770 ac (1,930 ha) of SRS adjacent to the Savannah River, is open to the public for hunting and fishing. Public hunts are allowed under DOE Order 4300.1C, which states that "all installations having suitable land and water areas will have programs for the harvesting of fish and wildlife by the public" (Noah 1995). SRS is a controlled area with public access limited to through traffic on South Carolina Highway 125 (SRS Road A), U.S. Highway 278, SRS Road 1, and the CSX railway line (DOE 1995a).

Land use at SRS can be classified into three major categories: forest/undeveloped, water/wetlands, and developed facilities. General land use at SRS and its vicinity is shown on Figure 4-6. Approximately 226 mi^2 (585 km^2) of SRS (i.e., 73% of the area) is undeveloped (DOE 1996b). Wetlands, streams, and lakes account for 70 mi^2 (181 km^2) or 22% of the site, while developed facilities including production and support areas, roads, and utility corridors only make up approximately 5% or 15 mi^2 (38.9 km^2) of SRS (DOE 1996b). The woodlands area is primarily in revenue-producing, managed timber production. The U.S. Forest Service, under an interagency agreement with DOE, harvests about 2.8 mi^2 (7.3 km^2) of timber from SRS each year (DOE 1997b). Soil map units that meet the requirements for prime farmland soils exist onsite. However, the U.S. Department of Agriculture, Natural Resources Conservation Service, does not identify these as prime farmlands because the land is not available for agricultural production (DOE 1996b).

In 1972, DOE designated all of SRS as a National Environmental Research Park. The National Environmental Research Park is used by the national scientific community to study the impacts of human activities on the cypress swamp and hardwood forest ecosystems (DOE 1996b). DOE has set aside approximately 22 mi^2 (57 km^2) of SRS exclusively for nondestructive environmental research (DOE 1997b).

Decisions on future land uses at SRS are made by DOE through the site development, land use, and future planning processes. SRS has established a Land Use Technical Committee composed of representatives from DOE, WSRC, and other SRS organizations. The discussion draft *SRS Long Range Comprehensive Plan* (DOE 2000a), issued in September 2000, includes the operation of the MFFF as part of the plan. In March 2000, DOE also issued a *Savannah River Site Strategic Plan* (DOE 2000c). Under the Nuclear Materials Stewardship Program, the NMS-1 Goal is to reduce the global nuclear danger by providing safe and secure storage, stabilization, and disposition of nuclear materials and spent nuclear fuel. The design, construction, and operation of the MFFF in F Area is one of the strategies that DOE plans to use to achieve this strategic goal. R1 R1

In addition to DOE planning, the state of South Carolina also conducts land use planning in the vicinity of SRS as discussed in Section 3.5.10.1.1 of the SPD EIS (DOE 1999c). The state of South Carolina requires local jurisdictions to undertake comprehensive planning. Regional-level planning also occurs within the state, which is divided into 10 planning districts guided by regional advisory councils (DOE 1996b). The counties of Aiken, Allendale, and Barnwell together constitute part of the Lower Savannah River Council of Governments. Private lands bordering SRS are subject to the planning regulations of these three counties.

No onsite areas are subject to Native American Treaty Rights. However, five Native American groups (the Yuchi Tribal Organization, the National Council of Muskogee Creek, the Indian Peoples Muskogee Tribal Town Confederacy, the Pee Dee Indian Association, and the Ma Chis Lower Alabama Creek Indian Tribe) have expressed concern over sites and items of religious significance on SRS. DOE routinely notifies these organizations about major planned actions at SRS and asks them to comment on SRS documents prepared in accordance with NEPA.

4.2.2 Proposed Facility Location

Land use in F Area is industrial, as described previously in Section 3.5.10.1.2 of the SPD EIS (DOE 1999c). Many buildings are situated within F Area. Included is Building 221-F, one of the canyons where plutonium was recovered from targets during DOE's plutonium production phase. Land use at Building 221-F in F Area is classified as heavy industrial.

F Area occupies approximately 395 ac (160 ha) of SRS. The proposed MFFF will occupy a 41-ac (16.6-ha) area just north of the cancelled Actinide Packaging and Storage Facility (DOE 2002a). R2

4.3 GEOLOGY

Section 3.5.6 of the SPD EIS (DOE 1999c) describes the geology of the MFFF site. Section 1.4.3 of the SRS GSAR (WSRC 1999a) provides a comprehensive presentation of the regional and SRS site geology. This section presents an overview of the site geology as presented in these two references and based on a detailed geotechnical program conducted in calendar year 2000 to provide site-specific design information for the MFFF site (WSRC 2000). R1

4.3.1 Regional Geology

The southeastern continental margin, within a 200-mi (322-km) radius of SRS, contains portions of all the major divisions of the Appalachian orogen (mountain belt) in addition to the elements that represent the evolution to a passive margin.

Within the Appalachian orogen, several lithotectonic terranes that have been extensively documented include the foreland fold belt (Valley and Ridge) and western Blue Ridge Precambrian-Paleozoic continental margin; the eastern Blue Ridge-Chauga Belt-Inner Piedmont terrane; the volcanic-plutonic Carolina Terrane; and the geophysically defined basement terrane beneath the Atlantic Coastal Plain. These geological divisions record a series of compressional and extensional events that span the Paleozoic. The modern continental margin includes the Triassic-Jurassic rift basins that record the beginning of extension and continental rifting during the early to middle Mesozoic. The offshore Jurassic-Cretaceous clastic-carbonate bank sequence covered by younger Cretaceous and Tertiary marine sediments, and the onshore Cenozoic sediments represent a prograding shelf-slope and the final evolution to a passive margin. Other offshore continental margin elements include the Florida-Hatteras shelf and slope and the unusual Blake Plateau basin and escarpment.

The two predominant processes sculpting the landscape during this tectonically quiet period included erosion of the newly formed highlands and subsequent deposition of the sediments on the coastal plain to the east. The passive margin region consists of a wedge of Cretaceous and Cenozoic sediments that thickens from near zero at the Fall Line to about 1,100 ft (335 m) in the center of SRS, and to approximately 4,000 ft (1,219 m) at the South Carolina coast. The fluvial to marine sedimentary wedge consists of alternating sand and clay with tidal and shelf carbonates common in the downdip Tertiary section.

4.3.1.1 Coastal Plain Stratigraphy

The sediments of the Atlantic Coastal Plain in South Carolina are stratified sand, clay, limestone, and gravel that dip gently seaward and range in age from Late Cretaceous to Recent. The sedimentary sequence thickens from essentially zero at the Fall Line to more than 4,000 ft (1,219 m) at the coast. Regional dip is to the southeast, although beds dip and thicken locally in other directions because of locally variable depositional regimes and differential subsidence of basement features such as the Cape Fear Arch and the South Georgia Embayment.

The Coastal Plain sedimentary sequence near the center of the region (i.e., SRS) consists of about 700 ft (213 m) of Upper Cretaceous quartz sand, pebbly sand, and kaolinitic clay, overlain by about 60 ft (18 m) of Paleocene clayey and silty quartz sand, glauconitic sand, and silt. The Paleocene beds are in turn overlain by about 350 ft (107 m) of Eocene quartz sand, glauconitic quartz sand, clay, and limestone grading into calcareous sand, silt, and clay. The calcareous strata are common in the upper part of the Eocene section in downdip parts of the study area. In places, especially at higher elevations, the sequence is capped by deposits of pebbly, clayey sand, conglomerate, and clay of Miocene or Oligocene age. Lateral and vertical facies changes are characteristic of most of the Coastal Plain sequence.

4.3.1.2 Coastal Plain Sediments

Upper Cretaceous sediments overlie Paleozoic crystalline rocks or lower Mesozoic sedimentary rocks throughout most of the study area. The Upper Cretaceous sequence includes the basal Cape Fear Formation and the overlying Lumbee Group, which is divided into three formations (see Figure 4-7). The sediments in this region consist predominantly of poorly consolidated, clay-rich, fine- to medium-grained, micaceous sand, sandy clay, and gravel and are about 700 ft (213 m) thick near the center of the study area. Thin clay layers are common. In parts of the section, clay beds and lenses up to 70 ft (21 m) thick are present.

Tertiary sediments range in age from Early Paleocene to Miocene and were deposited in fluvial to marine shelf environments. The Tertiary sequence of sand, silt, and clay generally grades into highly permeable platform carbonates in the southern part of the study area and these continue southward to the coast. The Tertiary sequence is divided into three groups, the Black Mingo Group, Orangeburg Group, and Barnwell Group, which are further subdivided into formations and members (see Figure 4-7). These groups are overlain by the ubiquitous Upland unit.

The Orangeburg Group underlies SRS and the MFFF site and consists of the lower middle Eocene Congaree Formation (Tallahatta equivalent) and the upper middle Eocene Warley Hill Formation and Tinker/Santee Formation (Lisbon equivalent) (see Figure 4-7). Over most of the study area, these post-Paleocene sediments are more marine in character than the underlying Cretaceous and Paleocene sediments of the Black Mingo group; they consist of alternating layers of sand, limestone, marl, and clay.

The group crops out at lower elevations in many places within and near SRS. The sediments thicken from about 85 ft (26 m) at well P-30 near the northwestern SRS boundary to 200 ft (61 m) at well C-10 in the south. Dip of the upper surface is 12 ft/mi (2 m/km) to the southeast.

In the central part of the study area, the Orangeburg group includes, in ascending order, the Congaree, Warley Hill, and Tinker/Santee Formations (see Figure 4-7). The units consist of alternating layers of sand, limestone, marl, and clay that are indicative of deposition in shoreline to shallow shelf environments. From the base upward, the Orangeburg Group passes from clean shoreline sand, characteristic of the Congaree Formation, to shelf marl, clay, sand, and limestone, typical of the Warley Hill and Tinker/Santee Formations. Near the center of the study area, the Santee sediments consist of up to 30% carbonate by volume. The sequence is transgressive, with the middle Eocene Sea reaching its most northerly position during Tinker/Santee deposition.

The late middle Eocene deposits overlying the Warley Hill Formation consist of moderately sorted yellow and tan sand, calcareous sand and clay, limestone, and marl. Calcareous sediments dominate downdip, are sporadic in the middle of the study area, and are missing in the northwest portion of SRS. The limestone represents the farthest advance to the northwest of the transgressing carbonate platform first developed in early Paleocene time near the South Carolina and Georgia coasts.

The Tinker/Santee interval is about 70 ft (21 m) thick near the center of SRS, and the sediments indicate deposition in shallow marine environments. Often found within the Tinker/Santee sediments, particularly in the upper third of the interval, are weak zones interspersed in stronger carbonate-rich matrix materials. The weak zones, which vary in apparent thickness and lateral extent, were noted where rod drops and/or lost circulation occurred during drilling, low blow counts occurred during soil penetration test pushes, etc. These weak zones have variously been termed in SRS reference documents as "soft zones," the "critical layer," "underconsolidated zones," "bad ground," and "void." The preferred term used to describe these zones is "soft zones." The soft zones can be in the form of irregular isolated pods, extended thin ribbons, or stacked thin ribbons separated by intervening unsilicified parent sediment. Soft zones encountered in one location could be absent at a location only a few feet away.

Upper Eocene sediments of the Barnwell Group (see Figure 4-7) represent the Upper Coastal Plain of western South Carolina and eastern Georgia. Sediments of the Barnwell Group are present at the MFFF site and overlie the Tinker/Santee Formation and consist mostly of shallow marine quartz sand containing sporadic clay layers. The group is about 70 ft (21 m) thick near the northwestern boundary of SRS and 170 ft (52 m) near its southeastern boundary. The regionally significant Santee Unconformity separates the Clinchfield Formation from the overlying Dry Branch Formation. The Santee Unconformity is a pronounced erosional surface observable throughout the SRS region.

In the northern part of the study area, the Barnwell Group consists of red or brown, fine to coarse-grained, well-sorted, massive sandy clay and clayey sand, calcareous sand and clay, as well as scattered thin layers of silicified fossiliferous limestone. All are suggestive of lower delta plain and/or shallow shelf environments.

4.3.1.3 Crustal Thickness

In general, the thickness of continental crust thins from west to east across the eastern United States continental margin. The zone of transition from continental crust to oceanic crust is thought to underlie the offshore Carolina Trough and the Blake Plateau basin. A cross-section through the continental margin offshore at South Carolina and North Carolina shows a geometry of thinning crust (see Figure 4-8). This is a typical Atlantic-type margin showing the geometry of oceanic crust to the east and continental crust to the west. The Moho deepens from east to west from about 9 mi (15 km) to about 25 mi (40 km), respectively. The continental crust along the margin has been extended and intruded during Mesozoic rifting and is described as rift stage crust. The data that support this interpretive model come largely from seismic reflection and refraction surveys and potential field surveys.

Further inland, the base of crust is discerned by following the configuration of the Moho on seismic refraction or reflection lines. From seismic reflection data collected at SRS, the Moho is interpreted at about 18.6 to 19.6 mi (30.0 to 31.5 km) depth. On the deep seismic profiles, a wide ban of reflections (200 to 300 milliseconds wide) at 10.5 to 11.05 seconds are interpreted to be the Moho. Luetgert et al. (1994) reports crustal thickness changes along a survey from SRS southeast to Walterboro, South Carolina.

4.3.1.4 Faulting

The most definitive evidence of crustal deformation in the Late Cretaceous through Cenozoic is the reverse sense faulting found in the Coastal Plain section of the eastern United States. Under the auspices of the Reactor Hazards Program of the late 1970s and early 1980s, the United States Geological Survey (USGS) conducted a field mapping effort to identify and compile data on all young tectonic faults in the Atlantic Coastal Plain. Consequently, many large, previously unrecognized Cretaceous and Cenozoic fault zones were found. Of 131 fault localities cited, 26 were within North Carolina and South Carolina. The identification of Cretaceous and younger faults in the eastern United States is greatly affected by distribution of geologic units of that age.

Prowell and Obermeier (1991) characterized the faults as mostly northeast trending reverse slip fault zones with up to 62 mi (100 km) lateral extent and up to 250 ft (76 m) vertical displacement in the Cretaceous. The faults dip 40° to 85°. Offsets were observed to be progressively smaller in younger sediments. This may be due to an extended movement history from Cretaceous through Cenozoic. Based on their similar characteristics, Prowell (1988) was able to associate Cretaceous and younger faulting in the Coastal Plain into several Fault Provinces. SRS falls into Prowell's (1988) Atlantic Coast Fault Province. A comparison of Cretaceous and younger faulting in SRS found that faulting on SRS shared similar characteristics with the faults in the Atlantic Coastal Fault Province including orientation and offset history. This comparison concluded that Cretaceous and younger faulting on SRS was not unique in comparison to the Atlantic Coast Fault Province in general and as a result shared the same seismic hazard.

Offset of Coastal Plain sediments at SRS includes all four Tertiary unconformities. Following deposition of the Late Paleocene Snapp Formation, some evidence indicates oblique-slip movement on the existing faults.

This faulting was followed by erosion and truncation of the Paleocene section at the Lang Syne/Sawdust Landing unconformity. Subsequent sediments were normal faulted following deposition of the Tinker/Santee Formation. Locally, however, offset of the overlying section indicates renewed movement on new or existing faults after deposition of Tobacco Road/Dry Branch sediments.

In conjunction with these observations of Coastal Plain faults, modern stress measurements provide an indication of the likelihood of Holocene movement. Moos and Zoback (1992, 1993) report a consistent northeast-southwest direction of maximum horizontal compressive stress (N 55-70°E) in the southeast United States. Their determination is based on direct in situ stress measurements, focal mechanisms of recent earthquakes, and young geologic indicators. Moos and Zoback (1992) conclude that the northeast directed stress would not induce damaging reverse and strike-slip faulting earthquakes on the Pen Branch fault, a northeast-striking Tertiary fault in the area. These same conclusions may be implied for the other northeast-trending faults.

4.3.1.5 SRS Geological Conditions

As discussed in this section, many SRS investigations and an extensive literature review support the conclusion that there are no geologic threats affecting the MFFF site, except the Charleston Seismic Zone and minor random Piedmont earthquakes. In the immediate region of SRS, there are no known capable faults. A capable fault is one that has had movement at or near the ground surface at least once within the past 35,000 years or recurrent movement within the past 500,000 years. Several faults have been identified from subsurface mapping and seismic surveys within the Paleozoic and Triassic basement beneath SRS. The largest of these is the Pen Branch Fault. There is no evidence of movement within the last 38 million years along this fault (DOE 1996b).

Three earthquakes of Intensity III or less occurred during recent years with epicenters inside the SRS boundary. On June 9, 1985, an earthquake with a local magnitude of III and a focal depth of about 0.6 mi (1 km) occurred at SRS. Its epicenter was west of C and K Areas. The acceleration produced by the earthquake did not activate seismic monitoring instruments in the reactor areas. (These instruments have detection limits of 0.002g.) On August 5, 1988, another earthquake with a local magnitude of I-II, a local duration magnitude of 2.0, and a focal depth of about 1.7 mi (2.7 km) occurred at SRS. Its epicenter was northwest of K Area. The seismic alarms in SRS facilities were not triggered. Existing information does not conclusively correlate the two earthquakes with any of the known faults on the site. Earthquakes capable of producing structural damage are not likely to occur in the vicinity of SRS (WSRC 2000c).

On May 17, 1997, an earthquake with a duration magnitude of 2.3 occurred. It was felt by workers in K Area and by nearby guards. An accelerograph, located 3 mi (4.8 km) east of the epicenter, was not triggered. Another more sensitive machine, located about 10 mi (16 km) away, was also not triggered. These events are small and appear to be shallow events associated with strain release near small-scale faults, intrusions, or edges of metamorphic belts. No damage has been reported (WSRC 2000c). On October 7, 2001, a minor earthquake with a duration magnitude of 2.5 lasting about 2 minutes occurred, producing audible rumbling, but no damage to any buildings in the area has been reported. Its epicenter was just north of the F and H Areas of SRS (Schneider and Chavis 2001). R1

Historically, two large earthquakes have occurred within 186 mi (300 km) of SRS. The largest of these, the Charleston earthquake of 1886, had an estimated Richter scale magnitude ranging from 6.5 to 7.5. The SRS area experienced an estimated peak horizontal acceleration of 0.10g during this earthquake.

There are no volcanic hazards at SRS. The area has not experienced volcanic activity within the last 230 million years. Future volcanism is not expected because SRS is along the passive continental margin of North America.

The soils at SRS are primarily sands and sandy loams. The somewhat excessively drained soils have a thick, sandy surface layer that extends to a depth of 6.6 ft (2 m) or more in some areas. Soil units that meet the soil requirements for prime farmland soils exist on SRS. However, the U.S. Department of Agriculture, Natural Resources Conservation Service, does not identify these lands as prime farmland due to the nature of site use; that is, the lands are not available for the production of food or fiber. The soils at SRS are considered acceptable for standard construction techniques. Detailed descriptions of the geology and the soil conditions at SRS are included in the S&D PEIS and the *Savannah River Site Waste Management Final Environmental Impact Statement* (DOE 1995b).

4.3.2 MFFF Site-Specific Geology

Soils in F Area are predominantly of the Fuquay-Blanton-Dothan association, consisting of nearly level to sloping, well-drained soils. Other soils include the Troup-Pickney-Lucy association, consisting of nearly level soils formed along, and parallel to, the floodplains of streams.

In 2000, 13 exploration borings and 63 cone penetration test (CPT) holes were used to define subsurface conditions at the MFFF site. Additional site geotechnical programs previously performed by others adjacent to and on this site were also used to evaluate site subsurface geologic and groundwater conditions. Actual conditions encountered at the MFFF site were evaluated with known geologic and groundwater hydrology conditions (described in Section 4.4.3), and no unusual conditions were encountered.

The CPT holes extended from approximately 64 ft (19.5 m) to 140 ft (42.7 m) below existing site grade. Each CPT hole provided a continuous profile of the soil conditions encountered at each test location. Seismic, resistivity, and piezometric measurements were obtained in many of the CPT holes. Some soft soil zones related to past solution and deposition activity were identified at depth on the MFFF site. The soft zones encountered were typical of those that have been described in previous F-Area investigations. The CPT holes were used to define limits of the soft zones. The planned locations of heavily loaded structures, such as the MOX Building and Diesel Generator Building, were adjusted on the MFFF site to minimize the potential impact of the underlying soft zones. This adjustment was necessitated by the potential of the soil to liquefy under certain conditions, forcing foundations to fail.The soil exploration borings extended from approximately 131 ft (40 m) to 181 ft (55.2 m) below existing site grade. The exploration borings were used to correlate with the CPT holes and to obtain soil samples for laboratory testing. Three cased holes for the exploration program were used for downhole seismic testing.

A comprehensive laboratory testing program was conducted to establish both static and dynamic design parameters for use in analysis. Laboratory results indicate that conditions at the MFFF site are consistent with those encountered in previous investigations in F Area and other studies in the same geologic units described at SRS.

The upper geologic units at the MFFF site are composed of the Barnwell Group described in Section 4.3.1.2. The exploration borings also extended through the Tinker/Santee Formation, Warley Hill Formation, and into the Congaree Formation of the Orangeburg Group.

The unconfined water table is within the Upper Three Runs aquifer, as described in Section 4.4.3.1. Based on the results of pore water pressure dissipation testing, the groundwater level at the MFFF site was generally encountered at a depth of 60 ft (18.3 m) or more below grade, at the time of site exploration. As indicated in WSRC (2002), the Upper Three Runs aquifer water table is generally at 210 ft (63.6 m) (msl). In the past ten years, during wetter seasons, it has reached 220 ft (67 m) (msl), well below the deepest MFFF construction excavation level of 242 ft (73.8 m) (msl). The water table and gradient at the MFFF site are consistent with Figure 4-9. R1

The subsurface conditions encountered at the MFFF site are considered suitable to support the proposed structures for the MFFF.

4.4 HYDROLOGY

This section addresses the baseline hydrology in the vicinity of the MFFF site. Hydrology was discussed in Section 3.5.7 of the SPD EIS (DOE 1999c). Some updated information is provided in the following sections. Section 4.4.1 discusses water use in the region, Section 4.4.2 discusses the surface water hydrology, and Section 4.4.3 discusses the groundwater hydrology.

4.4.1 Water Use

Water has historically been withdrawn from the Savannah River for use mainly as cooling water; however, some has been used for domestic purposes (DOE 1996b). Total water usage from the Savannah River in 2000 was 13.1 billion gal (49.7 billion L). Most of this water is returned to the river through discharges to various tributaries (DOE 1996b). R1

The average flow of the Savannah River is 10,000 ft^3/sec (283 m^3/sec). Three large upstream reservoirs (Hartwell, Richard B. Russell, and Strom Thurmond/Clarks Hill) regulate the flow in the Savannah River, thereby lessening the impacts of drought and flooding on users downstream (DOE 1995b).

Several communities in the area use the Savannah River as a source of domestic water. The nearest downstream water intake is the Beaufort-Jasper Water Authority in South Carolina, which withdraws about 8.1 ft^3/sec (0.23 m^3/sec) to service about 51,000 people. Treated effluent is discharged to the Savannah River from upstream communities and from treatment facilities at SRS. The average annual volume of flow discharged by the sewage treatment facilities at SRS is about 185 million gal (700 million L) (DOE 1996b).

Groundwater aquifers are classified by federal and state authorities according to use and quality. The federal classifications include Class I, II, and III groundwater. Class I groundwater either is the sole source of drinking water or is ecologically vital. Class IIA and IIB are current or potential sources of drinking water (or other beneficial use), respectively. Class III is not considered a potential source of drinking water and is of limited beneficial use. The state of South Carolina classifies groundwater as "GA" (exceptional quality), "GB" (suitable for domestic drinking water), or "GC" (little potential as an underground source of drinking water). All groundwater in the vicinity of SRS is classified as GB by South Carolina and as Class IIA by EPA.

Groundwater in the area is used extensively for domestic and industrial purposes. Most municipal and industrial water supplies are withdrawn from the Crouch Branch and McQueen Branch aquifers, while small domestic supplies are withdrawn from the Gordon aquifer. It is estimated that about 2.1 billion gal/yr (8 billion L/yr) are withdrawn from the aquifers within a R1
10-mi (16-km) radius of the site, which is similar to the volume used by SRS (DOE 1996b). The Crouch Branch and McQueen Branch aquifers are an important water resource for the SRS

region. The water is generally soft, slightly acidic, and low in dissolved and suspended solids (DOE 1995b).

Groundwater is the only source of domestic water at SRS (DOE 1995b). Depth to groundwater ranges from near the surface to about 150 ft (46 m) below ground surface (bgs). In 1993, SRS withdrew about 3.4 billion gal/yr (13 billion L/yr) of groundwater to support site operations (DOE 1996b). There are no designated sole source aquifers in the area (DOE 1999b).

Groundwater ranges in quality across the site; in some areas it meets drinking water quality standards, while in areas near some waste sites it does not. The Crouch Branch and McQueen Branch aquifers are generally unaffected except for an area near A Area, where trichloroethylene (TCE) has been reported. TCE has also been reported in A and M Areas in the Crouch Branch and McQueen Branch aquifers. Tritium has been reported in the Gordon aquifer in the Separations Area. The water table aquifer is contaminated with solvents, metals, and low levels of radionuclides at several SRS sites and facilities. Groundwater eventually discharges into onsite streams or the Savannah River (DOE 1996b), but groundwater contamination has not been detected beyond SRS boundaries (DOE 1995b).

Groundwater rights in South Carolina are associated with the absolute ownership rule. Owners of land overlying a groundwater source are allowed to withdraw as much water as they desire; however, the state requires users who withdraw more than 100,000 gal/day (379,000 L/day) to report their withdrawals. DOE is required to report because its usage is above the reporting level (DOE 1996b).

4.4.2 Surface Water Hydrology

Surface water includes marine or freshwater bodies that occur above the ground surface, including rivers, streams, lakes, ponds, rainwater catchments, embayments, and oceans.

4.4.2.1 General Site Description

The largest river in the area of SRS is the Savannah River, which borders the site on the southwest. Six streams flow through SRS and discharge into the Savannah River: Upper Three Runs, Beaver Dam Creek, Fourmile Branch, Pen Branch, Steel Creek, and Lower Three Runs. Upper Three Runs has two tributaries, Tims Branch and Tinker Creek; Pen Branch has one tributary, Indian Grave Branch; and Steel Creek has one tributary, Meyers Branch (DOE 1996b).

There are two manmade lakes at SRS: L Lake, which discharges to Steel Creek, and Par Pond, which discharges to Lower Three Runs. Also, about 299 Carolina bays (i.e., closed depressions capable of holding water) occur throughout the site. While these bays receive no direct effluent discharges, they do receive stormwater runoff (DOE 1996b; WSRC 1997a).

It is clear that the surplus plutonium disposition facilities would not be located within a 100-year floodplain, but there is no information concerning 500-year floodplains (DOE 1996b). No federally designated Wild and Scenic Rivers occur within the site (DOE 1996b). A map showing the 100-year floodplain is presented as Figure 4-10.

The Savannah River is classified as a freshwater source that is suitable for primary and secondary contact recreation; drinking, after appropriate treatment; fishing; balanced indigenous aquatic community development and propagation; and industrial and agricultural uses. A comparison of Savannah River water quality upstream (river-mi 160 [river-km 257]) and downstream (river-mi 120 [river-km 193]) of SRS showed no significant differences for non-radiological parameters (Arnett and Mamatey 1996). A comparison of current and historical data shows that the coliform data are within normal fluctuations for river water in this area. For the different river locations, however, there has been an increase in the number of analyses in which standards were not met. The data for the river's monitoring locations generally met the freshwater standards set by the state; a comparison of the 1995 and earlier measurements for river samples showed no abnormal deviations. As for radiological constituents, tritium is the only radionuclide detected above background levels in the Savannah River (Arnett and Mamatey 1996).

Surface water rights for SRS are determined by the Doctrine of Riparian Rights, which allows owners of land adjacent to or under the water to use the water beneficially (DOE 1996b). SRS has four NPDES permits, one (SC0000175) for industrial wastewater discharges, two (SCR000000 and SCR100000) for general stormwater discharges, and one (ND0072125) for land application. Permit SC0000175 regulates 31 outfalls. The compliance rate for these outfalls was 99.7% since 1999. The 46 stormwater-only outfalls regulated by the stormwater permits are monitored as required. A stormwater pollution prevention plan has been developed to identify where best available technology and best management practices must be used. For stormwater runoff from construction activities extending over 5 ac (2 ha), a sediment reduction and erosion plan is required (Arnett and Mamatey 1996). Presently, only Permit SC0000175 is active at SRS for industrial wastewater discharges. The other active permits are related to stormwater discharges. R1 R1

4.4.2.2 Proposed Facility Location

The land around F Area drains to Upper Three Runs and Fourmile Branch. Upper Three Runs is a large, cool blackwater stream that flows into the Savannah River. It drains about 210 mi^2 (544 km^2) and, during water year 1995, had a mean discharge of 245 ft^3/sec (6.9 m^3/sec) near its mouth. The 7-day, 10-year low flow over the period of record (water years 1974 to 1995) at SRS Road A is about 100 ft^3/sec (2.8 m^3/sec). The stream is about 25 mi (40 km) long, and only its lower reaches extend through SRS. It receives more water from underground sources (Dublin-Midville aquifer system) than any other SRS stream and therefore has lower dissolved solids, hardness, and pH values. It is the only major stream onsite that has not received thermal discharges. It receives permitted discharges from several areas at SRS, including F Area, S Area, the S-Area sewage treatment plant, and treated industrial wastewater from the Chemical Waste Treatment Facility steam condensate. Flow from the sanitary wastewater discharge averages less than 0.035 ft^3/sec (0.001 m^3/sec) or 16 gal/min (61 L/min). A comparison with the 7-day, 10-year low flow of 100 ft^3/sec (2.8 m^3/sec) in Upper Three Runs shows that the present discharges are very small. The analytical results for the active outfalls show the constituents of concern are maintained within permit limitations (Arnett and Mamatey 2000a, 2000b).

Fourmile Branch is a blackwater stream (freshwater, dark color resulting from organic debris) affected by past operational practices at SRS. Its headwaters are near the center of the site, and it flows southwesterly before discharging into the Savannah River. The watershed is about 21 mi^2 (54 km^2) and receives permitted effluent discharges from F and H Areas. This stream received cooling water discharges from C Reactor while it was operating. Since those discharges ceased in 1985, the maximum recorded temperature in the stream has been 90°F (32°C). The average flow in the stream since 1985 is about 64 ft^3/sec (1.8 m^3/sec) (DOE 1995b). In water year 1995, the mean flow of Fourmile Branch at SRS Road A-13.2 was 37.3 ft^3/sec (1.1 m^3/sec). The 7-day, 10-year low flow over the period of record (water years 1977 to 1995) at SRS Road A-13.2 was 8.2 ft^3/sec (0.23 m^3/sec) (WSRC 1997a). In its lower reaches, this stream widens and flows via braided channels through a delta. Downstream of this delta area, it re-forms into one main channel, and most of the flow discharges into the Savannah River at river-mi 152.1 (river-km 245). When the Savannah River floods, water from Fourmile Branch flows along the northern boundary of the floodplain and joins with other site streams to exit the swamp via Steel Creek instead of flowing directly into the Savannah River (DOE 1995b).

Prior to 1996, Fourmile Branch received effluents from 16 National Pollutant Discharge Elimination System (NPDES) outfalls in C, F, and H Areas, and Central Shops, as well as groundwater from beneath F and H Areas due to outcropping. With the new NPDES permit (SC0000175) issued in 1996, outfalls were reduced from 16 to 5 due to deletions of waste streams and the consolidation of the outfalls. Effluent from the new 1.05 million gal/day (4.0 million L/day) CSWTF began discharging to Fourmile Branch in 1995 (WSRC 1997a).

Fourmile Branch, either directly or via tributaries, receives the following NPDES-permitted discharges: 186 basin overflows, cooling water, floor drains, steam condensate, process wastewater, laundry effluent, stormwater, sanitary treatment wastewater, ash basin runoff, and lab drains (WSRC 1997a).

Table 4-1 (WSRC 1999a) presents the annual instantaneous discharges of the Savannah River at Augusta, Georgia.

4.4.2.3 Summary of Potential for Flooding

There is no evidence that the selected site has experienced flooding in the past. Storm-induced runoff will provide sheet flow toward the site, which will be controlled by construction of short diversion berms near the site. The potential for flooding is discussed in the SRS GSAR (WSRC 1999a) and presented in this section.

The annual instantaneous maximum flows for Upper Three Runs gauging stations at Highway 278 near SRS Road C and at SRS Road A are listed in Table 4-2 (WSRC 1999a). The station at Highway 278 has the longest historical record.

For Upper Three Runs at Highway 278, the maximum flood recorded was 820 ft^3/sec (23 m^3/sec) on October 23, 1991, and the corresponding flood stage elevation was 174 ft (53 m) above msl. Similarly, the maximum flow at SRS Road C was 2,040 ft^3/sec (58 m^3/sec) (132.9 ft [40.5 m] above msl) on October 12, 1991, and at SRS Road A was more than 2,000 ft^3/sec (57 m^3/sec) (98 ft [29.9 m] above msl) on October 12, 1990. No dams are located in Upper Three Runs.

The site grade will be set at a mean elevation of 272 ft (83 m) above msl to ensure that there will be no flooding at the site due to the hydrological activity of these two streams.

The calculated probable maximum flood (PMF) for Upper Three Runs, downstream from the point where it is joined by Tinker Creek, is 150,000 ft^3/sec (4,248 m^3/sec). The watershed area at this point is 163 mi^2 (422 km^2), based on the drainage area at the nearest upstream gauging station (Station 02197300) and the planimetered additional drainage area. The maximum stage corresponding to this flow is 173.5 ft (52.9 m) above msl.

The estimated PMF for Upper Three Runs results in a water level of about 175 ft (53 m) above msl near F, H, and S Areas. The PMF for a small, unnamed tributary of Upper Three Runs, located about 0.4 mi (0.6 km) northwest of F Canyon, corresponds to a peak stage of approximately 225 ft (69 m) above msl.

In F and E Areas, the 6-hr, 10-mi^2 (26-km^2) probable maximum precipitation (PMP) is 31 in (78.7 cm), as indicated in *Probable Maximum Precipitation Estimates, United States East of the 105th Meridian* (Schreiner and Reidel 1978), with a maximum intensity of 15.1 in (38.4 cm) in 1 hr. This rainfall was adjusted to a point PMP of 19 in (48.3 cm) in 1 hr, as shown by Hanson et al. (1993) and used to generate the PMF for the small watershed of the unnamed tributary near SRS. Incremental rainfall for 1-hr periods adjacent to the PMP was also determined as shown in Table 4-3 (WSRC 1999a). A synthetic hydrograph was used to determine peak flow. The peak stage corresponding to the PMF is 224.5 ft (68.4 m) above msl. Because F Area lies near a watershed divide, incident rainfall naturally drains away from the facilities.

The PMF flood peak for Upper Three Runs was calculated using the simplified method in Regulatory Guide 1.59. The PMF was plotted using the figures in Appendix B of Regulatory Guide 1.59 (NRC 1977b) for drainage areas ranging from 100 to 20,000 mi^2 (260 to 52,000 km^2); then interpolation of the logarithmic plot provided the PMF for the 163-mi^2 (423.8-km^2) watershed of Upper Three Runs (WSRC 1999a).

Unusual short-duration heavy rainfall occurred in F and E Areas in August 1990 and October 1990. Total rainfall measured in F Area was reported in the GSAR (WSRC 1999a) as follows:

- On August 22, 1990, 6.1 in (15.5 cm) of rainwater was collected.
- On October 11 and 12, 1990, about 10 in (25.4 cm) of rainfall was collected.

4.4.3 Groundwater Hydrology

Groundwater in the vicinity of the MFFF site is discussed in Section 3.5.7.2 of the SPD EIS (DOE 1999c). The following sections update that discussion using additional information from the SRS GSAR (WSRC 1999a).

4.4.3.1 General Site Description

The Southeastern Coastal Plain hydrogeologic province underlies 120,000 mi^2 (312,000 km^2) of the Coastal Plain of South Carolina, Georgia, Alabama, Mississippi, and Florida and a small contiguous area of southeastern North Carolina. This hydrogeologic province comprises a multi-layered hydraulic complex in which retarding beds composed of clay and marl are interspersed with beds of sand and limestone that transmit water more readily. Groundwater flow paths and flow velocity for each of these units are governed by the unit's hydraulic properties, the geometry of the particular unit, and the distribution of recharge and discharge areas. Miller and Renken (1988) divided the Southeastern Coastal Plain hydrogeologic province into seven regional hydrologic units: four regional aquifer units separated by three regional confining units. Six of the seven hydrologic units are recognized in the SRS area and are referred to as hydrogeologic systems. These systems have been grouped into three aquifer systems divided by two confining systems, all of which are underlain by the Appleton confining system. The Appleton confining system separates the Southeastern Coastal Plain hydrogeologic province from the underlying Piedmont hydrogeologic province. The regional aquifer/confining systems at SRS are presented in Figures 4-7 and 4-11 (WSRC 1999a).

In descending order, the aquifer systems beneath SRS are the Floridan aquifer system, the Dublin aquifer system, and the Midville aquifer system (see Figure 4-7). In descending order, the confining systems are the Meyers Branch confining system, the Allendale confining system, and the Appleton confining system. Beneath SRS, the Midville and Dublin aquifer systems each consists of a single aquifer, the McQueen Branch aquifer and Crouch Branch aquifer, respectively. Downdip, beyond SRS, aquifer systems are subdivided into several aquifers and confining units.

Beneath the MFFF site, the Floridan aquifer system consists of two aquifers – the Upper Three Runs aquifer and the underlying Gordon aquifer, which are separated by the Gordon confining unit. Northward, the Gordon and Upper Three Runs aquifer units coalesce to form the Steed Pond aquifer.

4.4.3.2 Proposed Facility Location

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Beneath the MFFF site, the Upper Three Runs aquifer is divided into upper and lower aquifer zones by the Tan Clay confining zone of the Dry Branch Formation. In the area near the MFFF site, the topography drops sharply to the north toward Upper Three Runs, and the water table R1 occurs not in the upper aquifer zone, but in the lower aquifer zone beneath the Tan Clay confining zone.

The Upper Three Runs aquifer is underlain and separated from the Gordon aquifer by clay-rich, Eocene age marine sediments. Hydrostratigraphically, this formation is the Gordon confining unit. Owing to the glauconitic sands and greenish clay beds in this unit, it has been referred to informally as the "green clay" in many previous SRS reports. The Gordon aquifer underlies and is confined by the Gordon confining unit at the MFFF site. R1

Groundwater quality in F Area is not significantly different from that for the site as a whole. It is abundant, usually soft, slightly acidic, and low in dissolved solids. High dissolved iron concentrations occur in some aquifers. Where needed, groundwater is treated to raise the pH and remove iron. Recently (September 2000), three wells (FNB-13, FNB-14, and FNB-15) at the Old F-Area Seepage Basin (OFASB) (see location on Figure 4.3) compliance boundary exceeded allowable standards for one nonradioactive constituent (nitrate) and several radioactive constituents (tritium, iodine-129, and strontium-90) (WSRC 2001). R1

F-Area groundwater quality can exceed drinking water standards for several contaminants. Near the F-Area seepage basins and inactive process sewer line, radionuclide contamination is widespread. Most of these wells contain tritium above drinking water standards. Other wells exhibit gross alpha, gross beta, iodine-129, and strontium-90 above their standards. Other radionuclides found above proposed standards in several wells include americium-241; curium-243 and -244; radium-226 and -228; strontium-90; total alpha-emitting radium; and uranium-233, -234, -235, and -238. Cesium-137, curium-245 and -246, and plutonium-238 were also found (Arnett and Mamatey 1996).

Near the F-Area Tank Farm, cadmium, gross alpha, lead, mercury, nitrate-nitrite as nitrogen, and tritium were detected above drinking water standards in one or more wells. The pH exceeded the basic standard, and trichlorofluoromethane (Freon 11), which has no drinking water standard, was present in elevated levels (Arnett and Mamatey 1996).

At the F-Area Sanitary Sludge Land Application Site, tritium, specific conductance, lead, and copper were found to exceed their drinking water standards in one or more wells (Arnett and Mamatey 1996). Groundwater near the F-Area Acid/Caustic Basin consistently exceeded drinking water standards for gross alpha. Alkalinity, gross beta, nitrate as nitrogen, pH, and total alpha-emitting radium were above their respective standards in one or more wells (Arnett and Mamatey 1996). The groundwater near the F-Area Coal Pile Runoff Containment Basin did not exceed any chemical or radiological standard during 1995 (Arnett and Mamatey 1996).

4.4.3.3 Potential Sources of Groundwater Contamination

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At SRS, groundwater monitoring for radioactive constituents began in the 1950s, while monitoring for nonradioactive constituents began in 1974. The SRS environmental monitoring R1 program now encompasses more than 100 locations, including waste disposal sites, chemical storage areas, tanks, sewers, spill areas, buildings, and proposed construction areas (Noah 1995).

Groundwater beneath an estimated 5% to 10% of SRS has been contaminated by industrial solvents, tritium, metals, or other constituents used or generated by operations. Groundwater in these areas contains one or more of these constituents at or above primary drinking water standards (Noah 1995). In most instances, the contamination is confined to the uppermost aquifer system (water table). R1

The groundwater in the Upper Three Runs aquifer beneath the MFFF site is contaminated with various heavy industrial and nuclear contaminants. Groundwater contamination is present beneath the entire MFFF site, but is most pronounced beneath the western edge of the site. The sources of groundwater contamination under the site are related to the OFASB and upgradient sources inside the F Area. R1

The 2000 RCRA Part B Permit Renewal Application, Volume VII, Mixed Waste Management Facility (MWMF) at SRS (WSRC 2000a) provides a comprehensive description of groundwater contamination plumes in F Area. Also, the RCRA Facility Investigation/Remedial Investigation Report for the Old F-Area Seepage Basin (OFASB; WSRC 1995) defines the soil and groundwater contamination from past disposal practices into the seepage basin.

The OFASB is located just northwest of the MFFF site. The contaminated soil zone at the OFASB was remediated in 2000. A mixing zone agreement was implemented to manage groundwater associated with the OFASB. Under the terms of the mixing zone agreement, SRS monitors a network of groundwater wells at OFASB (see Figure 4-12). Recently, three wells (FNB-13, FNB-14, and FNB-15) at the OFASB compliance boundary have exceeded allowable standards for one nonradioactive constituent (nitrate) and several radioactive constituents (tritium, iodine-129, and strontium-90). SRS is investigating whether these exceedances are related to OFASB or to another source(s) in F Area. (WSRC 2001).

Water elevation data and computer modeling indicate that shallow groundwater flows away from the OFASB in a north-northwesterly direction, and is captured by a tributary of Upper Three Runs. A small component of this groundwater flows beneath the westernmost corner of the MFFF site (see Figure 4-12). Depth to groundwater in the area near the OFASB and the MFFF site ranges from 76 to 93 ft (23.2 to 28.3 m) (below present ground surface). MFFF site preparation will involve shallow grading and excavation, only 40 ft (12.2 m) deep. These activities are not expected to encounter groundwater. R1

Recent comprehensive geotechnical investigations were conducted during the summer of 2000 at the MFFF site. Radiological testing was performed for drill cuttings and all samples. During this program, no radioactive contamination was encountered at the MFFF site.

As a consequence of the exceedances in wells FNB-13, FNB-14, and FNB-15 noted above, DCS performed a groundwater survey on the MFFF site before beginning additional geotechnical work. The results of that sampling confirm the absence of groundwater above the Tan Clay confining zone. Groundwater beneath the Tan Clay confining zone is contaminated from upgradient sources, and not solely from the OFASB. Concentrations of gross alpha and beta activity, tritium, uranium, and trichloroethyene exceeded maximum contaminant limits for drinking water. The source of groundwater contamination is from various heavy industrial and nuclear operations over the past 50 years in the F-Area. The contaminants appear to originate inside F Area and extend beneath the MFFF site with movement in a fan-like direction of groundwater flow under the MFFF site. Contamination is most pronounced under the western edge of the site. Contamination was confined to the groundwater below the Tan Clay confining zone of the Dry Branch Formation (WSRC 2002). The deepest MFFF construction activities are anticipated to occur at least 30 ft (9.1 m) above the zone of contamination.

4.4.3.4 Potential Changes in Baseline Hydrology as a Result of Recent Activities

At SRS, the Atlantic Coastal Plain sediments are divided into two major aquifer systems (Floridan and Dublin-Midville) and two confining systems (Appleton and Meyers Branch). These systems are subdivided further into additional aquifer and confining units. The Dublin-Midville aquifer system is known to sustain single-well yields of 2.7 million gal/day (10.2 million L/day). This system is being utilized well below its capacity.

At SRS, most groundwater production is from the Dublin-Midville aquifer system (i.e., about 9 to 12 million gal/day [34 to 45 million L/day]), with a few lower-capacity wells pumping from the Floridan aquifer system, the uppermost aquifer system. Every major operating area at SRS has groundwater production wells.

SRS uses groundwater as a main water supply source because of (1) the convenience afforded by the availability of a prolific source, (2) the transmissivity of the Dublin-Midville aquifer system, and (3) the high quality of the water. Groundwater withdrawals are used primarily for process water, while other uses include domestic water and fire protection. Further withdrawals could potentially impact the productivity and stability of the aquifer system.

4.5 METEOROLOGY AND AIR QUALITY

This section describes the meteorology and air quality in the locale of the MFFF. The local meteorology is characterized in Section 4.5.1 in terms of temperature, precipitation, humidity, wind patterns, atmospheric transport and dispersion climatology, and storm characteristics. The sources of the meteorological data are also provided in Section 4.5.1. Existing levels of air pollution and the local air quality are discussed in Section 4.5.2. Lastly, the impact of local terrain and large bodies of water on meteorological conditions is discussed in Section 4.5.3.

4.5.1 Onsite Meteorological Conditions

The climate in the region around and the area near the MFFF is summarized and discussed in the following sections.

4.5.1.1 Data Sources

The description of the regional climatology of SRS is based on *Climatography of the United States No. 60, Climate of South Carolina* published by the National Climatic Data Center (DOC 1977) and the discussion in Section 1.4.1 of the SRS GSAR (WSRC 1999a). It is also based on long-term meteorological data collected by the National Weather Service at Bush Field in Augusta, Georgia, as summarized by the National Climatic Data Center (DOC 1999a). Bush Field is located approximately 12 mi (19.3 km) northwest of SRS. Normals, means, and extremes of temperature, precipitation, and wind speed are taken from DOC (1999a). Data on tornado occurrences and hurricanes are derived from Grazulis (1993) and the SRS GSAR (WSRC 1999a).

4.5.1.2 General Climate

The general climate was described in Section 3.5.1.1 of the SPD EIS (DOE 1999c) and has been modified and updated.

The SRS region has a temperate climate with short, mild winters and long, humid summers. Throughout the year, the climate is frequently affected by warm, moist maritime air masses. Summer weather usually lasts from May through September, when the area is subject to the influence of the western extension of the semi-permanent Atlantic subtropical anticyclone, or the "Bermuda high" pressure system. As a result, winds are generally light and weather associated with low-pressure systems and fronts usually remain well to the north of the area. Because the Bermuda high is a persistent feature, there are few breaks in the summer heat. High temperatures during the summer months are greater than 90°F (32.2°C) on more than half of all days (DOC 1999a). The relatively high heat and humidity often result in scattered afternoon and evening thunderstorms.

The influence of the Bermuda high begins to diminish during the fall, resulting in drier weather and temperatures that are more moderate. During the month of October, a semi-permanent Appalachian anticyclone results in mild dry weather. Average rainfall for the fall months is lower than average for the other months of the year. Frequently, fall days are characterized by cool, clear mornings and warm, sunny afternoons. Average daily temperatures in the fall range from a high of 76°F (24.4°C) to a low of 50°F (10°C). During the winter, migratory low-pressure systems and associated fronts influence the weather of SRS. Conditions frequently alternate between warm, moist, subtropical air from the Gulf of Mexico region and cool, dry, polar air. Occasionally, an arctic air mass will influence the area; however, the Appalachian Mountains to the north and northwest of SRS moderate the cold temperatures associated with the polar or arctic air. Consequently, less than one-third of the winter days have minimum temperatures below freezing, and temperatures below 20°F (-6.7°C) are infrequent.

Spring is characterized by a higher frequency of occurrence of tornadoes and severe thunderstorms than the other seasons of the year. This weather is often associated with the passage of cold fronts. Although weather during the spring is variable and relatively windy, temperatures are usually mild.

The average annual temperature at SRS is 63.2°F (17.3°C). A second data set from SRS yields an annual average temperature of 64.7°F (18.2°C) (WSRC 2000c). Temperatures vary from an average daily minimum of 32°F (0°C) in January to an average daily maximum of 91.7°F (33.2°C) in July. Long-term monthly and annual temperature data for Bush Field in Augusta, Georgia are summarized in Table 4-4. The average annual precipitation at SRS is about 45 in (114 cm). Data from 1967 to 1996 at SRS show an annual average precipitation of 49.5 in (126 cm). Precipitation is distributed fairly evenly throughout the year, with the highest in summer and the lowest in autumn. The summer precipitation amounts are mainly due to afternoon thunderstorms or the influence of tropical storms. Long-term monthly and annual precipitation data for Bush Field are summarized in Table 4-5.

On an annual average basis, relative humidities at Bush Field range from a high of 83% in the early morning hours to 51% in the afternoon. Comparable August values at SRS are 97% in the early morning hours to 50% in the afternoon. On a seasonal basis, the highest relative humidities occur in late summer during the months of August and September while spring (i.e., March and April) relative humidities are generally the lowest. The highest early morning relative humidity in August and September is 91% while the lowest afternoon values are 55% and 56% for August and September, respectively. In April, the early morning relative humidity averages 85% and the afternoon value is 45%.

A better measure of atmospheric moisture is the dew point temperature, which indicates the actual amount of moisture in the air because it is the temperature at which saturation occurs. Monthly average dew point temperatures in this area range from a high of approximately 69°F (20.6°C) in July and August to lows of approximately 34°F (1.1°C) in January. Heavy fog with visibility below 0.25 mi (0.4 km) occurs at Bush Field with an average annual frequency of 31.6 days per year.

Based on a short record of measurements from the SRS Central Climatology Station (i.e., 1995 to 1996), the annual average absolute humidity is 11.1 g/m^3, ranging from 18.4 g/m^3 in July to 6.0 g/m^3 in December and January (WSRC 2000c).

The mixing height is the level of the atmosphere below which pollutants are easily mixed; it is often used to approximate the base of an elevated inversion. Estimates of seasonally averaged morning mixing heights for SRS were interpolated from data presented in *Mixing Heights, Wind Speeds, and Potential for Urban Air Pollution Throughout the Contiguous United States* (Holzworth 1972) and are presented in Table 4-6. The Holzworth data[1] are derived from radiosonde observations during the five-year period 1960 to 1964.

[1] Although the source of data is for a 40-year old period, this is the only available data source supplying this type of information and the age of the data should not be relevant to seasonally averaged mixing heights.

4.5.1.3 Wind Patterns and Dispersion Climatology

Winds in the SRS region are generally light to moderate with the highest speeds occurring during spring with an average of approximately 7 mph (11.3 km/hr) for those months at Bush Field. The lightest winds occur in the summer and fall with the lowest monthly average wind speed of 5.1 mph (8.2 km/hr) occurring in August. The highest monthly wind speed of 7.7 mph (12.4 km/hr) occurs in March, and the long-term mean wind speed for the year is 6.2 mph (10 km/hr) at Bush Field. The prevailing wind direction at Augusta is generally from the northwest during the winter months, from the southeast during the late spring and early autumn, and from the southwest in the summer. There is no overall prevailing wind direction because it is variable throughout the year.

The highest observed 1-minute wind speed at Augusta is 62 mph (100 km/hr) from the east (June 1965) based on 42 years of observations, while the peak gust is 60 mph (96.5 km/hr) from the northwest (June 1988) based on 10 years of observations. The peak gust should be higher than the fastest mile wind speed due to its shorter duration, but in this case, the difference in the period of record (42 years vs. 10 years) results in a smaller peak gust. Higher localized wind speeds have occurred during storms (see Section 4.5.1.4).

A meteorological database for the 5-year period 1992 to 1996 is currently used for safety analysis at SRS. An averaged wind rose plot for the H-Area tower for this period of record is shown in Figure 4-13. As indicated by this plot, there is no strong prevailing wind direction at the site. | R1
Northeasterly winds occurred approximately 10% of the time (mostly during late summer, fall, and early winter), and west to southwest winds occurred about 8% of the time (mostly late winter, spring, and early summer). Annual average wind speeds ranged from 9.4 to 8.0 mph (15.1 to 12.9 km/hr).

The relative ability of the atmosphere to disperse air pollutants is commonly characterized in terms of Pasquill stability class. The Pasquill stability classes range from class A (very unstable conditions characterized by considerable turbulence producing rapid dispersion) to class G (extremely stable conditions with little turbulence and very weak dispersion). The percent occurrence of Pasquill stability class for each of the eight SRS area towers is summarized in Table 4-7. Stable conditions were observed between 20% and 30% of the time during the five-year report.

A joint frequency distribution of wind speed, wind direction, and stability class for the 1992 to 1996 period of observations from the 200-ft (61.0-m) elevation of the SRS H-Area meteorological tower are presented in Table 4-8.

4.5.1.4 Storms

The SRS region occasionally experiences severe weather in the form of violent thunderstorms, tornadoes, and hurricanes. Although thunderstorms are common in the summer months, the more violent storms are commonly associated with squall lines and active cold fronts in the spring. Augusta averages 52.9 thunderstorm days per year with the highest number of days (9 to

12 days per month) occurring in June, July, and August (DOC 1999a). The occurrence of hail with thunderstorms is infrequent. Based on observations in a 1-degree square of latitude and longitude that includes SRS, hail occurs once every two years on the average (Pautz 1969).

A total of 17 "significant" tornadoes occurring in Aiken or Barnwell Counties in South Carolina or in Burke County, Georgia, have been documented (Grazulis 1993) for the period 1880 to 1995. This reference defines a "significant" tornado as one causing confirmable Fujita Scale classification F2 damage or one that has killed a person. The Fujita Scale classification system is explained in Table 4-9. In addition, there have been nine confirmed tornadoes passing through or close to SRS since operations began. A tornado that occurred on October 1, 1989, knocked down several thousand trees over a 16-mi (25.7-km) path across the southern and eastern portions of the site. Wind speeds produced by this F-2 tornado were estimated to be as high as 150 mph (241 km/hr). Four F-2 tornadoes struck forested areas of SRS on three separate days during March 1991 (Parker 1991). Considerable damage to trees was observed in the affected area. The other four confirmed tornadoes were classified as F-1 and produced relatively minor damage. None of the nine tornadoes caused damage to buildings. Tropical storms or hurricanes affect the state about every other year. A total of 36 hurricanes have caused damage in South Carolina between 1700 and 1989. Most hurricanes only affect the Outer Coastal Plain and rapidly decrease in intensity as they move inland. However, considerable flooding can occur from hurricanes that come far inland. The average frequency of occurrence of a hurricane in the state is once every eight years. However, the observed interval between hurricane occurrences has ranged from two months to 27 years. Approximately 80% have occurred in August and September when hurricane activity in the Atlantic Ocean reaches its maximum.

Because SRS is approximately 100 mi (161 km) inland, winds associated with tropical weather systems usually diminish below hurricane force (sustained speeds of 75 mph [120 km/hr] or greater). However, winds associated with Hurricane Gracie, which passed to the north of SRS on September 29, 1959, were measured as high as 75 mph (121 km/hr) on an anemometer located in F Area. No other hurricane force wind has been measured onsite. On September 22, 1989, the center of Hurricane Hugo passed about 100 mi (161 km) northeast of SRS. The maximum 15-minute average wind speed observed onsite during this hurricane was 38 mph (61 km/hr). The highest observed instantaneous wind speed was 62 mph (100 km/hr). The data were collected from the onsite tower network (measurements taken at 200 ft [60 m] above ground). Extreme rainfall and tornadoes, which frequently accompany tropical weather systems, usually have the most significant hurricane-related impact on SRS operations (Hunter 1990).

4.5.2 Existing Levels of Air Pollution

Existing air quality was discussed in Section 3.5.1.1.1 of the SPD EIS (DOE 1999c) and has been updated to reflect more recent data. Air pollution refers to any substance in the air that | R1 could harm human or animal populations, vegetation, or structures, or that unreasonably interferes with the comfortable enjoyment of life and property. Air pollutants are transported, dispersed, or concentrated by meteorological and topographical conditions. Air quality is affected by air pollutant emission characteristics, meteorology, and topography.

SRS is near the center of the Augusta-Aiken Interstate Air Quality Control Region #53. None of the areas within SRS and its surrounding counties are designated as non-attainment areas with respect to the National Ambient Air Quality Standards (NAAQS) for criteria air pollutants (40 CFR §81.311 and §81.341). Existing ambient concentrations are compared to applicable NAAQS and the ambient air quality standards for the states of South Carolina and Georgia in Table 4-10.

There are no prevention of significant deterioration (PSD) Class I areas within 62 mi (100 km) of SRS. None of the facilities at SRS have been required to obtain a PSD permit (DOE 1996b).

The primary emission sources of criteria air pollutants and/or air toxics at SRS are the nine coal-burning boilers and four fuel-oil-burning package boilers (when operating) that produce steam and electricity, diesel engine-powered equipment, the DWPF, groundwater air strippers, and various other process facilities. Other emissions and sources include fugitive particulates from coal piles and coal-processing facilities, vehicles, controlled burning of forestry areas, and temporary emissions from various construction-related activities (DOE 1996b).

Table 4-10 presents the ambient air concentrations attributable to sources at SRS. These concentrations are based on emissions for the year 1994 (DOE 1998a; DOE 1998b). Only those hazardous pollutants that would be emitted for the MFFF alternatives are presented. Additional information on ambient air quality at SRS is in the *SRS Environmental Report for 1999* (Arnett and Mamatey 2000a). Concentrations shown in Table 4-10 attributable to SRS are in compliance with applicable guidelines and regulations. Data for 2000 from nearby South Carolina monitors R1
at Beech Island, Jackson, and Barnwell indicate that the NAAQS for particulate matter, lead, ozone, sulfur dioxide, and nitrogen dioxide are not exceeded in the area around SRS (SCDHEC 2002). Air pollutant measurements at these monitoring locations during 2000 showed for nitrogen dioxide an annual average concentration of 9.4 μg/m^3; for sulfur dioxide, concentrations of 57 μg/m^3 for 3-hr averaging, 18 μg/m^3 for 24-hr averaging, and 5 μg/m^3 for the annual average; for total suspended particulates, an annual average concentration of 40 μg/m^3; and for particulate matter, concentrations of 62 μg/m^3 for 24-hr averaging and 19 μg/m^3 for the annual average. R1

4.5.3 Impact of Local Terrain and Large Bodies of Water on Meteorological Conditions

Local terrain in the form of hills, valleys, and large water bodies can have a significant impact on the meteorological conditions. In the vicinity of the facility, the terrain can be described as gently rolling, forested hills. In general, terrain elevations decrease gradually from the Appalachian foothills northwest of the site toward the Atlantic coastal plain to the southeast. The local SRS terrain elevations also generally decrease gradually toward the Savannah River, which runs along the southwestern boundary of the site. Site elevations range from 100 ft (30.5 m) to about 400 ft (122 m) above msl.

The closest pronounced topographic feature (e.g., hill, large lake) is approximately 20 mi (32.2 km) from the site; the local terrain has little effect on wind and stability climatology at

SRS. During stable atmospheric conditions, some channeling or airflow stagnation could occur in some of the more pronounced valleys. However, any terrain-induced increase in pollutant concentrations would be much localized and short-lived. SRS is too far from the Atlantic Ocean to experience any meaningful sea breeze activity.

4.6 ECOLOGY

Section 3.5.8 of the SPD EIS (DOE 1999c) discusses the ecological resources in the vicinity of the MFFF site. This discussion has been updated.

Ecological resources are defined as terrestrial (i.e., predominantly land) and aquatic (i.e., predominantly water) ecosystems characterized by the presence of native and naturalized plants and animals. For the purposes of this ER, those ecosystems are differentiated in terms of habitat support of threatened, endangered, and other special-status species (i.e., "nonsensitive" versus "sensitive" habitat).

4.6.1 Nonsensitive Habitat

Nonsensitive habitat comprises those terrestrial and aquatic areas of the site that typically support the region's major plant and animal species.

4.6.1.1 General Site Description

At least 90% of the SRS land cover is composed of upland pine and bottomland hardwood forests (DOE 1997a). Five major plant communities have been identified at SRS: bottomland hardwood (most commonly sweetgum and yellow poplar); upland hardwood-scrub oak (predominantly oaks and hickories); pine/hardwood; loblolly, longleaf, and slash pine; and swamp. The loblolly, longleaf, and slash pine community covers about 65% of the upland areas of SRS. Swamp forests and bottomland hardwood forests occur along the Savannah River and the numerous streams found on SRS.

The biodiversity of the region is extensive due to the variety of plant communities and the mild climate. Animal species known to inhabit SRS include 44 species of amphibians, 255 species of birds, 54 species of mammals, and 59 species of reptiles. Common species include the eastern box turtle, Carolina chickadee, common crow, eastern cottontail, and gray fox (DOE 1996b; WSRC 1997a). Game animals include a number of species, two of which, the white-tailed deer and feral hogs, are hunted onsite (DOE 1996b). Raptors, such as the Cooper's hawk and black vulture, and carnivores, such as the raccoon, are ecologically important groups at SRS (DOE 1996b).

Aquatic habitat within SRS includes manmade ponds, Carolina bays, reservoirs, and the Savannah River and its tributaries.

There are more than 50 manmade impoundments throughout the SRS site that support populations of bass and sunfish. Carolina bays, a type of wetland unique to the southeastern

United States, are natural shallow depressions that occur in interstream areas. These bays can range from lakes to shallow marshes, herbaceous bogs, shrub bogs, or swamp forests. Among the 299 Carolina bays found throughout SRS, fewer than 20 have permanent fish populations. Redfin pickerel, mud sunfish, lake chubsucker, and mosquito fish are present in these bays.

Although sport and commercial fishing is only permitted on portions of SRS (Crackerneck Wildlife Management Area), the Savannah River is used extensively for both. Important commercial species are the American shad, hickory shad, and striped bass, all of which are anadromous. The most important warm-water game fish are bass, pickerel, crappie, bream, and catfish (DOE 1996b; WSRC 1997a).

4.6.1.2 Proposed Facility Location

F Area is situated on an upland plateau between the drainage areas of Upper Three Runs and Fourmile Branch. This heavily industrialized area is dominated by buildings, paved parking lots, graveled construction areas, and lay down yards (Figure 4-14); little natural vegetation remains R1 inside the fenced areas. Grassed areas occur around the administration buildings, and some vegetation is present along drainage ditches, but most of the developed areas have no vegetation (DOE 1994a; 1995a). The most common plant communities in the vicinity of F Area include loblolly, longleaf, and slash pine; upland hardwood-scrub oak; pine/hardwood; and bottomland hardwood (DOE 1995b; DOE 1996b). Cleared fields are also common in F Area, and a roughly 15-ac (6.1-ha) oak-hickory forest area designated as a National Environmental Research Park set aside is northwest of F Area (DOE 1996b). The MFFF site is composed primarily (68%) of mixed evergreen and evergreen forest in its undeveloped areas (Figure 4-14) (DOE 1995b). R1

A recent (1994 to 1997) study was conducted to document the composition and diversity of urban wildlife, those species of amphibians, birds, mammals, and reptiles that inhabit or temporarily use the developed areas on SRS. Results indicate that the use of the developed areas by wildlife species is more common than has been previously reported (Mayer and Wike 1997). A total of 41 wildlife species were observed in and around F Area, including 18 species of birds, 11 species of mammals, and 12 species of reptiles.

Bird species commonly seen include the bufflehead, turkey vulture, black vulture, killdeer, rock dove, mourning dove, chimney swift, great crested flycatcher, barn swallow, common crow, fish crow, northern mockingbird, American robin, European starling, and common grackle. Frequently sighted mammals include the Virginia opossum, eastern cottontail, house mouse, feral cat, striped skunk, and raccoon. The only reptile commonly observed is the banded water snake (Mayer and Wike 1997).

Upper Three Runs and its tributaries and three Carolina bays constitute the aquatic habitat in the vicinity of F Area. Streams support largemouth bass, black crappie, and various species of pan fish. Upper Three Runs has a rich fauna; more than 551 species of aquatic insects have been collected (DOE 1996b; WSRC 1997a). It is important as a spawning area for blueback herring, and as a seasonal nursery habitat for American shad, striped bass, and other Savannah River species. Aquatic resources information on the three Carolina bays is unavailable (DOE 1996b).

4.6.2 Sensitive Habitat

Sensitive habitat comprises those terrestrial and aquatic (including wetlands) areas of the site that support threatened and endangered, state-protected, and other special-status plant and animal species.

4.6.2.1 General Site Description

SRS wetlands, most of which are associated with floodplains, streams, and impoundments, include bottomland hardwood, cypress-tupelo, scrub-shrub, and emergent vegetation, as well as open water. Swamp forest along the Savannah River is the most extensive wetlands vegetation type (DOE 1996b).

Sixty-one threatened, endangered, and other special-status species listed by the federal government or the state of South Carolina may be found in the vicinity of SRS. Table 4-11 identifies those potentially occurring in the vicinity of F Area. No critical habitat for threatened or endangered species exists on SRS (DOE 1996b).

4.6.2.2 Proposed Facility Location

Figures 4-14 and 4-15 identify the land cover characteristics and show the location of wetlands in the general vicinity of F Area. No wetlands are located in the MFFF and WPB site areas (refer to Figure 4-3 for WSB location). R1

No federally listed threatened or endangered species are known to occur in F Area. The American alligator, although listed as threatened (by virtue of similarity in appearance to the endangered crocodile) is fairly abundant on SRS. It was recently observed near F Area, but its occurrence there is seen as uncommon. Furthermore, no state-listed protected species have been found in any developed area on SRS, and of the state-listed organisms known to occur, none would be expected to use any of the disturbed areas for extended periods (Mayer and Wike 1997).

The Pen Branch area, about 8.7 mi (14 km) southwest of the proposed sites, and an area south of Par Pond, about 7.5 mi (12 km) to the southeast, support active bald eagle nests. Wood storks have been observed about 13 mi (21 km) from the proposed site, near the Fourmile Branch delta. The closest colony of red-cockaded woodpeckers is about 3.1 mi (5 km) away, but suitable forage habitat exists on the proposed sites. The smooth purple coneflower, the only endangered plant species found on SRS, could be found on the proposed sites (DOE 1996b). Botanical surveys conducted by the Savannah River Forest Station in 1992 and 1994 identified three populations of Oconee azalea in the area northwest of F Area. This state-listed rare plant species was found on the steep slopes adjacent to the Upper Three Runs floodplain (DOE 1995b).

Surveys conducted in 1998 and 2000 in the area north of F Area and east of Upper Three Runs did not find any federally listed threatened, endangered, proposed, or sensitive plant or animal species (DOA 2000). Of the listed species, appropriate habitat was found only for the red-cockaded woodpecker, although there were no sightings during the survey. Appropriate habitat is lacking in the survey area for the bald eagle, wood stork, American alligator, and shortnosed sturgeon.

4.7 NOISE

Noise is unwanted sound that interferes or interacts negatively with the human or natural environment. Noise may disrupt normal activities or diminish the quality of the environment. The existing sources of noise were described in Section 3.5.1.2 of the SPD EIS (DOE 1999c).

4.7.1 General Site Description

Major noise sources at SRS are primarily in developed or active areas and include various industrial facilities, equipment, and machines (e.g., cooling systems, transformers, engines, pumps, boilers, steam vents, paging systems, construction and materials-handling equipment, and vehicles). Major noise emission sources outside of these active areas consist primarily of vehicles and rail operations. Existing SRS-related noise sources of importance to the public are those related to transportation of people and materials to and from the site, including trucks, private vehicles, helicopters, and trains (DOE 1996b).

Another important contributor to noise levels is traffic to and from SRS operations along access highways through the nearby towns of New Ellenton, Jackson, and Aiken. Noise measurements recorded during 1989 and 1990 along South Carolina Highway 125 in the town of Jackson at a point about 50 ft (15 m) from the roadway indicate that the 1-hr equivalent sound level from traffic ranged from 48 to 72 dBA. The estimated day-night average sound levels along this route were 66 dBA for summer and 69 dBA for winter. Similarly, noise measurements along South Carolina Highway 19 in the town of New Ellenton at a point about 50 ft (15 m) from the roadway indicate that the 1-hr equivalent sound level from traffic ranged from 53 to 71 dBA. The estimated average day-night average sound levels along this route were 68 dBA for summer and 67 dBA for winter (NUS 1990).

Most industrial facilities at SRS are far enough from the site boundary that noise levels from these sources at the boundary would not be measurable or would be barely distinguishable from background levels.

The states of Georgia and South Carolina, and the counties in which SRS is located, have not established any noise regulations that specify acceptable community noise levels, with the exception of a provision in the Aiken County Zoning and Development Standards Ordinance that limits daytime and nighttime noise by frequency band (DOE 1996b).

The EPA guidelines for environmental noise protection recommend an average day-night average sound level of 55 dBA as sufficient to protect the public from the effects of broadband environmental noise in typically quiet outdoor and residential areas (EPA 1974). Land-use compatibility guidelines adopted by the Federal Aviation Administration and the Federal Interagency Committee on Urban Noise indicate that yearly day-night average sound levels less than 65 dBA are compatible with residential land uses and levels up to 75 dBA are compatible with residential uses if suitable noise reduction features are incorporated into structures (14 CFR Part 150). It is expected that for most residences near SRS, the day-night average sound level is less than 65 dBA and is compatible with the residential land use, although for some residences along major roadways noise levels may be higher.

4.7.2 Proposed Facility Location

No distinguishing noise characteristics at F Area have been identified. F Area is far enough (5.8 mi [9.3 km]) from the site boundary that noise levels from the facilities are not measurable or are barely distinguishable from background levels.

4.8 REGIONAL HISTORIC, SCENIC, AND CULTURAL RESOURCES

Field studies conducted over the past two decades by the South Carolina Institute of Archaeology and Anthropology of the University of South Carolina have provided considerable information about the distribution and content of cultural resources at SRS. About 60% of SRS has been surveyed, and 858 historic and prehistoric archaeological sites have been identified. Although final eligibility determinations have not yet been made on a majority of the sites, 67 are considered potentially eligible for listing on the National Register of Historic Places (DOE 1999c).

Cultural resources at SRS are managed under the terms of a Programmatic Memorandum of Agreement (PMOA) executed between DOE-SR, the South Carolina State Historic Preservation Officer, and the Advisory Council on Historic Preservation, on August 24, 1990. Guidance on the management of cultural resources at SRS is included in the *Archaeological Resource Management Plan of the Savannah River Archaeological Research Program* (SRARP 1989).

Historic, prehistoric, visual, and Native American resources are discussed in Sections 4.8.1 through 4.8.4, respectively.

4.8.1 Historic Resources

About 400 historic sites or sites with historic components have been identified within SRS property. None of the identified historic sites fall within the location of the proposed MFFF facility.

4.8.2 Prehistoric Resources

Prehistoric sites at SRS consist of the remains of villages, base camps, limited-activity sites, quarries, and workshops. An extensive archaeological survey program, begun at SRS in 1974, includes numerous field studies that include reconnaissance surveys, shovel testing, and intensive site testing and excavation. There is prehistoric evidence in more than 800 sites, some of which fall in the vicinity of the proposed facility. Fewer than 8% of the 800 sites have been evaluated for National Register eligibility (DOE 1999c); many of the sites are away from development and are in little danger of serious loss.

Archaeological surveys of F Area in the vicinity of the proposed MFFF site identified four prehistoric sites (38AK330, 38AK548, 38AK546/547, and 38AK757) that could be affected by construction of the proposed facilities[2]. Sites 38AK330, 38AK548, and 38AK546/547 were identified during 1993 to 1994 surveys. Site 38AK757 was identified during surveys conducted between December 11, 1998, and February 9, 2000, and also in mid-November 1999. Of these sites, 38AK546/547 and 38AK757 have been found eligible for listing in the National Register of Historic Places under Criterion D[3] (Green 2000). The State Historic Preservation Office also concurred with the finding that sites 38AK330 and 38AK548 were not eligible and that no further work was required concerning those two sites (Green 2000). Mitigation activities R1 associated with the archaeological site that is located on the MFFF site commenced in December 2001. All field activities associated with mitigating site 38AK546/547 were completed in April R1 2002. Mitigation of Site 38AK757 should be complete by August 2002.

4.8.3 Visual Resources

Visual resources at SRS were discussed in Section 3.5.10.2 of the SPD EIS (DOE 1999c).

The dominant viewshed in the vicinity of SRS consists mainly of agricultural land and forest, with some limited residential and industrial areas. The SRS landscape is characterized by wetlands and upland hills. Vegetation is composed of bottomland hardwood forests, scrub oak and pine woodlands, and wetland forests. DOE facilities are scattered throughout SRS and are brightly lit at night. These facilities are generally not visible offsite because views are limited by rolling terrain, frequent hazy atmospheric conditions, and heavy forests and vegetation. The only areas visually impacted by the DOE facilities are those within the view corridors of South Carolina Highway 125 and SRS Road 1.

The developed areas and utility corridors (i.e., transmission lines and aboveground pipelines) of SRS are consistent with a Visual Resources Management (VRM) Class IV designation. The remainder of SRS is consistent with VRM Class III or IV (DOE 1996b; DOI 1986a, 1986b).

Industrial facilities within F Area consist of large concrete structures, smaller administrative and support buildings, and parking lots (DOE 1994a). The structures range in height from 10 to 100

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[2]Although the SPD EIS ROD (DOE 2000b) identified five sites that were potentially affected by MFFF construction, subsequent shifting of the facility site left one site outside the potential impact area.

[3]Criterion D – "Property has yielded, or is likely to yield, information important in prehistory or history." (DOI 1991).

ft (3 to 30 m), with a few stacks and towers that reach 200 ft (61 m). The facilities in this area are brightly lit at night and visible when approached via SRS access roads. Visual resource conditions in F Area are consistent with VRM Class IV (DOI 1986a, 1986b; Sessions 1997a). F Area is about 4.3 mi (7 km) from South Carolina Highway 125 and 5.3 mi (8.5 km) from SRS Road 1. Public view of F-Area facilities is restricted by heavily wooded areas bordering segments of the SRS Road 1 system and site-crossing South Carolina Highway 125. Moreover, those facilities are not visible from the Savannah River, which is about 6.2 mi (10 km) to the west.

4.8.4 Native American Resources

Less than 1% of the population of counties within a 10-mi (16-km) radius of the proposed MFFF site are of American Indian decent. Native American groups with traditional ties to the area include the Apalachee, Cherokee, Chickasaw, Creek, Shawnee, Westo, and Yuchi. At different times, each of these groups was encouraged by the English to settle in the area to provide protection from the French, Spanish, or other Native American groups. Main villages of both the Cherokee and Creek were located southwest and northwest of SRS, respectively, but both groups may have used the area for hunting and gathering activities. During the early 1800s, most of the remaining Native Americans residing in the region were relocated to the Oklahoma Territory (DOE 1999c).

Native American resources in the region include remains of villages or town sites, ceremonial lodges, burials, cemeteries, and natural areas containing traditional plants used in religious ceremonies. Literature reviews and consultations with Native American representatives have revealed concerns related to the American Indian Religious Freedom Act within the central Savannah River valley, including some sensitive Native American resources and several plants traditionally used in ceremonies.

In 1991, DOE conducted a survey of Native American concerns about religious rights in the central Savannah River valley. During this study, three Native American groups, the Yuchi Tribal Organization, the National Council of Muskogee Creek, and the Indian People's Muskogee Tribal Town Confederacy, expressed continuing interest in the SRS region with regard to the practice of their traditional religious beliefs. The Yuchi Tribal Organization and the National Council of Muskogee Creek have expressed concerns that several plant species (e.g., redroot [*Lachnanthese carolinianum*], button snakeroot [*Erynglum yuccifolium*], and American ginseng [*Panax quinquefolium*]) traditionally used in tribal ceremonies could exist on SRS. Redroot and button snakeroot are known to occur on SRS but are typically found in wet, sandy areas such as evergreen shrub bogs and savannas. Neither species is likely to be found in F Area due to clearing prior to the establishment of SRS in the 1950s (DOE 1994a). Consultations were initiated with appropriate Native American groups to determine any concerns associated with the actions evaluated in the SPD EIS (DOE 1999c).

4.9 REGIONAL DEMOGRAPHY

A demographic evaluation was conducted to identify population distribution and anticipated growth within a 50-mi (80-km) radius of the proposed MFFF site. The analysis also reviewed detailed characteristics of the population within a more local, 10-mi (16-km) radius. All land within a 5-mi (8-km) radius of the MFFF is within SRS and contains no residential population.

4.9.1 Permanent Population

A total of about 621,527 people resided within 50 mi (80 km) of the MFFF site in 1990. That population is projected to grow by about 92% to a total of 1,042,483 by the year 2030. Table 4-12 through 4-16 present population distribution for 1990, 2000, 2010, 2020, and 2030, respectively. The 1990 numbers are based on 1990 U.S. Census counts, while years 2000 through 2030 are projections compiled for the SRS GSAR (WSRC 1999a) and are based on growth projections provided by the University of Georgia (WSRC 1993). The population growth projected by the GSAR was compared to actual population growth as determined by the 2000 census. The GSAR predicted a 14% increase in population within 50 mi (80 km) of the MFFF for the year 2000. Checking against actual increases from the 2000 census DCS determined that the county populations within 50 mi (80 km) actually increased by 16%. Therefore the GSAR underestimated population increase by 2%. Calculation of the population dose for the offsite public used the projected population for 2030. Operation of the MFFF is expected to end in 2027 based on a 20-year license and startup in 2007. Use of a population distribution projected for a time later than the end of operational life ensures conservative dose calculations and provides a buffer for underestimates of population growth or if the start of the project is delayed.

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The analysis included spatial distribution of the population based on a circular grid comprised of 22 ½ degree sectors centered on the 16 cardinal compass point directions and six radial distances of 0 to 5, 5 to 10, 10 to 20, 20 to 30, 30 to 40, and 40 to 50 miles (0 to 8, 8 to 16, 16 to 32.2, 32.2 to 48.3, 48.3 to 64.4, and 64.4 to 80 km). Since all land within a 5-mi (8-km) radius of the MFFF site is within SRS and contains no residential population, the usual 1 mi (1.6 km) increment analysis for the area within 5 mi (8 km) of the site is not shown.

Of the combined population of counties that are partially or entirely within the 50-mi (80-km) radius of the MFFF, about 48% is male and 52% is female. Racially, the population is predominantly white, with 34% black and about 1% Asian or Pacific Islander. Less than 0.1% of the population is of Hispanic decent (DOC 1998a, 1998b).

The area within 50 mi (80 km) includes all, or portions of, two major metropolitan areas where large concentrations of population may be found. The Augusta-Aiken Metropolitan Statistical Area[4] (MSA), which includes Columbia, Richmond, and McDuffie Counties in Georgia, and Edgefield and Aiken Counties in South Carolina, is anchored by the city of Augusta, which is over 20 mi (32.2 km) west-northwest of the site. The Augusta MSA contained 415,220 people in 1990, and an estimated 458,271 people in 1998, primarily in the cities of Augusta, Aiken, and North Augusta (DOC 1999b). The closest boundary of the Columbia City MSA, which includes Lexington and Richland Counties (South Carolina), is located over 30 mi (48.3 km) northeast of the MFFF site: Columbia City, the core of this MSA, is located outside of the 50-mi (80-km) radius. The Columbia City MSA contained 453,932 people in 1990 and an estimated 512,316 people in 1998 (DOC 1999c). Greater than 50% of the population in the Columbia City MSA live over 50 mi (80 km) from the MFFF site.

The local area within a 10-mi (16-km) radius around the MFFF site is comprised of portions of three counties, Aiken and Barnwell, South Carolina, and Burke County, Georgia. The MFFF is located on SRS in Aiken County. Only SRS facilities, and no residential population, are located within 5 mi (8 km) of the proposed site.

The area between 5 and 10 mi (8 and 16 km) from the MFFF site contained about 6,500 people in 1990 (WSRC 1999a). That population is projected to grow to a total of approximately 12,000 by the year 2040 (WSRC 1999a). A majority of this local population resides to the north and northwest of the site in the towns of New Ellenton and Jackson, which contained estimated populations of 7,197 and 2,843 people in 1998, respectively (DOC 2000a). Existing and projected population between 5 and 10 mi (8 and 16 km) of the MFFF site are included in Tables 4-12 through 4-16.

As shown in Table 4-17, the racial and ethnic mix of the local counties' populations, as well as the states of South Carolina and Georgia, is predominantly white or black. Less than 2% of the population is comprised of individuals of Hispanic, Native American, or other non-white or black racial or ethnic background.

The U.S. Census Bureau estimated that 1,765 people resided in group quarters[5] in Aiken County, 297 in Barnwell County, and 216 in Burke County in 1997 (DOC 1998b). The only residential institutions classified as "group quarters" within 10 mi (16 km) of the site are three residential care facilities located in New Ellenton: the New Ellenton Nursing Center (26 beds), Coleman's Residential Care (10 beds), and Parker's Residential Care Home (nine beds) (SCDHEC 1999b).

[4] The U.S. Census Bureau defines a Metropolitan Statistical Area (MSA) as a large population nucleus, together with adjacent communities that have a high degree of economic and social integration with that nucleus. Each MSA contains one or more central counties containing the area's main population concentration, an urbanized area with at least 50,000 inhabitants. An MSA may also include outlying counties that have close economic and social relationships with the central counties.

[5] Group quarters include prisons, nursing homes, psychiatric hospitals, juvenile institutions, college dormitories, military quarters, and homeless shelters.

The closest of these three facilities, Parker's Residential Care Home on Pine View Drive, is over 6 mi (9.6 km) northwest of the proposed MFFF site.

A minimal number of facilities, mostly schools, containing transient populations are located within the 10-mi (16-km) area surrounding the proposed MFFF site. Five public schools are located within the area to the northwest and west, with the closest being over 6 mi (9.6 km) away from the site. Table 4-18 lists local public schools within 10 mi (16 km) of the MFFF site and recent enrollments (1998 to 1999). The students in these schools are assumed to be part of the resident population within 50 mi (80 km) of the MFFF.

4.9.2 Transient Population

The proposed MFFF site is located in F Area of SRS. There are no facilities or population within 5 mi (8 km) of the MFFF site that are not part of the SRS complex. In December 1998, the total onsite employment at SRS during the day shift of a weekday was 14,177, including 12,622 WSRC employees; 520 DOE employees; and 742 Wackenhut Services Inc. (WSI) employees (the balance included United States Forest Service, Savannah River Ecology Lab, and other contractors to DOE-SR). The population of workers at SRS has decreased to approximately 13,590 in 2002, including 12,051 employed by WSRC (M&O Contractor); 823 employed by WSI; 459 employees under DOE-SR; and 257 other SRS contract employees (Bozzone 2002). R1 Table 4-19 identifies the distribution of SRS employees by county of residence within the region of influence (ROI).

The local area surrounding the proposed facility is not a destination for tourism. As a result, seasonal variations in population resulting from tourist activities are negligible.

4.10 SOCIOECONOMIC CHARACTERISTICS AND COMMUNITY SERVICES

4.10.1 Local Socioeconomic Characteristics

As of April, 2002, SRS employed approximately 13,590 persons. As shown in Table 4-19, R1 approximately 90% of that workforce resides within five counties: Aiken, Barnwell, and Edgefield, South Carolina, and Columbia and Richmond, Georgia. This information was used to determine the residential preference of people currently employed at SRS and to estimate where new workers might reside if they must relocate into the area. The five-county area is referred to as the ROI.

As shown on Table 4-20, over 20% of the population of a majority of the counties in the 50-mi (80-km) region (i.e., 14 out of 21) had income levels below the federal poverty threshold; only Aiken and Lexington Counties in South Carolina, and Columbia and Glascock Counties in Georgia had lower percentages of population below the poverty threshold than their respective state averages. Only Aiken and Lexington Counties exceeded state averages for per capita income in 1994 (DOC 1998a, 1998b).

Within the three counties that make up the local 10-mi (16-km) area, Burke County, Georgia, contains the least affluent population, with a 1990 per capita income of $11,172 and about 30.3% of its population living below the poverty level in 1989 (Table 4-21). In the same years, the per capita income for the state of Georgia was $17,123 with approximately 14.7% of its population living below the poverty level. Within South Carolina, Aiken County had per capita income and poverty levels superior to the state average, but Barnwell County was considerably below in income (i.e., about 20% below the state average) and contained a higher percentage of individuals below poverty level. As shown in the two right column of Table 4-21, while income levels have grown slightly since 1989, the percentage of the population with incomes below the poverty level in each of the three local counties has remained consistent (DOC 1998a). Unemployment in the local area ranged from a high of 16% in Burke County to a low of 7% in Aiken County in 1996 (DOC 1996). R1 R1

4.10.2 Regional Economic Characteristics

4.10.2.1 Employment

Selected unemployment and regional economic statistics for counties located partially or entirely within 50 mi (80 km) of the MFFF site are summarized in Table 4-20. In 1996, unemployment in the region ranged from a high of 16% in Burke County, Georgia, to a low of 3.1% in Bulloch County, Georgia. With the exception of Bulloch and Columbia Counties in Georgia and Lexington County in South Carolina, the county rates of unemployment were consistently higher than the respective state averages of 6% and 4.6%, respectively, for South Carolina and Georgia. In May 2000, the average unemployment rates for the Augusta-Aiken and Columbia City MSAs were 4.5% and 2.7%, respectively.

Within the counties that are entirely or partially within a 50-mi (80-km) radius of the MFFF site, over 90,000 workers, or about 29%, were employed in the services sector of the workforce in 1997. Construction workers comprised about 6% of that workforce, or 18,290 workers, in that same year. Table 4-22 lists 1997 employment by business sector for the counties that are within 50 mi (80 km) of the MFFF site.

4.10.2.2 Housing

The six-county ROI contained over 165,000 housing units in 1990, approximately 10% of which were vacant. Richmond County in Georgia contained the largest number of units (77,288) in this region, followed by Aiken County in South Carolina (49,266) and Columbia County in Georgia (23,745). Barnwell County and Edgefield County in South Carolina each contained less than 8,000 units.

Of the six counties, Columbia County has seen the fastest growth in housing over the past 30 years with increases of 109.2% from 1970 to 1980, and 68.4% from 1980 to 1990. This trend is in line with that county's rapid population growth and appears to be continuing. From 1970 to 1980 and from 1980 to 1990, Columbia County's population grew approximately 80% and 47%, respectively. The state of Georgia estimates that the population of Columbia County grew by an additional 50% to a total of 88,812 people between 1990 and 1997. In 1997, Columbia County issued the largest number of construction permits for new housing (i.e., 868 permits) when compared to the other six ROI counties.

4.10.3 Community Services

4.10.3.1 Education

Five public schools are located within a 10-mi (16-km) radius of the MFFF site, all over 6 mi (9.6 km) from the site. These schools, and their 1999-2000 enrollments, are listed in Table 4-18. The schools operate for 180 days each year, from early-August through mid-May. There are no private schools or colleges in the 10-mi (16-km) area. | R1

4.10.3.2 Public Safety

The five-county ROI (excluding Bamberg County) was served by a total of 973 sworn police officers in 1997, with an average officer-to-population ratio of 2.1 officers per 1,000 persons (DOE 1999c). In 1990, Georgia averaged 2.0 officers per 1,000 persons and South Carolina averaged 1.8 officers per 1,000 persons (DOE 1999c).

Firefighting services in the SRS ROI (excluding Bamberg County) were provided by 1,712 paid and volunteer firefighters in 1997. The average firefighter-to-population ratio in the ROI was 3.8 firefighters per 1,000 persons (DOE 1999c). The average 1990 firefighter-to-population ratios for Georgia and South Carolina were 1.0 firefighter per 1,000 persons, and 0.8 firefighter per 1,000 persons, respectively (DOE 1999c).

4.10.3.3 Health Care

No hospitals are located within a 10-mi (16-km) radius of the MFFF site. The nearest hospital, the Aiken Regional Medical Center, is located about 20 mi (32.2 km) from the MFFF site in the city of Aiken. In 1996, a total of 1,722 physicians served the ROI (excluding Bamberg County). The average physician-to-population ratio in the ROI was 3.8 physicians per 1,000 persons. This ratio compares with a 1996 state average of 2.3 physicians per 1,000 persons for Georgia and 2.2 physicians per 1,000 persons for South Carolina. In 1997, there were 10 hospitals serving the ROI (excluding Bamberg County). The hospital bed-to-population ratio averaged 7.7 beds per 1,000 persons. This ratio compares with a 1990 state average of 4.1 beds per 1,000 persons for Georgia and 3.3 beds per 1,000 persons for South Carolina (DOE 1999c)

4.10.3.4 Local Transportation

Vehicular access to SRS is provided by South Carolina Highways 19, 64, 78, 125, and 278. Two road segments in the ROI could be affected by the disposition alternatives: South Carolina Highway 19 from U.S. Route 78 at Aiken to U.S. Route 278 and South Carolina Highway 230 from U.S. 25 Business at North Augusta to U.S. Routes 25, 78, and 278. Three road improvement projects are planned that are independent of the proposed action but would alleviate traffic congestion leading into SRS.

The first improvement project is the widening of South Carolina Highway 302 (Pine Log Road) from U.S. Route 78 and the construction of new segments to extend the route to South Carolina Highway 19. U.S. Route 25 is also being widened for one-half mile south of I-20. The widening project will be in conjunction with the second improvement project, the new construction of the Bobby Jones Expressway (I-520). The expressway will head in a southwest direction crossing South Carolina Highways 126 and 125 and U.S. Route 1 and continue over the Savannah River to connect with the Georgia portion of the Bobby Jones Expressway, which is already constructed. The third improvement project is the completion of South Carolina Highway 118 around Aiken. South Carolina Highway 118 will be widened with the construction of new segments to complete the by-pass (DOE 1999c). With the exception of the U.S. Route 25 project, which is expected to be completed the year MFFF construction begins, these projects will be completed prior to MFFF construction (SCDOT 2000).

There is no public transportation to SRS. Rail service in the ROI is provided by the Norfolk Southern Corporation and CSX Transportation. SRS is provided rail access via Robbins Station on the CSX Transportation line.

Waterborne transportation is available via the Savannah River. Currently, the Savannah River is used primarily for recreation. SRS has no commercial docking facilities, but it has a boat ramp that has accepted large transport barge shipments.

Columbia Metropolitan Airport in the city of Columbia, South Carolina, and Augusta Regional Airport (Bush Field) in the city of Augusta, Georgia, receive jet air passenger and cargo service from both national and local carriers. Numerous smaller private airports are located in the ROI (DOE 1999c).

4.10.4 Environmental Justice

"Environmental Justice" refers to a federal policy under which federal actions should not result in disproportionately high and adverse environmental impacts on low-income or minority populations. As a general matter, a minority population is defined to exist if the percentage of minorities within a specified area exceeds the percentage of minorities in an entire state by 20%, or if the percentage of minorities within the area is at least 50%. Executive Order 12898 directs federal executive agencies to consider environmental justice under NEPA. Although it is not subject to the executive order, the NRC has voluntarily committed to undertake environmental justice reviews. The scope of DCS' review includes an analysis of impacts on low-income and minority populations.

In determining the area to review for environmental justice, guidance provided by the NRC specifies that "If a facility is located outside the city limits or in a rural area, a 4-mi (6.4-km) radius (50 mi^2 [130 km^2]) should be used. ... The goal is to evaluate the "communities," neighborhoods, or areas that may be disproportionately impacted" (NRC 1999a). The MFFF site within SRS is extremely rural, is entirely within the boundaries of the SRS property, and contains no communities, neighborhoods, or other areas that may be impacted by MOX operations. The nearest population is located more than 5 mi (8 km) from the MFFF site.

A majority of the population within a 10-mi (16-km) radius of the proposed MFFF site resides within Aiken County. Figure 4-16 shows the distribution of minority populations within a 10-mi (16-km) radius of the MFFF site. The figure is based on U.S. Census 1990 block group data. Ethnic and racial characteristics of the total population of each county that is partially located within a 10-mi (16-km) radius of the MFFF site and for the states of Georgia and South Carolina are listed in Table 4-17. Only the racial mix of Burke County is significantly different[6] from that of the state, with the black portion of the county population 29 percentage points higher than the overall black portion of Georgia's population. The portion of Burke County's population within 10 mi (16 km) of the MFFF site, however, is extremely small and over 7 mi (11.3 km) away at its closest point. The racial mix of South Carolina counties within the local area is not significantly different from that of the state as a whole.

Economically, Aiken County exceeds the state averages for per capita income and has a lower percentage of persons with incomes below the poverty threshold (e.g., $9,981 for a family of three with one related child under 18 in 1990). As shown in Table 4-20, both Barnwell and Burke Counties are somewhat below their respective state averages in per capita income and have significantly higher portions of their population with income levels below the poverty threshold. As noted above, however, the portion of Burke County's population within 10 mi (16 km) of the MFFF site is extremely small as is the case for Barnwell County and no population is located within 5 mi (8 km) of the MFFF site. Figure 4-17, based on 1990 U.S. Census block group data, shows the distribution of the population living below the poverty threshold within a 10-mi (16-km) radius of the proposed MFFF site. Additional details of the environmental justice analysis are provided in Appendix C.

4.11 CURRENT RISK FROM IONIZING RADIATION

Major sources and levels of background radiation exposure to individuals in the vicinity of SRS are shown in Table 4-23. Annual background radiation doses to individuals are expected to remain constant over time. The total dose to the population, in terms of person-rem, changes as the population size changes. Background radiation doses are unrelated to SRS operations.

Releases of radionuclides to the environment from SRS operations provide another source of radiation exposure to individuals in the vicinity of SRS. Types and quantities of radionuclides released from SRS operations in 1999 are listed in the *Savannah River Site Environmental Report for 1999* (Arnett and Mamatey 2000a).

[6] NRC (1999a) guidance states that "As a general matter (and where appropriate), staff may consider differences greater than 20 percent to be significant."

Doses to the public resulting from these releases are presented in Table 4-24. These doses fall within radiological limits prescribed by 10 CFR Part 20 (DOE 1993), and are much lower than those of background radiation.

SRS workers receive the same dose as the general public from background radiation but may also receive an additional dose from working in facilities with nuclear materials. Table 4-25 presents the average worker and cumulative worker dose to SRS workers based on the most recent published data. These doses fall within the radiological regulatory limits of 10 CFR Part 20.

4.12 EXISTING SRS INFRASTRUCTURE

Site infrastructure includes utilities and other resources to support construction and operation of the MFFF. As discussed elsewhere in the ER, one of the reasons that DOE selected the SRS F Area as the site for the surplus plutonium disposition facilities was the availability of infrastructure to support the facilities. Section 3.5.11 of the SPD EIS (DOE 1999c) discusses the current infrastructure at SRS and in F Area.

SRS uses a 115-kV system in a ring arrangement to supply power to the operations areas. Power is supplied by three transmission lines from the South Carolina Electric & Gas Company. Power for F-Area is provided by the 200-F power loop, supplied by the 251-F electrical substation. This substation consists of two 115/13.8-kV, 24/32 kVA transformers and associated switchgear. F-Area consumption averages about 63,000 MWh/yr. The F-Area capacity is about 700,000 MWh/yr (see Table 4-26). R1

SRS uses a new central domestic water system consisting of several wells and water treatment plants. System capacity is 2,950 gal/min (11,165 L/min). Current usage in F Area is 100 million gal/yr (378 million L/yr) compared to a capacity of 235 million gal/yr (890 million L/yr). R1 Additional process and service water can be provided through deep-well systems in F Area. F Area is served by four wells–with a capacity of 1,100 million gal/yr (4,163 million L/yr). R1 Current usage in F Area is 370 million gal/yr (1,401 million L/yr).

SRS does not use natural gas.

SRS also provides a fire department through three fire stations using a 12-hr rotational shift. Part of the fire department is the SRS Hazardous Materials Response Team and Rescue Team. The fire department is supported by a fleet of 20 vehicles, including six pumpers, one pumper-tanker, one tanker, and one aerial platform ladder truck.

SRS provides an integrated-site emergency response organization. The site emergency response organization provides infrastructure to support all SRS operations, South Carolina and Georgia emergency response teams, and national and international emergency response teams as necessary.

4.13 EXISTING SRS WASTE MANAGEMENT INFRASTRUCTURE

Waste management includes minimization, characterization, treatment, storage, transportation, and disposal of waste generated from ongoing DOE activities. The waste at SRS is managed according to appropriate treatment, storage, and disposal technologies and in compliance with applicable federal and state statutes and DOE Orders. SRS waste management is described in Section 3.5.2 of the SPD EIS (DOE 1999c) and presented below.

4.13.1 Overview of Waste Inventories and Activities

SRS manages the following types of waste: HLW, TRU, mixed TRU, LLW, mixed LLW, hazardous, and nonhazardous. HLW would not be generated by surplus plutonium disposition activities at SRS, and therefore, will not be discussed further. The most recent waste generation R1 rates and the inventory of stored waste from activities at SRS are provided in Table 4-27. More detailed descriptions of the waste management system capabilities at SRS are included in the S&D PEIS (DOE 1996b) and the *Savannah River Site Waste Management Final Environmental Impact Statement* (DOE 1995b).

[Text Deleted] R1

4.13.2 Transuranic and Mixed Transuranic Waste

TRU waste generated between 1974 and the present is stored on 22 storage pads in E Area. The R1 TRU waste storage pads are in the Low-Level Radioactive Waste Disposal Facility (DOE 1995b).

A TRU Waste Characterization and Certification Facility provides extensive containerized waste R1 certification capabilities. The facility prepares TRU waste for treatment and certifies TRU waste for disposal at the Waste Isolation Pilot Plant (WIPP). Drums that are certified for shipment to WIPP will be placed in interim storage on concrete pads in E Area (DOE 1996b). LLW containing concentrations of TRU nuclides between 10 and 100 nCi (referred to as alpha-contaminated LLW) is managed like TRU waste because its physical and chemical properties are similar and similar procedures will be used to determine its final disposition (DOE 1996b). WIPP began receiving waste from SRS on May 8, 2001. R1

4.13.3 Low-Level Radioactive Waste

Both liquid and solid LLW are treated at SRS. Most aqueous LLW streams are sent to the F- and H-Area Effluent Treatment Facility and treated by filtration, reverse osmosis, and ion exchange to remove the radionuclide contaminants. After treatment, the effluent is discharged to Upper Three Runs within the NPDES Permit discharge limitations.

After completion of a series of extensive readiness tests, the Consolidated Incineration Facility began radioactive operations in 1997. The Consolidated Incineration Facility is designed to incinerate both solid and liquid LLW, mixed LLW, and hazardous waste (WSRC 1997b). The

Consolidated Incineration Facility went into temporary shutdown on September 30, 2000, and is presently in suspension. R1

Solid LLW is segregated into several categories to facilitate proper treatment, storage, and disposal. Solid LLW that radiates less than 200 mrem/hr at 2 in (5.1 cm) from the unshielded container is considered low-activity waste. If it radiates greater than 200 mrem/hr at 2 in (5.1 cm), it is considered intermediate-activity waste. Intermediate-activity tritium waste is intermediate-activity waste with more than 10 Ci of tritium per container. Long-lived waste is contaminated with long-lived isotopes that exceed the WAC for onsite disposal (DOE 1996b).

Four basic types of vaults and buildings are used for storing the different waste categories: low-activity waste vaults, intermediate-level non-tritium vaults, intermediate-level tritium vaults, and the long-lived waste storage building. The vaults are below-grade concrete structures, and the storage building is a metal building on a concrete pad (DOE 1996b).

Currently, DOE places low-activity LLW in carbon steel boxes and deposits them in the low-activity waste vaults in E Area. Intermediate-activity LLW is packaged according to waste form and disposed of in the intermediate-level waste vaults in E Area. Long-lived wastes are stored in the Long-Lived Waste Storage Building in E Area until treatment and disposal technologies are developed (DOE 1995b).

Saltstone generated in the solidification of LLW salts extracted from HLW is disposed of in the Z-Area Saltstone Vaults. Saltstone is solidified grout formed by mixing the LLW salt with cement, flyash, and furnace slag. Saltstone is the highest volume of solid LLW disposed of at SRS. SRS disposal facilities are projected to meet solid LLW disposal requirements, including LLW from offsite, for the next 20 years (DOE 1996b).

4.13.4 Mixed Low-Level Radioactive Waste

The Federal Facility Compliance Agreement (FFCA) of October 6, 1992, addresses SRS R1 compliance with RCRA Land Disposal Restrictions (LDR). The FFCA requires DOE facilities storing mixed waste to develop site-specific treatment plans and to submit them for approval (DOE 1996b). The site treatment plan for mixed waste specifies treatment technologies or technology development schedules for SRS mixed waste (Arnett and Mamatey 1996). SRS is allowed to continue to generate and store mixed waste, subject to LDR. Schedules to provide compliance through treatment in the Consolidated Incineration Facility are included in the FFCA (DOE 1996b).

The SRS mixed waste program consists primarily of safe storage and characterization for R1 commercial treatment and disposal. Mixed LLW is stored in A, E, M, N, and S Areas in various tanks and buildings. These facilities include burial ground solvent tanks, the M-Area Process Waste Interim Treatment/Storage Facility, the Savannah River Technology Center Mixed Waste Storage Tanks, and the DWPF Organic Waste Storage Tank (DOE 1995b). These South Carolina Department of Health and Environmental Control permitted facilities will remain in use until appropriate treatment and disposal is performed on the waste (DOE 1996b).

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4.13.5 Hazardous Waste

Hazardous waste is accumulated at the generating facility for a maximum of 90 days, or stored in DOT-approved containers in three RCRA-permitted hazardous waste storage buildings and on three interim status storage pads in B and N Areas. Most of the waste is shipped offsite to commercial RCRA-permitted treatment and disposal facilities using DOT-certified transporters. In 1995, 2,538 ft^3 (72 m^3) of hazardous waste were sent to onsite storage. Of this amount, 712 ft^3 (20 m^3) were shipped offsite for commercial treatment or disposal (Arnett and Mamatey 1996).

4.13.6 Nonhazardous Waste

In 1994, the centralization and upgrading of the sanitary wastewater collection and treatment systems at SRS were completed. The program included the replacement of 14 of 20 aging treatment facilities scattered across the site with a new 1.1 million-gal/day (4.1 million L/day) central treatment facility and connecting them with a new 18-mi (29-km) sanitary sewer system. The central treatment facility treats sanitary wastewater by the extended aeration activated sludge process. The treatment facility separates the wastewater into two forms: clarified effluent and sludge. The liquid effluent is further treated by the nonchemical method of ultraviolet light disinfection to meet NPDES discharge limitations for the outfall to Fourmile Branch. The sludge is further treated to reduce pathogen levels to meet proposed land application criteria. The remaining sanitary wastewater treatment facilities are being upgraded as necessary by replacing existing chlorination treatment systems with nonchemical ultraviolet light disinfection systems to meet NPDES limitations (DOE 1996b).

SRS has privatized the collection, hauling, and disposal of its sanitary waste (Arnett and Mamatey 1996). SRS-generated solid sanitary waste is sent to the Three Rivers Landfill, which is located just southwest of B Area (DOE 1998b). SRS conducts a recycling program using the City of North Augusta Regional Material Recovery Facility. In 1999, in excess of 35% of the compactible sanitary waste stream was recycled (WSRC 1999b). SRS disposes of other nonhazardous waste that consists of scrap metal, powerhouse ash, domestic sewage, scrap wood, construction debris, and used railroad ties in a variety of ways. Scrap metal is sold to salvage vendors for reclamation. Powerhouse ash and domestic sewage sludge are used for land reclamation. Scrap wood is burned onsite or chipped for mulch. Construction debris is used for erosion control. Railroad ties are shipped offsite for disposal (DOE 1996b).

4.13.7 Waste Minimization

The total amount of waste generated and disposed of at SRS has been and continues to be reduced through the efforts of the pollution prevention and waste minimization program at the site. This program is designed to achieve continuous reduction of waste and pollutant releases to the maximum extent feasible and in accordance with regulatory requirements while fulfilling national security missions (DOE 1996b). The program focuses mainly on source reduction, recycling, and increasing employee participation in pollution prevention. For example, 1995 nonhazardous solid waste generation was 32% below that of 1994, and the disposal volume of other solid waste, including radioactive and hazardous wastes, was 38% below 1994 levels. In 1995, SRS achieved a 9% reduction in its radioactive waste generation volume compared with 1994. Total solid waste volumes have declined by more than 70% since 1991. Radioactive solid waste volumes have declined by about 63%, or more than 600,000 ft (182,880 m) from 1991 through 1995. In 1995, more than 3,300 tons (2,990 metric tons) of nonradioactive materials were recycled at SRS, including 1,062 tons (963 metric tons) of paper and cardboard (Arnett and Mamatey 1996). During 1999, over 90 projects were implemented by waste generators that resulted in an avoidance of approximately 88,000 ft^3 (2,492 m^3) of radioactive and hazardous waste (WSRC 1999b).

Figures

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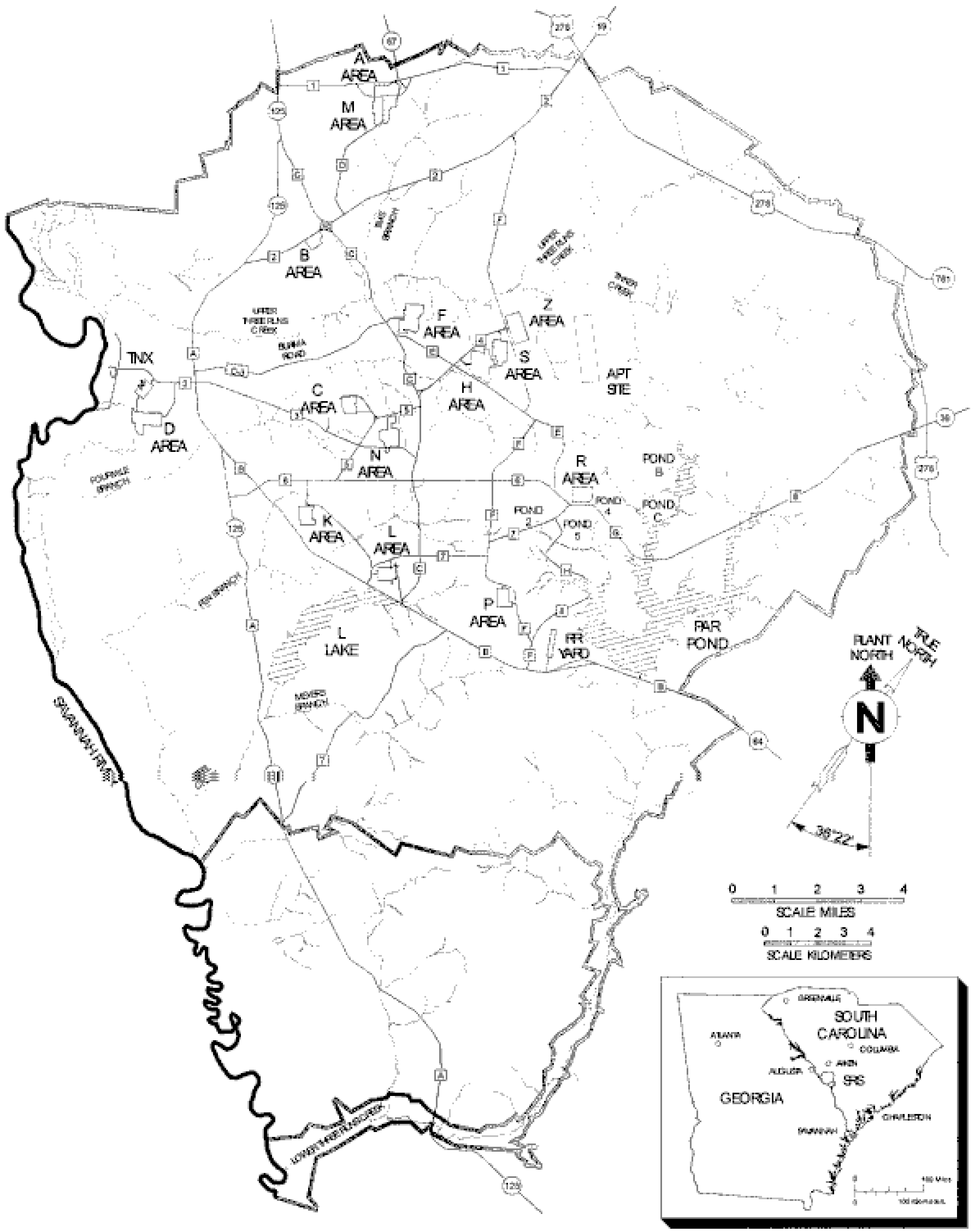

Figure 4-1. Location of the Savannah River Site

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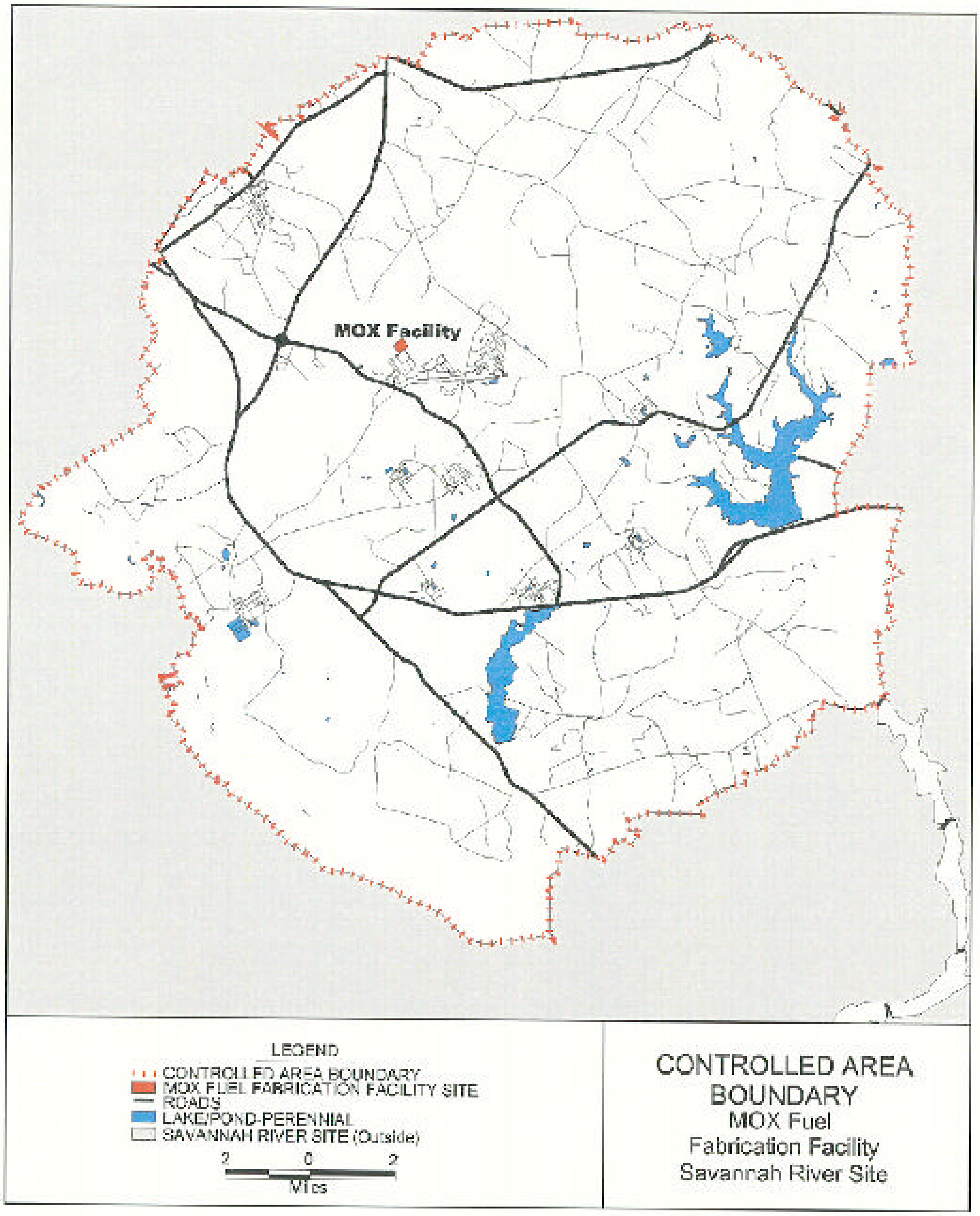

Figure 4-2. Location of F Area and Controlled Area Boundary

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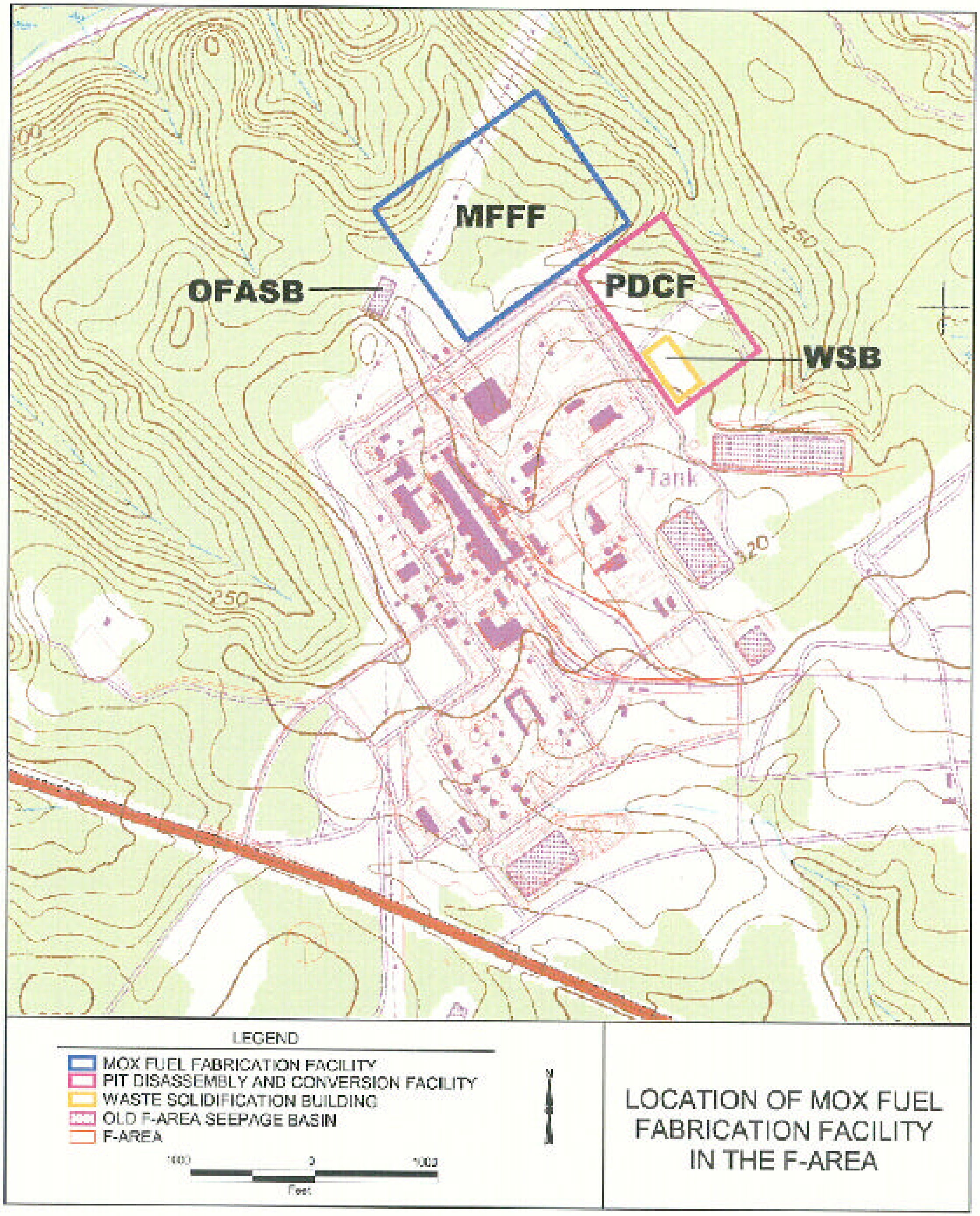

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Figure 4-3. Location of MOX Fuel Fabrication Facility in the F Area

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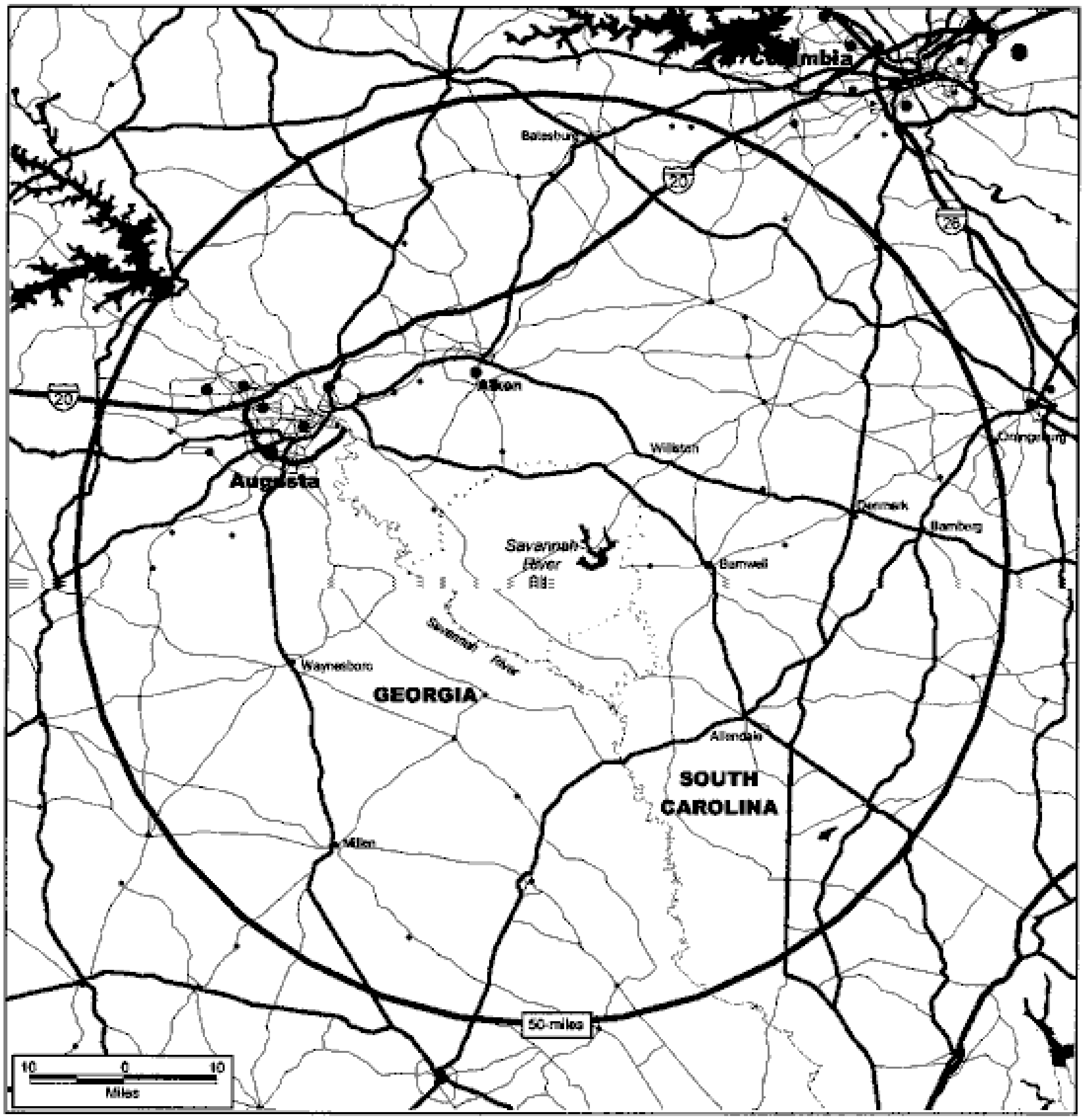

Figure 4-4. Fifty-Mile (80-km) Radius with Towns and Roads

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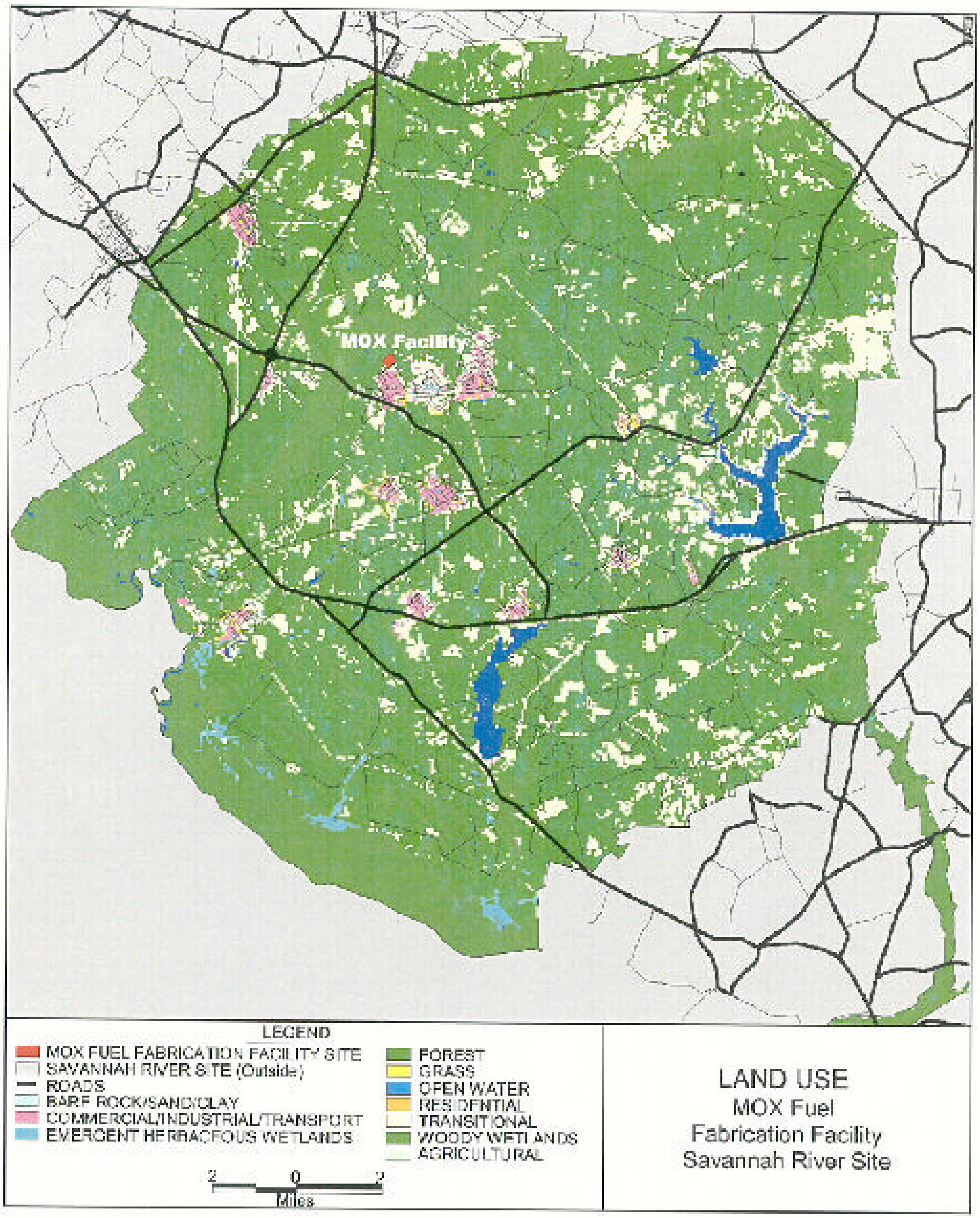

Figure 4-6. Generalized Land Use at SRS

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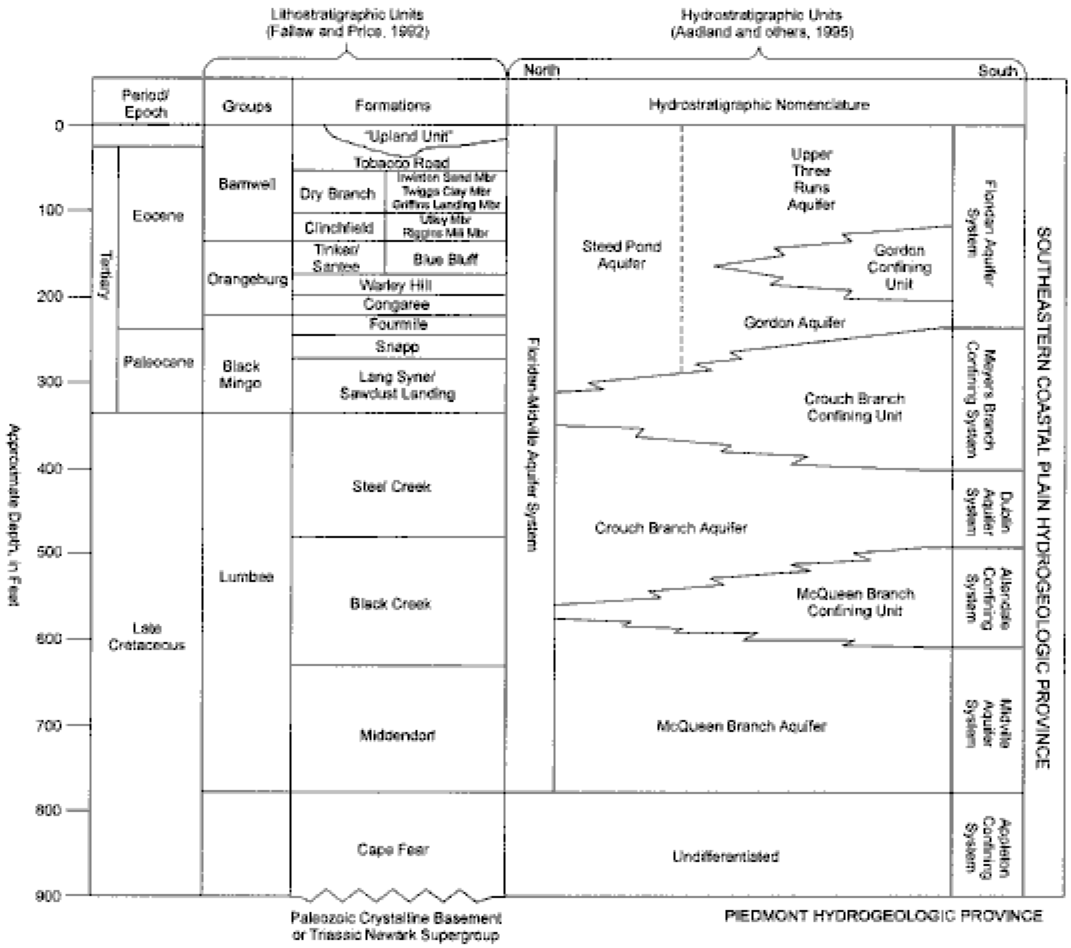

Source: SRS GSAR (WSRC 1999a)

Figure 4-7. Relationship Between the Hydro- and Lithostratigraphic Units at SRS

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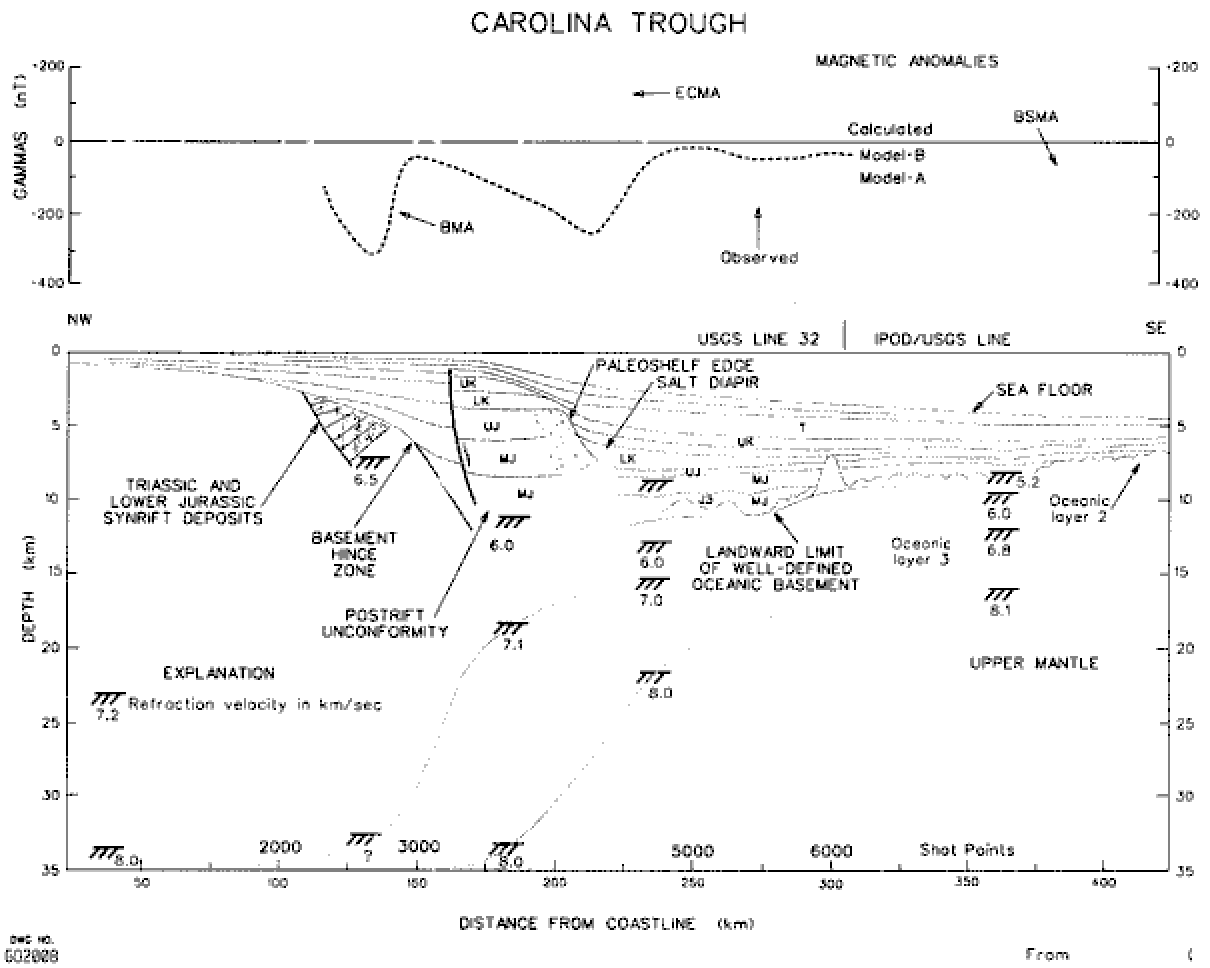

Source: SRS GSAR (WSRC 1999a)

Figure 4-8. Crustal Geometry for Offshore South Carolina and North Carolina

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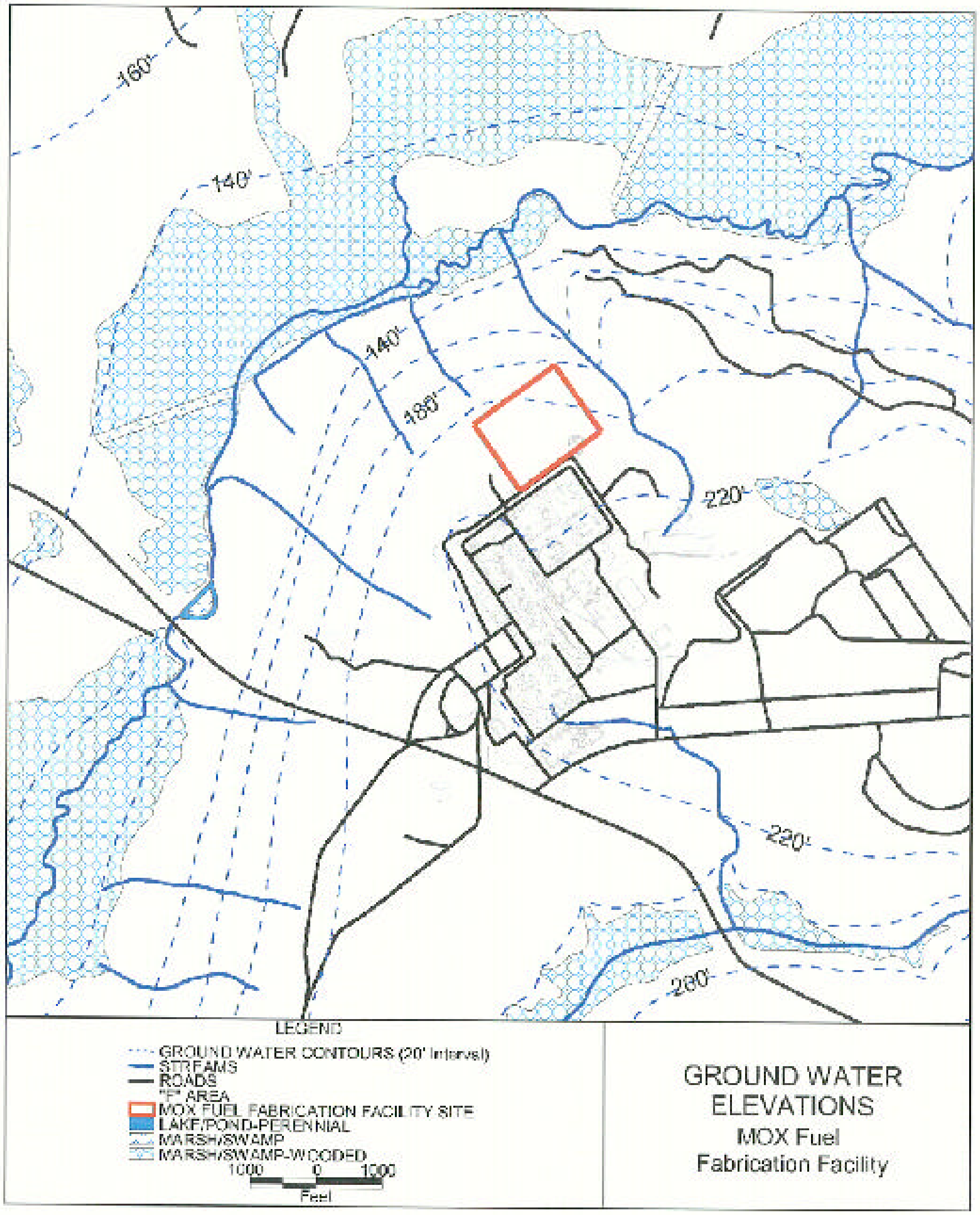

Figure 4-9. Elevation of Water Table in F Area

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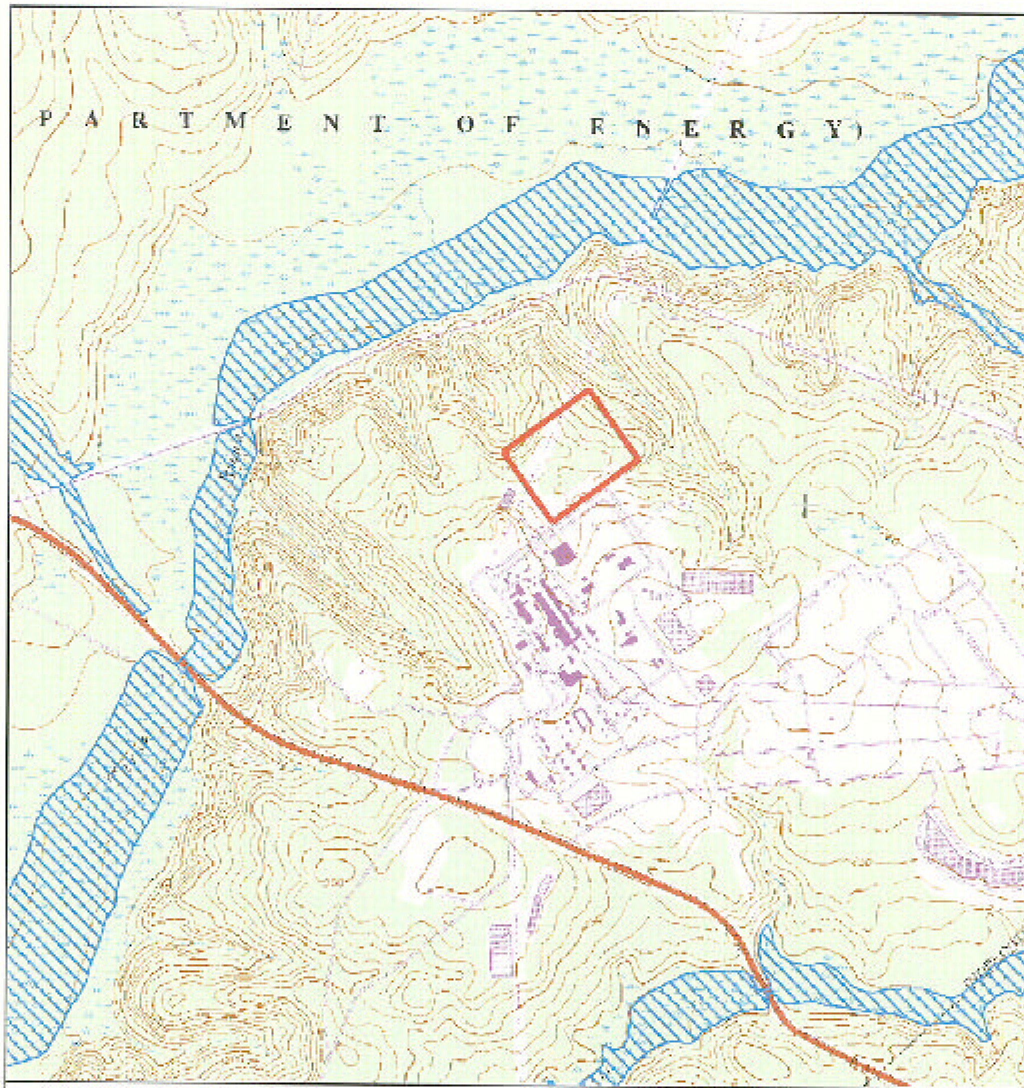

Figure 4-10. Location of 100-Year Floodplain in the Vicinity of the MOX Fuel Fabrication Facility

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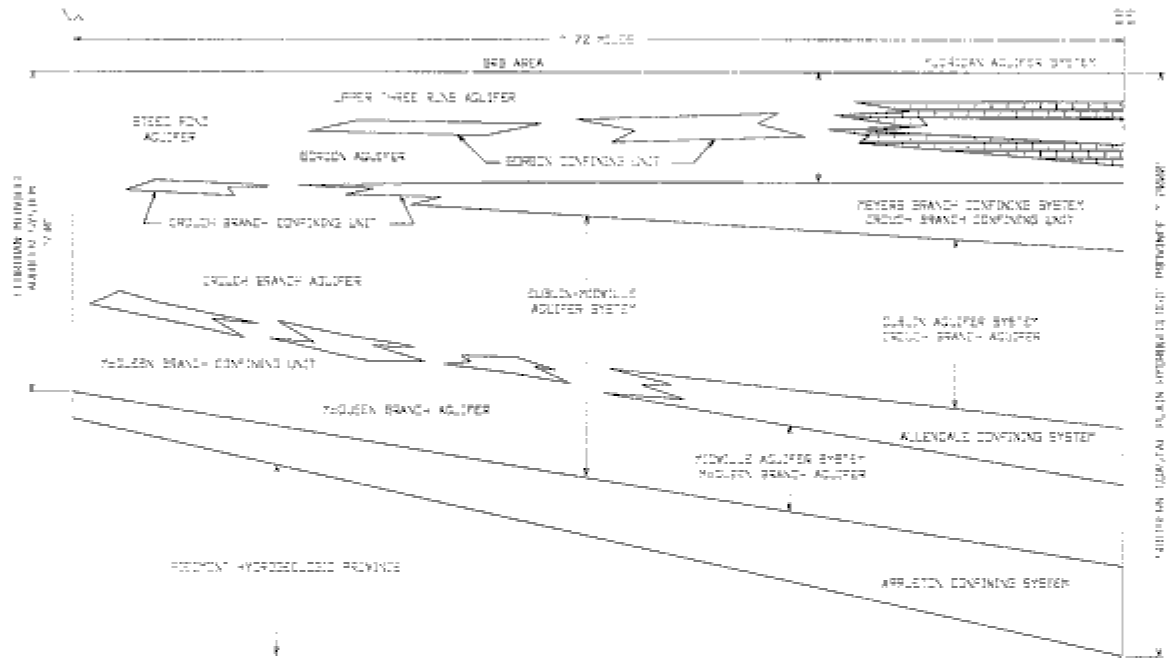

Source: SRS GSAR (WSRC 1999a)

Figure 4-11. Generalized Hydrostratigraphic Cross Section of SRS

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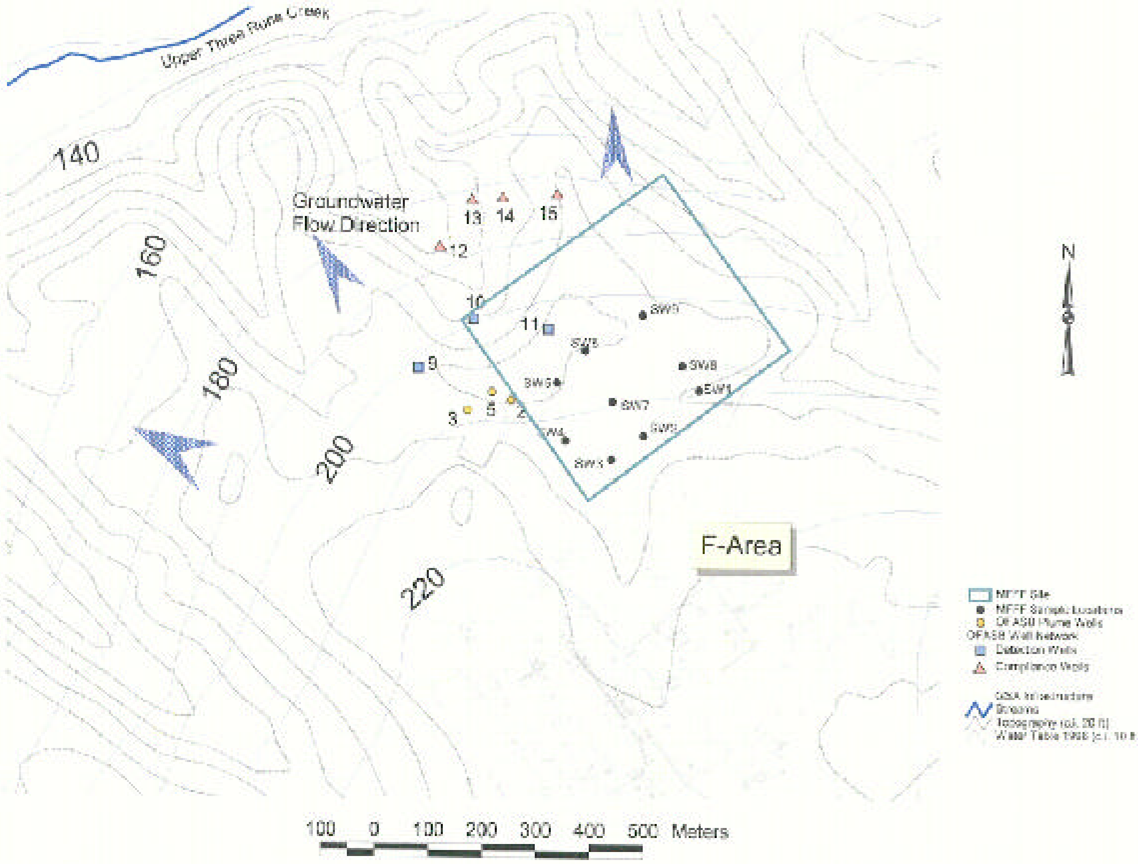

Figure 4-12. Groundwater Monitoring Network Near the OFASB R1, 2

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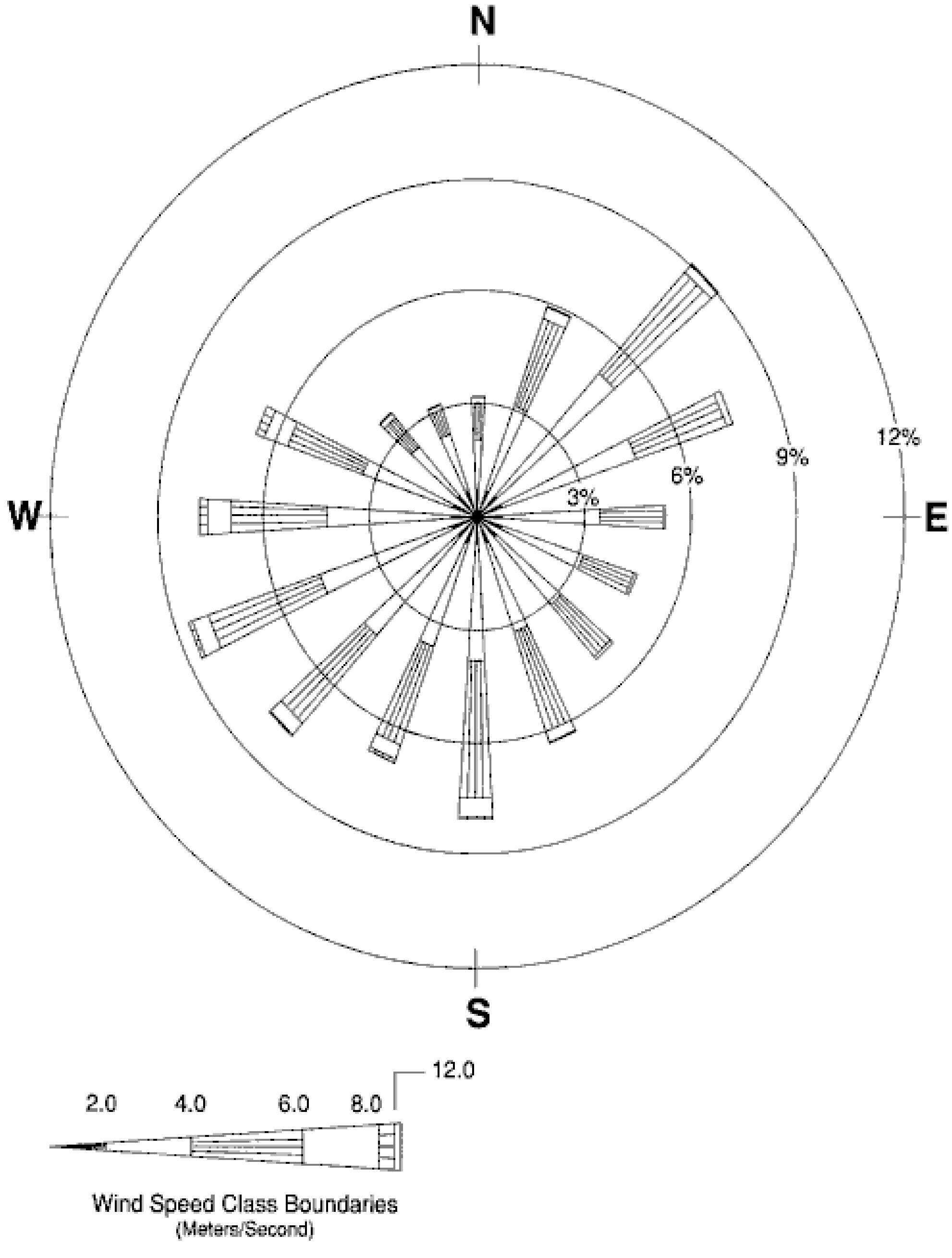

Source: SRS GSAR (WSRC 1999a)

Figure 4-13. Wind Rose Diagram for SRS

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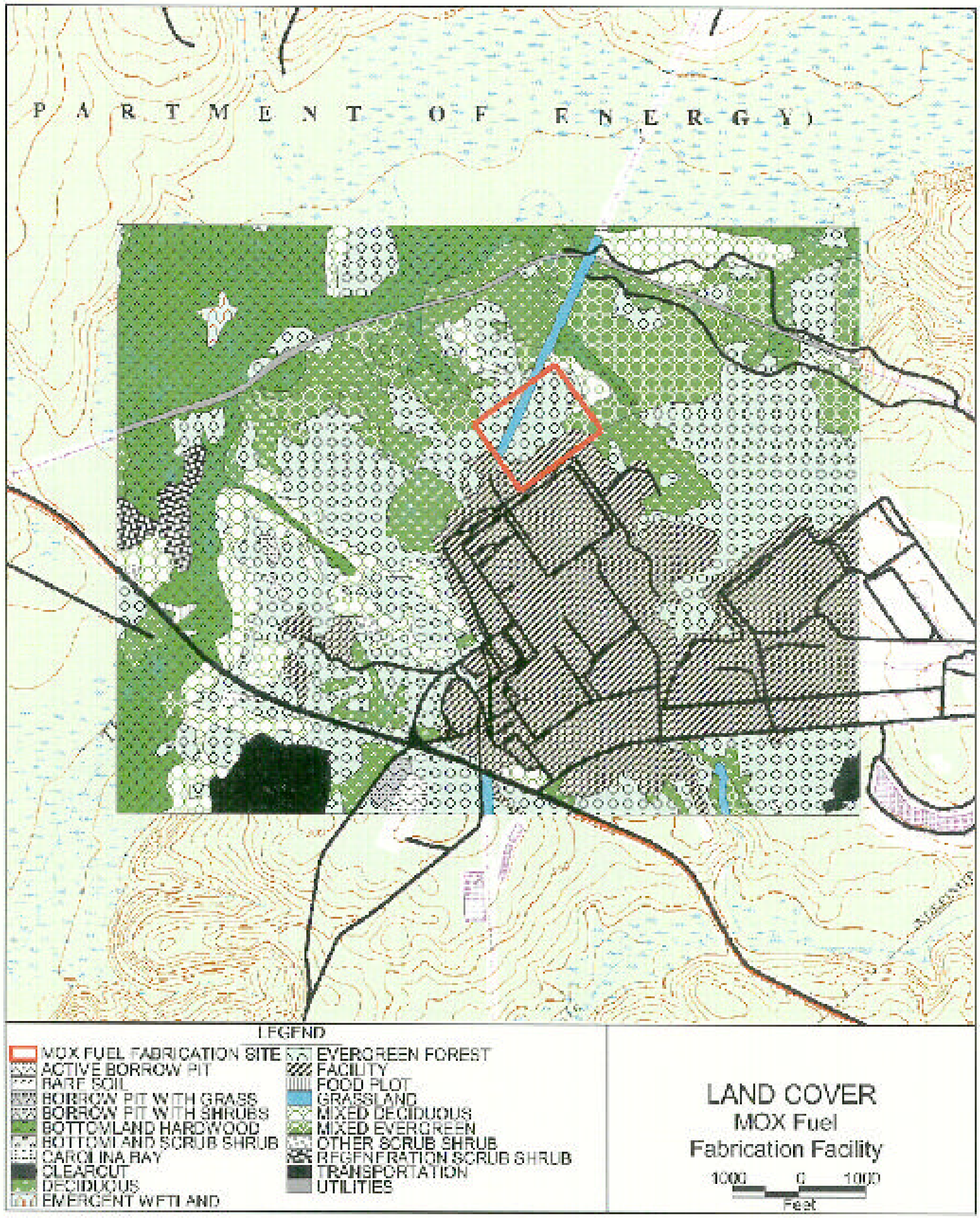

Figure 4-14. Land Cover in F Area

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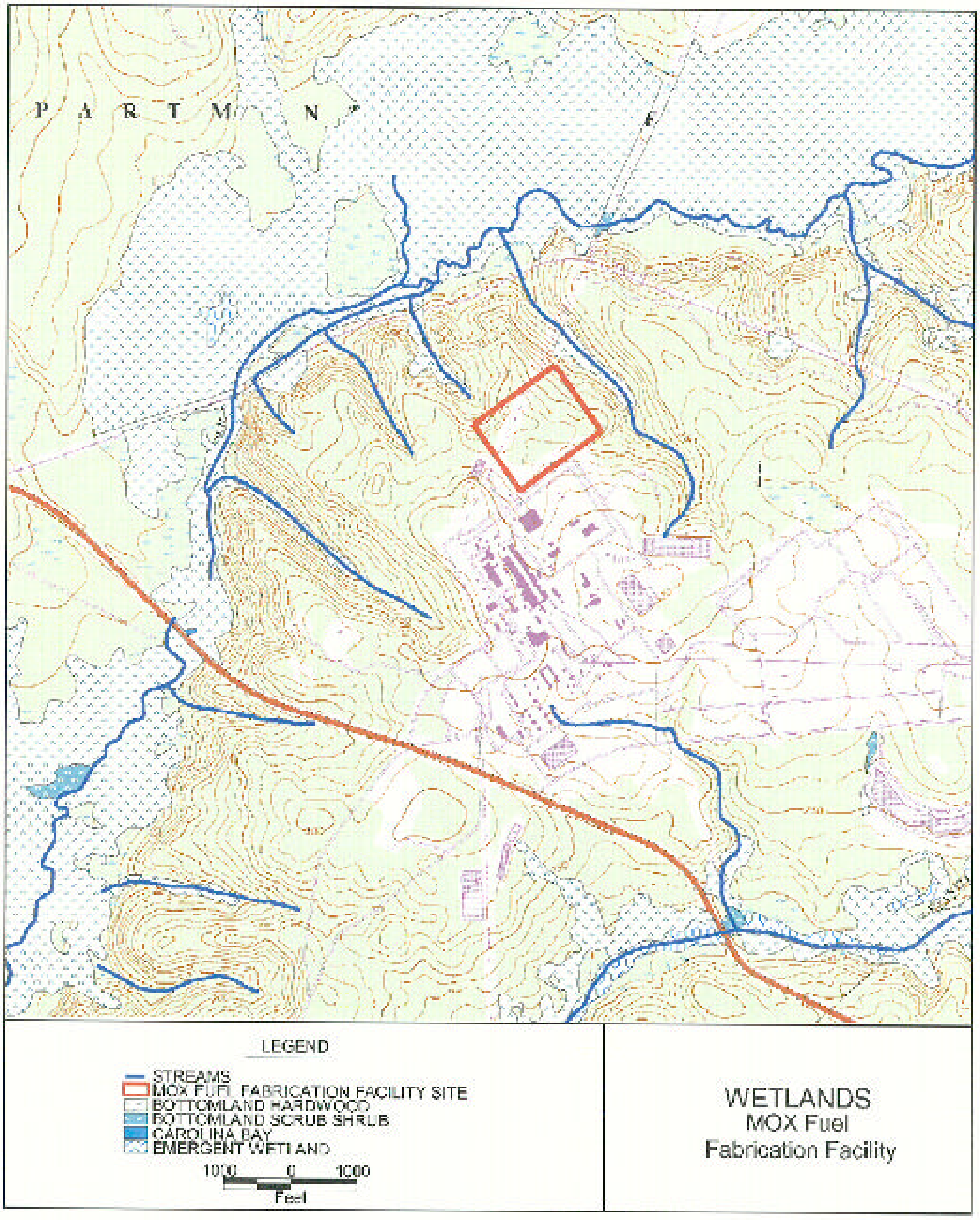

Figure 4-15. Surface Water and Wetlands in F Area

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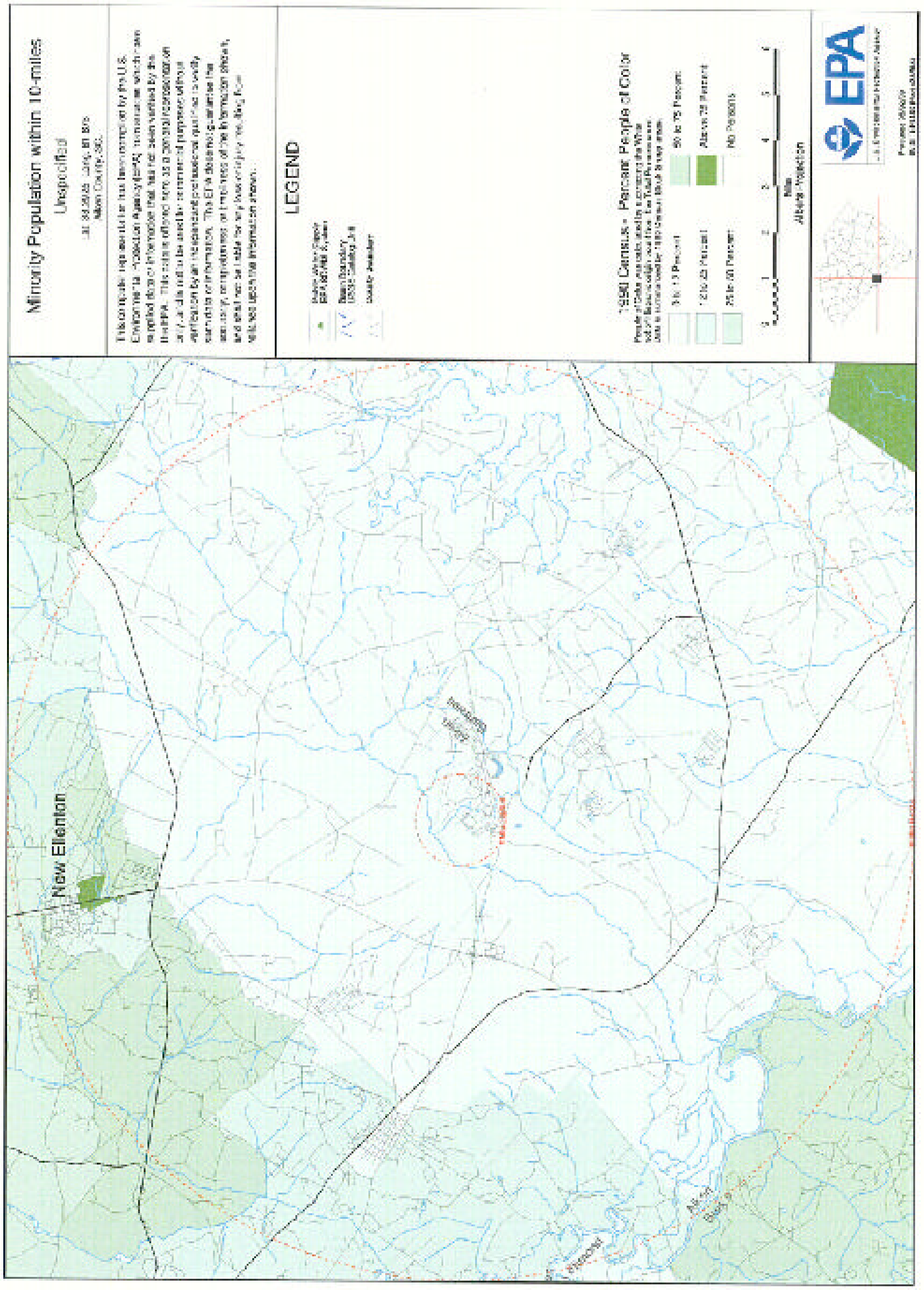

Figure 4-16. Distribution of Minority Population Within 10 Miles (16 km) of the MOX Fuel Fabrication Facility

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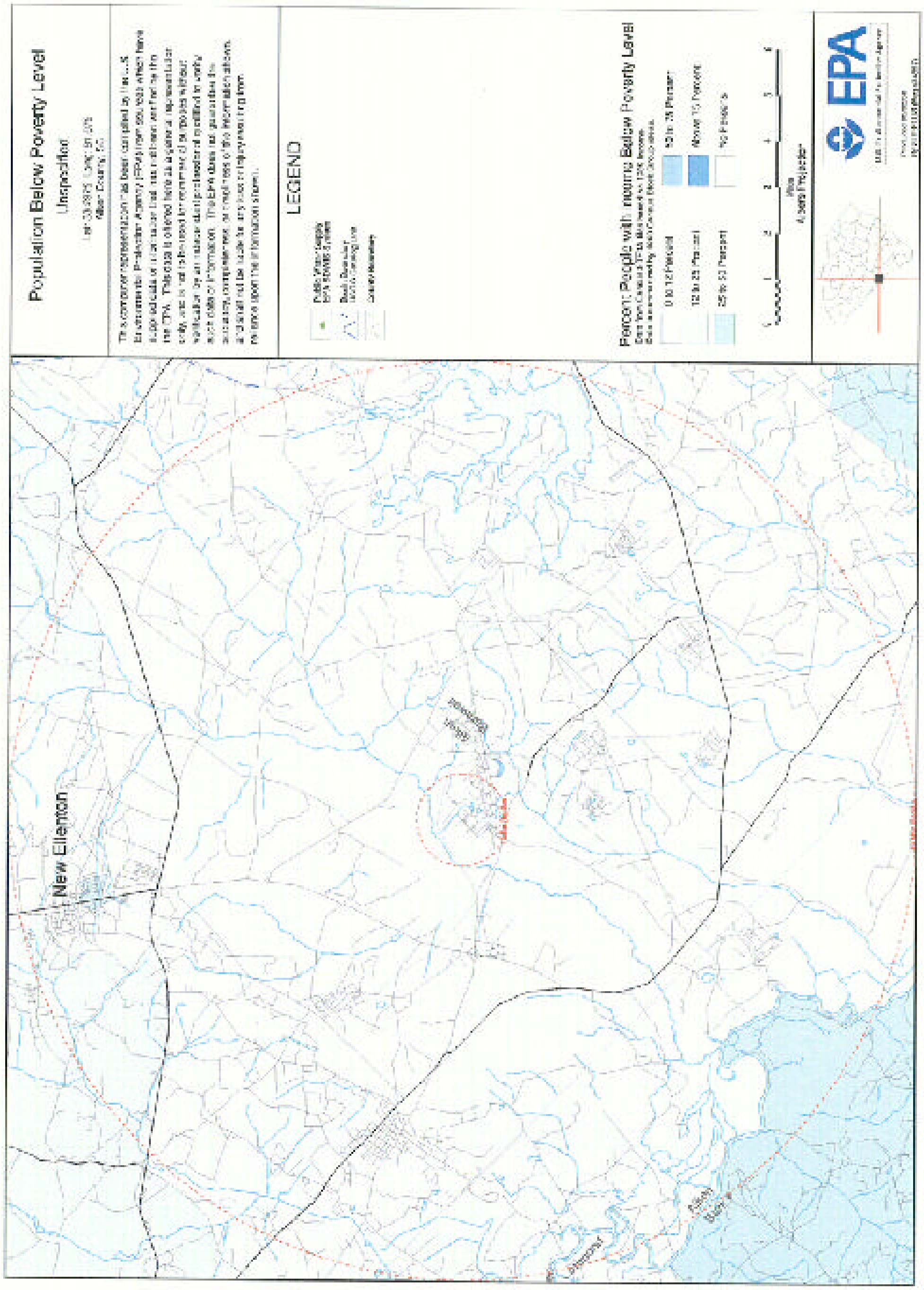

Figure 4-17. Distribution of Population Living Below the Poverty Threshold within 10 Miles (16 km) of the MOX Fuel Fabrication Facility

Tables

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Table 4-1. Annual Maximum Instantaneous Discharges of the Savannah River at Augusta, Georgia, for Water Years 1921 through 1995 (USGS Flow Data, 1922-1995)

Year	Discharges (cfs)	Year	Discharge (cfs)
1921	129,000	1959	28,500
1922	92,000	1960	34,900
1923	59,700	1961	34,800
1924	56,400	1962	32,500
1925	150,000	1963	31,300
1926	55,300	1964	87,100
1927	39,000	1965	34,600
1928	226,000	1966	39,300
1929	191,000	1967	35,900
1930	350,000	1968	35,900
1931	26,100	1969	45,600
1932	93,800	1970	25,200
1933	48,200	1971	63,900
1934	73,200	1972	33,700
1935	63,700	1973	40,200
1936	258,000	1974	32,900
1937	90,200	1975	45,600
1938	65,300	1976	33,300
1939	82,400	1977	34,200
1940	252,000	1978	43,100
1941	52,200	1979	37,300
1942	115,000	1980	47,200
1943	132,000	1981	17,300
1944	141,000	1982	30,700
1945	62,100	1983	66,100
1946	109,000	1984	34,000
1947	90,200	1985	25,700
1948	76,100	1986	21,000
1949	172,000	1987	29,200
1950	32,500	1988	13,600
1951	41,400	1989	20,200
1952	39,300	1990	35,300
1953	35,200	1991	59,200
1954	25,500	1992	22,100
1955	23,900	1993	45,100
1956	18,600	1994	40,700
1957	18,000	1995	33,600
1958	66,300		

Source: *Water Resources Data for South Carolina USGS Annual Data Reports for Water Years 1967 – 1995* (USGS 1995)

Table 4-2. Annual Maximum Instantaneous Discharges of Upper Three Runs for Water Years 1967 through 1997 R1

Water Year	Discharge at Highway 278[a] (cfs)	Discharge at SRS Road C[b] (cfs)	Discharge at SRS Road A[c] (cfs)
1967	320	-[d]	
1968	237	-	-
1969	301	-	-
1970	303	-	-
1971	420	-	-
1972	382	-	-
1973	472	-	-
1974	260	-	-
1975	341	233	-
1976	429	218	1,230
1977	304	210	717
1978	344	195	Not gauged
1979	341	220	996
1980	420	207	951
1981	308	177	620
1982	364	187	793
1983	472	200	1,010
1984	466	235	861
1985	400	186	893
1986	360	167	780
1987	370	202	869
1988	278	156	428
1989	304	172	592
1990	202	174	572
1991	820	253	Unknown
1992	742	243	926
1993	421	266	1,100
1994	302	252	
1995	412	286	1,010
1996	-	222	-
1997	-	211	-

R1

Source: USGS, 2001. *Surface Water Data for South Carolina*; 02197310 Upper Three Runs Above Road C (SRS), SC. http://water.usgs.gov/sc/nwis/annual/calendar_year.

R1

[a] Station 02197300; drainage area 87 mi^2 (225 km^2).

[b] Station 02197310; drainage area 176 mi^2 (456 km^2).

[c] Station 02197315; drainage area 203 mi^2 (526 km^2).

[d] Indicates discharge point that was not monitored.

Table 4-3. Probable Maximum Precipitation for F Area

Time (hr)	Incremental Rainfall (in)	Total Rainfall (in)
0	--	0
1	2.2	2.2
2	2.8	5.0
3	3.1	8.1
4	15.1	23.2
5	4.9	28.1
6	2.7	30.8

Source: *Probable Maximum Precipitation Estimates, United States East of the 105th Meridian,* Hydrometeorological Report No. 51 (Schreiner and Reidel 1978)

Table 4-4. MFFF Site [a] Climatological Summary -- Temperature (°F)

Month	Daily Maximum	Daily Minimum	Monthly	Record Highest	Year Occurred	Record Lowest	Year Occurred
January	55.7	32.0	43.9	84	1985	-1	1985
February	60.1	34.7	47.4	86	1962	3	1998
March	68.6	42.2	55.5	93	1995	12	1998
April	76.6	48.6	62.7	96	1986	26	1982
May	83.7	57.5	70.7	100	1964	35	1971
June	89.3	65.6	77.5	105	1952	47	1984
July	91.7	69.9	80.8	107	1980	55	1951
August	90.3	69.1	79.7	108	1983	54	1968
September	85.7	63.1	74.5	105	1999	36	1967
October	77.2	50.3	63.8	97	1954	22	1952
November	68.3	41.6	55.0	90	1961	15	1970
December	59.5	34.8	47.2	82	1998	5	1981
Year	75.6	50.8	63.2	108	1983	-1	1985

Source: *Local Climatological Data, Annual Summary with Comparative Data, 1999, Augusta, GA* (DOC 1999a) R1

[a] Taken at Bush Field, Augusta, Georgia, national weather station

Table 4-5. MFFF Site [a] Climatological Summary – Precipitation (inches)

Month	Normal Monthly	Maximum Monthly	Year Occurred	Minimum Monthly	Year Occurred	24-Hour Maximum	Year Occurred
January	4.05	8.91	1987	0.75	1981	3.61	1960
February	4.27	7.67	1961	0.69	1968	3.69	1985
March	4.65	11.92	1980	0.88	1968	5.31	1967
April	3.31	8.43	1961	0.60	1970	3.96	1955
May	3.77	9.61	1979	0.48	1951	4.44	1981
June	4.13	8.84	1989	0.68	1984	5.08	1981
July	4.24	11.43	1967	1.02	1987	3.71	1979
August	4.50	11.34	1986	0.65	1980	5.98	1964
September	3.02	9.51	1975	0.31	1984	7.30	1998
October	2.84	14.82	1990	T	1953	8.57	1990
November	2.48	7.76	1985	0.09	1960	3.82	1985
December	3.40	8.65	1981	0.32	1955	3.12	1970
Year	44.66	14.82	1990	T	1953	8.57	1990

Source: *Local Climatological Data, Annual Summary with Comparative Data, 1999, Augusta, GA* (DOC 1999a) R1

T – Trace

[a] Taken at Bush Field, Augusta, Georgia, national weather station

Table 4-6. SRS Seasonal Mixing Heights

Season	Mixing Height (meters)	
	Morning	Afternoon
Winter	1,148	3,362
Spring	1,230	5,576
Summer	1,312	5,904
Fall	984	4,592
Annual	1,230	4,756

Source: *Mixing Heights, Wind Speeds, and Potential for Urban Air Pollution Throughout the Contiguous United States* (Holzworth 1972)

Table 4-7. Percent Occurrence of Atmospheric Stability Class for SRS Meteorological Towers

Stability Class	Percent Occurrence Per Year							
	A Area	**C Area**	**D Area**	**F Area**	**H Area**	**K Area**	**L Area**	**P Area**
A	17.5	15.6	20.5	13.3	25.9	15.4	16.8	14.9
B	10.6	8.8	11.9	8.3	13.2	9.8	10.2	9.4
C	17.6	15.7	19.4	15.2	20.1	17.0	18.0	16.4
D	26.6	27.1	24.9	28.6	22.1	25.4	25.1	26.5
E	19.6	20.6	17.4	24.9	15.5	21.2	18.7	21.1
F/G	8.0	12.1	6.0	10.6	3.2	11.1	11.1	11.8

Period of record: 1992-1996.

Source: "Updated Meteorological Data for Revision 4 of the SRS Generic Safety Analysis Report" (Hunter 1999).

Table 4-8. Joint Frequency Distribution of Wind Speed, Wind Direction, and Atmospheric Stability Class for 1992-1996 SRS H-Area Meteorological Tower Data

Stability Class A Number of Hourly Observations							
Winds From	**Wind Speed (mph)**						
	1-3	**4-7**	**8-12**	**13-18**	**19-24**	**25+**	**Total**
N	109	385	452	91	5	0	1,042
NNE	86	320	290	79	2	0	777
NE	105	404	231	15	0	0	755
ENE	106	454	220	14	0	0	794
E	93	463	195	5	0	0	756
ESE	78	345	130	9	1	0	563
SE	65	306	113	10	0	0	494
SSE	80	242	87	4	0	0	413
S	74	324	163	10	0	0	571
SSW	76	341	189	16	1	0	623
SW	94	493	263	24	0	0	874
WSW	96	599	305	43	3	0	1,046
W	78	521	310	38	7	1	955
WNW	80	361	210	50	7	0	708
NW	68	246	105	15	0	0	434
NNW	92	251	160	40	3	1	547
TOTAL	1,380	6,055	3,423	463	29	2	11,352

Note: Total number of observations used for the 1992 to 1996 period = 43,848

Table 4-8. Joint Frequency Distribution of Wind Speed, Wind Direction, and Atmospheric Stability Class for 1992-1996 SRS H-Area Meteorological Tower Data (continued)

Stability Class B Number of Hourly Observations							
Winds From	**Wind Speed (mph)**						
	1-3	**4-7**	**8-12**	**13-18**	**19-24**	**25+**	**Total**
N	9	104	94	7	0	0	214
NNE	13	160	251	75	4	0	503
NE	13	187	283	54	0	0	537
ENE	12	191	292	19	0	0	514
E	5	154	142	18	0	0	319
ESE	2	111	103	11	0	0	227
SE	1	82	71	20	0	0	174
SSE	5	92	82	19	1	0	199
S	5	114	137	16	0	0	272
SSW	6	107	145	39	1	0	298
SW	11	147	242	78	7	0	485
WSW	15	165	331	137	14	1	663
W	2	127	240	202	34	0	605
WNW	12	109	159	151	28	2	461
NW	13	69	68	40	6	0	196
NNW	8	72	77	13	1	0	171
TOTAL	132	1,991	2,717	899	96	3	5,838

Note: Total number of observations used for the 1992 to 1996 period = 43,848

Table 4-8. Joint Frequency Distribution of Wind Speed, Wind Direction, and Atmospheric Stability Class for 1992-1996 SRS H-Area Meteorological Tower Data (continued)

Stability Class C Number of Hourly Observations							
Winds From	**Wind Speed (mph)**						
	1-3	**4-7**	**8-12**	**13-18**	**19-24**	**25+**	**Total**
N	8	66	70	1	0	0	145
NNE	5	172	301	81	3	0	562
NE	4	322	655	203	1	0	1,185
ENE	8	218	376	90	2	0	694
E	5	173	292	37	3	0	510
ESE	4	104	194	38	0	0	340
SE	9	105	184	72	5	0	375
SSE	11	129	184	98	16	1	439
S	13	145	229	86	17	1	491
SSW	4	157	254	126	23	1	565
SW	6	187	326	179	23	0	721
WSW	5	213	341	203	35	1	798
W	4	148	340	321	78	3	894
WNW	7	124	248	270	45	3	697
NW	6	99	119	59	7	0	290
NNW	6	77	62	4	1	0	150
TOTAL	105	2,439	4,175	1,868	259	10	8,856

Note: Total number of observations used for the 1992 to 1996 period = 43,848

Table 4-8. Joint Frequency Distribution of Wind Speed, Wind Direction, and Atmospheric Stability Class for 1992-1996 SRS H-Area Meteorological Tower Data (continued)

Stability Class D Number of Hourly Observations							
Winds From	**Wind Speed (mph)**						
	1-3	**4-7**	**8-12**	**13-18**	**19-24**	**25+**	**Total**
N	4	38	54	0	1	0	97
NNE	10	109	228	40	0	0	387
NE	0	257	718	82	2	0	1,059
ENE	7	151	417	36	0	0	611
E	9	136	354	24	0	0	523
ESE	5	118	307	25	0	0	455
SE	6	147	368	55	1	0	577
SSE	7	163	491	203	14	0	878
S	7	182	648	190	10	0	1,037
SSW	10	170	459	106	9	0	754
SW	7	166	554	105	6	0	838
WSW	6	146	558	53	1	0	764
W	3	133	444	55	10	12	657
WNW	3	98	384	48	2	2	537
NW	5	114	218	31	0	0	368
NNW	11	92	86	2	0	0	191
TOTAL	100	2,220	6,288	1,055	56	14	9,733

Note: Total number of observations used for the 1992 to 1996 period = 43,848

Table 4-8. Joint Frequency Distribution of Wind Speed, Wind Direction, and Atmospheric Stability Class for 1992-1996 SRS H-Area Meteorological Tower Data (continued)

Stability Class E Number of Hourly Observations							
Winds From	**Wind Speed (mph)**						
	1-3	**4-7**	**8-12**	**13-18**	**19-24**	**25+**	**Total**
N	0	4	28	2	0	0	34
NNE	0	40	281	40	0	0	361
NE	2	123	474	27	0	0	626
ENE	0	48	355	40	1	0	444
E	0	34	274	29	0	0	337
ESE	0	70	272	24	0	0	366
SE	2	75	358	20	0	0	455
SSE	2	80	431	41	0	0	554
S	3	112	525	57	0	0	697
SSW	3	98	481	42	0	0	624
SW	1	84	466	85	0	0	636
WSW	0	88	489	30	2	0	609
W	2	58	276	8	6	0	350
WNW	0	59	205	7	1	0	272
NW	0	50	183	3	0	0	236
NNW	0	59	106	0	0	0	165
TOTAL	15	1,082	5,204	455	10	0	6,766

Note: Total number of observations used for the 1992 to 1996 period = 43,848

Table 4-8. Joint Frequency Distribution of Wind Speed, Wind Direction, and Atmospheric Stability Class for 1992-1996 SRS H-Area Meteorological Tower Data (continued)

Stability Class F Number of Hourly Observations							
Winds	**Wind Speed (mph)**						
From	**1-3**	**4-7**	**8-12**	**13-18**	**19-24**	**25+**	**Total**
N	0	3	10	0	0	0	13
NNE	0	8	98	16	0	0	122
NE	0	10	82	10	0	0	102
ENE	0	5	32	12	0	0	49
E	0	2	44	5	0	0	51
ESE	0	12	68	14	0	0	94
SE	0	9	80	7	0	0	96
SSE	0	11	74	6	0	0	91
S	0	15	96	6	0	0	117
SSW	0	14	71	5	0	0	90
SW	0	10	93	11	0	0	114
WSW	1	21	120	10	0	0	152
W	0	1	29	6	0	0	36
WNW	0	5	28	0	0	0	33
NW	0	8	20	2	0	0	30
NNW	0	16	26	1	0	0	43
TOTAL	1	150	971	111	0	0	1,233

Note: Total number of observations used for the 1992 to 1996 period = 43,848

Table 4-8. Joint Frequency Distribution of Wind Speed, Wind Direction, and Atmospheric Stability Class for 1992-1996 SRS H-Area Meteorological Tower Data (continued)

Stability Class G Number of Hourly Observations							
Winds From	**Wind Speed (mph)**						
	1-3	**4-7**	**8-12**	**13-18**	**19-24**	**25+**	**Total**
N	0	0	1	0	0	0	1
NNE	0	2	7	0	0	0	9
NE	0	0	5	0	0	0	5
ENE	0	0	0	1	0	0	1
E	0	0	1	0	0	0	1
ESE	0	0	6	1	0	0	7
SE	0	0	5	2	0	0	7
SSE	0	0	5	0	0	0	5
S	0	0	8	0	0	0	8
SSW	0	0	5	2	0	0	7
SW	0	1	3	0	0	0	4
WSW	0	0	8	0	0	0	8
W	0	1	0	1	0	0	2
WNW	0	0	1	0	0	0	1
NW	0	0	1	0	0	0	1
NNW	0	2	1	0	0	0	3
TOTAL	0	6	57	7	0	0	70

Note: Total number of observations used for the 1992 to 1996 period = 43,848

Table 4-9. Fujita Tornado Intensity Scale

	Classification	Wind Speed (Mph)	Description of Damage
F0	Gale Tornado	40 - 72	Light damage. Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages sign boards.
F1	Moderate Tornado	73 - 112	Moderate damage. The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.
F2	Significant Tornado	113 - 157	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light-object missiles generated.
F3	Severe Tornado	158 - 206	Severe damage. Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted; heavy cars lifted off ground and thrown.
F4	Devastating Tornado	207 - 260	Devastating damage. Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.
F5	Incredible Tornado	261 - 318	Incredible damage. Strong frame houses lifted off foundation and carried considerable distances to disintegrate; automobile-sized missiles fly through the air in excess of 100 meters; trees debarked; steel-reinforced concrete structures badly damaged.
F6	Inconceivable Tornado	319 - 379	These winds are very unlikely. The small area of damage they might produce would probably not be recognizable along with the mess produced by the F4 and F5 wind that would surround the F6 winds. Missiles, such as cars and refrigerators, would do serious secondary damage that could not be directly identified as F6 damage. If this level is ever achieved, evidence for it might only be found in some manner of ground swirl pattern, for it may never be identifiable through engineering studies.

Table 4-10. Comparison of Ambient Air Concentrations from SRS Sources With Most Stringent Applicable Standards or Guidelines, 1994

Pollutant	Averaging Period	Most Stringent Standard or Guideline[a] (µg/m³)	Concentration (µg/m³)
Criteria pollutants			
Carbon monoxide	8 hours	10,000[b]	632
	1 hour	40,000[b]	5,010
Nitrogen dioxide	Annual	100[b]	8.8
Ozone	8 hours	157[c]	(d)
PM_{10}	Annual	50[b]	4.8
	24 hours	150[b]	80.6
$PM_{2.5}$	3-year annual	15[c]	(e)
	24 hours (98th percentile over 3 years)	65[c]	(e)
Sulfur dioxide	Annual	80[b]	16.3
	24 hours	365[b]	215
	3 hours	1,300[b]	690
Lead	Calendar quarter	1.5[b]	<0.01
Other regulated pollutants			
Gaseous fluoride	30 days	0.8[f]	(g)
	7 days	1.6[f]	0.11
	24 hours	2.9[f]	0.60
	12 hours	3.7[f]	241
Total suspended particulates	Annual	75[f]	43.3

PM – particulate matter

Table 4-10. Comparison of Ambient Air Concentrations from SRS Sources With Most Stringent Applicable Standards or Guidelines, 1994 (continued)

Notes:

[a] The more stringent of the federal and state standards is presented if both exist for the averaging period. The National Ambient Air Quality Standards (NAAQS) (40 CFR Part 50), other than those for ozone, particulate matter, and lead, and those based on annual averages, are not to be exceeded more than once per year. The 1-hr ozone standard is attained when the expected number of days per year with maximum hourly average concentrations above the standard is 1. The 1-hr ozone standard applies only to non-attainment areas. The 8-hr ozone standard is attained when the 3-year average of the annual fourth-highest daily maximum 8-hr average concentration is less than or equal to 157 $\mu g/m^3$. The 24-hr particulate matter standard is attained when the expected number of days with a 24-hr average concentration above the standards is 1. The annual arithmetic mean particulate matter standard is attained when the expected annual arithmetic mean concentration is less than or equal to the standard.

[b] Federal and state standard.

[c] Federal standard.

[d] Not directly emitted or monitored by the site.

[e] No data are available with which to assess $PM_{2.5}$ concentrations.

[f] State standard.

[g] No concentration reported.

Note: The NAAQS also includes standards for lead. No sources of lead emissions have been identified for any of the alternatives presented in Chapter 4. Emissions of other air pollutants not listed here have been identified at SRS but are not associated with any of the alternatives evaluated. These other air pollutants are quantified in the S&D PEIS (DOE 1996b). EPA recently revised the ambient air quality standards for particulate matter and ozone. The new standards, finalized on July 18, 1997, changed the ozone primary and secondary standards from a 1-hr concentration of 235 $\mu g/m^3$ (0.12 ppm) to an 8-hr concentration of 157 $\mu g/m^3$ (0.08 ppm). During a transition period while states are developing state implementation plan revisions for attaining and maintaining these standards, the 1-hr ozone standard will continue to apply in non-attainment areas (EPA 1997a). The 8-hr standard cannot be enforced at this time due to legal challenges. For particulate matter, the current annual standard is retained, and two PM standards are added. These standards are set at a 15-$\mu g/m^3$ 3-year annual arithmetic mean based on community-oriented monitors and a 65-$\mu g/m^3$ 3-year average of the 98th percentile of 24-hr concentrations at population-oriented monitors. The revised 24-hr standard is based on the 99th percentile of 24-hr concentrations. The existing standards will continue to apply in the interim period (EPA 1997b). Values may differ from those of the source document due to rounding.

Source: DOE 1998a, 1998b; 40 CFR Part 50; SCDHEC 1999a.

Table 4-11. Threatened or Endangered Species Potentially Occurring in the Vicinity of F Area

Common Name	Scientific Name	Federal Status	State Status
Birds			
Bald eagle	*Haliaeetus leucocephalus*	Threatened	Endangered
Red-cockaded woodpecker	*Picoides borealis*	Endangered	Endangered
Wood stork	*Mycteria americana*	Endangered	Endangered
Plants			
Oconee azalea	*Rhododendron flammeum*	Not listed	Species of Concern
Smooth purple coneflower	*Echinacea laevigata*	Endangered	Endangered
Reptiles			
American alligator	*Alligator mississippiensis*	Considered Threatened (S/A)[a]	Not listed

[a] Protected under the Similarity of Appearance Provision of the Endangered Species Act.

Source: "Threatened and Endangered Species at SRS" (Osteen 2000)

Table 4-12. Population Distribution – 1990

	5 to 10 mi (3 to 16 km)	10 to 20 mi (16 to 32 km)	20 to 30 mi (32 to 48 km)	30 to 40 mi (48 to 64 km)	40 to 50 mi (64 to 80 km)	TOTAL
N	2,072	21,439	9,195	6,687	10,462	49,855
NNE	235	1,782	2,081	4,100	17,085	25,283
NE	8	1,545	2,730	5,240	11,442	20,965
ENE	0	3,277	4,657	5,189	31,845	44,968
E	1	4,773	5,086	10,908	5,512	26,280
ESE	8	2,166	2,577	2,839	2,891	10,481
SE	0	563	4,543	6,387	10,432	21,925
SSE	0	364	683	1,046	2,507	4,600
S	0	545	1,596	6,730	3,560	12,431
SSW	99	780	2,186	4,805	2,591	10,461
SW	110	1,171	4,578	2,093	2,711	10,663
WSW	101	1,523	4,472	2,586	6,149	14,831
W	241	6,031	10,519	8,946	6,959	32,696
WNW	1,380	5,066	129,791	32,475	14,790	183,502
NW	1,102	15,212	81,259	9,385	3,296	110,254
NNW	1,171	19,728	11,205	6,884	3,344	42,332
TOTAL	6,528	85,965	277,158	116,300	135,576	621,527

Source: SRS GSAR (WSRC 1999a)

Table 4-13. Projected Population Distribution – 2000

	5 to 10 mi (3 to 16 km)	10 to 20 mi (16 to 32 km)	20 to 30 mi (32 to 48 km)	30 to 40 mi (48 to 64 km)	40 to 50 mi (64 to 80 km)	TOTAL
N	2,362	24,440	10,482	7,623	11,927	56,834
NNE	268	2,031	2,372	4,674	19,477	28,822
NE	9	1,761	3,112	5,974	13,044	23,900
ENE	0	3,736	5,309	5,915	36,303	51,263
E	1	5,441	5,798	12,435	6,284	29,959
ESE	9	2,469	2,938	3,236	3,296	11,948
SE	0	642	5,179	7,281	11,892	24,994
SSE	0	415	779	1,192	2,858	5,244
S	0	621	1,819	7,672	4,058	14,170
SSW	10	889	2,492	5,478	2,954	11,823
SW	125	1,335	5,219	2,386	3,091	12,156
WSW	115	1,736	5,098	2,948	7,010	16,907
W	275	6,875	11,992	10,198	7,933	37,273
WNW	1,573	5,775	147,962	37,022	16,861	209,193
NW	1,256	17,342	92,635	10,699	3,757	125,689
NNW	1,335	22,490	12,774	7,848	3,812	48,259
TOTAL	7,338	97,998	315,960	132,581	154,557	708,434

Source: SRS GSAR (WSRC 1999a)

Table 4-14. Projected Population Distribution – 2010

	5 to 10 mi (3 to 16 km)	10 to 20 mi (16 to 32 km)	20 to 30 mi (32 to 48 km)	30 to 40 mi (48 to 64 km)	40 to 50 mi (64 to 80 km)	TOTAL
N	2,693	27,862	11,950	8,690	13,596	64,791
NNE	305	2,316	2,704	5,328	22,204	32,857
NE	10	2,008	3,548	6,810	14,870	27,246
ENE	0	4,259	6,052	6,744	41,386	58,441
E	1	6,203	6,610	14,176	7,163	34,153
ESE	10	2,815	3,349	3,690	3,757	13,621
SE	0	732	5,904	8,301	13,557	28,494
SSE	0	473	888	1,359	3,258	5,978
S	0	708	2,074	8,746	4,627	16,155
SSW	12	1,014	2,841	6,245	3,367	13,479
SW	143	1,522	5,950	2,720	3,523	13,858
WSW	131	1,979	5,812	3,361	7,991	19,274
W	313	7,838	13,670	11,626	9,044	42,491
WNW	1,793	6,584	168,676	42,205	19,221	238,479
NW	1,432	19,770	105,604	12,197	4,283	143,286
NNW	1,522	25,639	14,562	8,946	4,346	55,015
TOTAL	8,365	111,722	360,194	151,144	176,193	807,618

Source: SRS GSAR (WSRC 1999a)

Table 4-15. Projected Population Distribution – 2020

	5 to 10 mi (3 to 16 km)	10 to 20 mi (16 to 32 km)	20 to 30 mi (32 to 48 km)	30 to 40 mi (48 to 64 km)	40 to 50 mi (64 to 80 km)	TOTAL
N	3,070	31,763	13,623	9,907	15,500	73,863
NNE	348	3,640	3,083	6,074	25,312	38,457
NE	12	2,289	4,045	7,763	16,952	31,061
ENE	0	4,855	6,900	7,688	47,180	66,623
E	1	7,071	7,535	16,161	8,166	38,934
ESE	12	3,209	3,818	4,206	4,283	15,528
SE	0	834	6,731	9,463	15,455	32,483
SSE	0	539	1,012	1,550	3,714	6,815
S	0	807	2,365	9,971	5,274	18,417
SSW	13	1,156	3,239	7,119	3,839	15,366
SW	163	1,735	6,783	3,101	4,016	15,798
WSW	150	2,256	6,625	3,831	9,110	21,972
W	357	8,935	15,584	13,254	10,310	48,440
WNW	2,045	7,506	192,291	48,113	21,912	271,867
NW	1,633	22,537	120,389	13,904	4,883	163,346
NNW	1,735	29,228	16,601	10,199	4,954	62,717
TOTAL	9,539	128,360	410,624	172,304	200,860	921,687

Source: SRS GSAR (WSRC 1999a)

Table 4-16. Projected Population Distribution – 2030

	5 to 10 mi (3 to 16 km)	10 to 20 mi (16 to 32 km)	20 to 30 mi (32 to 48 km)	30 to 40 mi (48 to 64 km)	40 to 50 mi (64 to 80 km)	TOTAL
N	3,500	36,210	15,530	11,294	17,670	84,204
NNE	397	3,010	3,515	6,925	28,857	42,704
NE	14	2,609	4,611	8,850	19,325	35,409
ENE	0	5,535	7,865	8,764	53,785	75,949
E	2	8,061	8,590	18,423	9,310	44,386
ESE	14	3,658	4,352	5,466	488	13,978
SE	0	951	7,673	7,409	17,619	33,652
SSE	0	615	1,154	1,767	4,234	7,770
S	0	920	2,696	11,367	6,013	20,996
SSW	15	1,317	3,692	8,115	4,376	17,515
SW	186	1,978	7,732	3,535	4,579	18,010
WSW	171	2,572	7,553	4,368	10,385	25,049
W	407	10,186	17,766	15,109	11,753	55,221
WNW	2,331	8,556	219,212	54,849	24,980	309,928
NW	1,861	25,692	137,243	15,851	5,567	186,214
NNW	1,978	33,320	18,925	11,627	5,648	71,498
TOTAL	10,876	145,190	468,109	193,719	224,589	1,042,483

Source: SRS GSAR (WSRC 1999a)

Table 4-17. Racial and Ethnic Mix of Local Area Population, 1997 (Estimated)

	Aiken County, SC	**Barnwell County, SC**	**Burke County, GA**	**Georgia**	**South Carolina**
Total Population	133,980	21,830	22,725	6,478,216	3,486,703
White	74.3%	56.0%	43.8%	71.0%	69.0%
Black	24.9%	43.7%	56.0%	26.9%	29.8%
American Indian, Eskimo or Aleut	0.2%	0.2%	0.1%	0.2%	0.3%
Asian or Pacific Islander	0.6%	0.1%	0.2%	1.1%	0.6%
Hispanic (any race)	1.0%	0.8%	0.5%	0.6%	0.3%

Source: *USA Counties™ 1998, General Profile* (DOC 1998a)

Table 4-18. Public School Population within 10 Miles (16 km) of the MFFF

School	Location	Grades	1998 - 1999 Enrollment
Greendale Elementary	New Ellenton, SC	Pre-K through 5	426
Jackson Middle	Jackson, SC	6 through 8	517
New Ellenton Middle	New Ellenton, SC	6 through 8	263
Redcliff Elementary	Jackson, SC	Pre-K through 5	967
Silver Bluff High	Aiken, SC	9 through 12	914

Source: *South Carolina Education Profiles* (SCDE 1999)

Table 4-19. Year 2002 SRS Employees (approximate) by County of Residence R1

County	WSRC/ M&O	DOE-SR Operations	Savannah River Ecology Lab	WSI	Total	Percent
Aiken, SC	6,380	296	109	360	7,216	53.1
Columbia, GA	1,868	66	5	72	2,012	14.8
Richmond, GA	1,577	66	19	231	1,899	14.0
Barnwell, SC	863	11	3	64	947	7.0
Edgefield, SC	224	3	1	8	236	1.7
Other Counties	1,139	17	28	88	1,280	9.4
TOTAL	12,051	459	165	823	13,590	100

R1

Source: Personal Communication (Bozzone 2002) R1
NA – Not Available

Table 4-20. Economic and Unemployment Data for Counties Within 50 Miles (80 km) of the MFFF

County	1994 Per Capita Income	1993 Percent of Pop. Below Poverty	Unemployment Rate – 1996 (%)
South Carolina	$17,710	16.6	6.0
Aiken	$19,468	13.8	7.0
Allendale	$12,175	34.3	9.1
Bamberg	$13,253	27.9	9.9
Barnwell	$16,736	21.9	10.9
Colleton	$13,988	24.1	6.8
Edgefield	$15,076	17.4	7.4
Hampton	$14,595	24.4	7.3
Lexington	$20,111	9.8	3.3
McCormick	$12,500	21.1	10.2
Orangeburg	$14,932	25.6	10.4
Saluda	$15,316	17.7	6.6
Georgia	$20,212	16.8	4.6
Bulloch	$14,319	22.4	3.1
Burke	$14,270	29.2	16.0
Columbia	$17,810	7.7	4.1
Glascock	$16,417	16.1	9.0
Jefferson	$15,303	27.7	13.4
Jenkins	$14,098	25.2	4.7
Lincoln	$15,358	17.5	6.4
McDuffie	$16,422	20.7	9.3
Richmond	$19,251	21.9	7.3
Warren	$13,747	27.1	9.8

Source: *USA Counties™ 1998, General Profile* (DOC 1998a)

Table 4-21. Income and Poverty Data for the Three-County Local Area

County	1990 Population	1990 Per Capita Income	1989 % Population Below Poverty	1994 Per Capita Income	1993 % Below Poverty
Aiken, SC	120,940	$17,156	14.0	$19,468	13.8
Barnwell, SC	20,293	$13,397	21.8	$16,736	21.9
Burke, GA	20,579	$11,172	30.3	$14,270	29.2
Georgia	6,478,216	$17,123	14.7	$20,212	16.8
So. Carolina	3,487,714	$15,106	15.4	$17,710	16.6

Source: U.S. Census Bureau, 1990 US Census Data; Database: C90STF3C1.
USA Counties™ 1998, General Profile (DOC 1998a)

Table 4-22. 1997 Employment by Business Sector - Counties Within 50 Miles (80 km) of the MFFF

County	Agr., Forestry & Fishing	Mining	Construct.	Manuf.	Transp. & P.U.	Wholesale Trade	Retail Trade	Finance In., & RE	Services	Unclass.	Total
Aiken, SC	252	1,832	1,832	20,843	1,840	643	9,537	1,261	13,066	31	51,137
Allendale, SC	(A)	0	153	1563	(B)	(B)	351	58	318	(A)	2443
Bamberg, SC	35	0	70	1281	169	57	823	118	1041	0	3594
Barnwell, SC	(A)	0	300	3,403	396	(C)	1,290	103	994	(A)	6,961
Colleton, SC	86	(A)	531	1,965	349	496	2,408	486	2,002	(A)	8,323
Edgefield, SC	125	0	213	2,185	89	84	634	98	881	2	4,311
Hampton, SC	51	0	254	1,523	268	281	1,316	136	797	6	4,632
Lexington, SC	452	142	5,534	10,513	4,525	5,376	15,291	2,591	17,003	14	61,441
McCormick, SC	(A)	(A)	83	389	(A)	(B)	(E)	104	(E)	(A)	576
Orangeburg, SC	131	0	875	9,467	631	1,022	6,892	1,147	7,274	1	27,440
Saluda, SC	95	0	160	2,501	106	105	539	61	597	1	4,165
Bulloch, GA	100	0	1,082	3,270	381	718	5,231	615	3,414	16	14,827
Burke, GA	(B)	0	113	1,355	1,750	268	927	125	900	(A)	5,438
Columbia, GA	207	(B)	2,287	6,315	640	954	5,364	946	9,242	(A)	25,955
Emmanuel, GA	(A)	(A)	157	2,326	146	281	1,195	234	1,132	(A)	5,471
Glascock,GA	(A)	0	(A)	59	13	0	41	(A)	(C)	(A)	113
Jefferson, GA	86	382	160	2,198	176	203	832	182	602	1	4,822
Jenkins, GA	12	-	45	1,295	87	71	319	59	329	-	2,217
Lincoln, GA	(B)	(A)	83	847	73	40	251	(B)	183	(A)	1,477
McDuffie, GA	(B)	(B)	370	1,806	182	134	2,028	283	1,660	(A)	6,463
Richmond, GA	261	(B)	3,884	12,435	3,255	2,827	19,481	3,752	30,433	(B)	76,328
Screven, GA	(A)	0	103	1,340	54	89	516	101	584	(A)	2,787
Warren, GA	25	(A)	1	879	25	11	144	(A)	333	0	1,418

Notes to table: (A) - 0 to 19; (B) - 20 to 99; (C) - 100 to 249; (E) - 250 to 499.

Source: *1997 County Business Patterns* (DOC 1997)

Table 4-23. Sources of Radiation Exposure to Individuals in the SRS Vicinity Unrelated to SRS Operations

Source	Effective Dose Equivalent (mrem/yr)
Natural background radiation [a]	
Cosmic radiation	27
External radiation	28
Internal terrestrial radiation	40
Radon in homes (inhaled)	200[b]
Total	295
Anthropogenic background radiation [c]	
Diagnostic x rays and nuclear medicine	53
Weapons test fallout	<1
Air travel	1
Consumer and industrial products	10
Total	65
Total	360

[a] Source: *Savannah River Site Environmental Report for 1998* (Arnett and Mamatey 1999)

[b] An average for the United States.

[c] Source: *Ionizing Radiation Exposure of the Population of the United States* (NCRP 1987).

Table 4-24. Radiation Doses to the Public from Normal SRS Operations in 1999 (Total Effective Dose Equivalent)

	Atmospheric Releases		Liquid Releases		Total	
Members of the Public	**Standard**[a]	**Actual**	**Standard**[a]	**Actual**[b]	**Standard**[c]	**Actual**
Maximally exposed individual (mrem/yr)	10	0.06[d]	4	0.22[d]	100	0.28[e]
Population within 50 mi (80 km) (person-rem/yr)[f]	None	2.6[d]	None	4.0[d]	None	6.6[e]
Average individual within 50 mi (80 km) (mrem/yr)[g]	None	3.7E-03	None	5.6E-03	None	9.3E-03

[a] The 10-mrem/yr limit from airborne emissions is required by the Clean Air Act and Regulatory Guide 4.20, and the 4-mrem/yr limit is required by the Safe Drinking Water Act; for this ER document, the 4-mrem/yr value is conservatively assumed to be the limit for the sum of doses from all liquid pathways.

[b] Conservatively includes all water pathways, not just the drinking water pathway. The population dose includes contributions to Savannah River users downstream of SRS to the Atlantic Ocean.

[c] The total dose of 100 mrem/yr is the limit for all pathways combined (10 CFR Part 20, Subpart D).

[d] Source: SRS GSAR (WSRC 1999a).

[e] Calculated as the sum of the dose due to atmospheric releases and the dose due to liquid releases.

[f] About 708,450 (see Table 4-2) in 2000. For liquid releases, an additional 85,000 water users in Port Wentworth, Georgia, and Beaufort, South Carolina (about 98 mi [160 km] downstream), are included in the assessment.

[g] Obtained by dividing the population dose by the number of people living within 50 mi (80 km) of the site for atmospheric releases; for liquid releases the number of people includes water users who live more than 50 mi (80 km) downstream of the site.

Source: *Savannah River Site Environmental Report for 1998* (Arnett and Mamatey 1999).

Table 4-25. Radiation Doses to Workers from Normal SRS Operations (Total Effective Dose Equivalent)

	Onsite Releases and Direct Radiation	
Occupational Personnel	**Standard** [a]	**Actual**
Average radiation worker (mrem/yr)	5,000	46[b]
Total workers (person-rem/yr) [c]	NA	625[d]

R1

[a] The radiological limit for an individual worker is 5,000 mrem/yr (10 CFR Part 835). However, DOE's goal is to maintain radiological exposure as low as reasonably achievable. It has therefore established an administrative control level of 2,000 mrem/yr (DOE 1994b); DOE must make reasonable attempts to maintain worker doses below this level.

[b] Source: DOE, 1999e. DOE/EH-629, *DOE Occupational Radiation Exposure 1999 Report,* Exhibit 3-17, Collective TEDE and Number of Individuals with Measurable TEDE by site. R1

[c] About 13,590 in 2002.

[d] Calculated as average worker dose times total number of workers receiving a measurable TEDE. R1

Table 4-26. Existing Infrastructure in the Vicinity of the MFFF Site

Resource	F-Area Usage	F-Area Capacity	SRS Usage	SRS Capacity
Electricity Consumption (MWh/yr)	63,000	700,800	370,000	4,400,000
Electricity peak load (MW)	10	64	60	500
Domestic Water (mill L/yr)	378	890	1,440	11,166
Natural gas (m^3/yr)	0	0	0	0

R1

Source: SPD EIS (DOE 1999c), Tables 3-48 and 3-49

Table 4-27. Waste Generation Rates and Inventories at SRS

Waste Type	Generation Rate (yd^3/yr)	Inventory (m^3)	Projected 2002 Generation Rate (m^3/yr)
TRU[a]			616
Contact handled	93	14,400	
Remotely handled	0	1	
LLW	10,615	12,000	10,000
Mixed LLW			46
RCRA	22	2500	
TSCA	0	30	
Hazardous	37	174[b]	90
Nonhazardous			
Liquid[c] (gal/yr)	90,867,868	NA[e]	Not available
Solid[d]	40,000	NA[e]	Not available

[a] Includes mixed TRU wastes.
[b] Information represents FY2001 generation/inventory.
[c] This includes only sanitary wastewater, not process wastewater.
[d] Waste volumes as delivered to the sanitary landfill.
[e] Generally, nonhazardous wastes are not held in long-term storage.

R1
R1
R1

Key: LLW, low-level radioactive waste; NA, not applicable; RCRA, Resource Conservation and Recovery Act; TRU, transuranic; TSCA, Toxic Substances Control Act.

Source: *Integrated Data Base Report - 1995: U.S. Spent Nuclear Fuel and Radioactive Waste Inventories, Projections, and Characteristics* (DOE 1996a), except for hazardous and nonhazardous solid waste (DOE 1996b) and nonhazardous liquid waste (Sessions 1997b), 2001 projections (Mottel 2000).

5. ENVIRONMENTAL CONSIDERATIONS

This chapter discusses potential environmental impacts resulting from site preparation and facility construction (Section 5.1), facility operation (Section 5.2), deactivation (Section 5.3), radioactive material transportation (Section 5.4), and potential facility accidents (Section 5.5). Also presented is a discussion of cumulative impacts (Section 5.6), impacts from alternatives to the proposed action (Section 5.7), impacts on short-term uses and long-term environmental productivity (Section 5.8), and commitment of resources (Section 5.9). Finally, an overview of environmental monitoring is discussed in Section 5.10. Environmental impacts that were projected in the SPD EIS (DOE 1999c) and remain valid in this ER are incorporated by reference but not discussed extensively.

The MFFF facility will be located on SRS land adjacent to F Area. F Area will be expanded to include the material disposition facilities. F Area has been used for over 40 years for the separation of plutonium. The area is highly industrialized and has undergone numerous land disturbances. The MFFF will be located on 41 ac (16.6 ha) of land, some of which most recently was used as the spoils area from the excavation of the Actinide Packaging and Storage Facility (APSF). F Area, near the geographic center of SRS, is at least 5 mi (8 km) away from public access. The public will be relatively insulated from any near-field impact of the MFFF. The previous use of the land in and adjacent to F Area and the relative isolation from the public are important factors in evaluating the environmental impacts of the construction and operation of the MFFF.

5.1 IMPACT OF SITE PREPARATION AND FACILITY CONSTRUCTION

This section discusses the effects of site preparation and construction activities on various environmental resources.

5.1.1 Land Use

Construction and grading on and around the MFFF site will require approximately 52 ac (21 ha); the completed facility will occupy 41 ac (16.6 ha) of land. A number of construction areas exist within F Area but are currently inactive. F Area has ample space available for construction (UC 1998). Land area requirements for the MFFF are relatively small. Because the land is used for industrial activities and could continue to be used for industrial activities after the MFFF deactivation, no permanent loss of land use would result from construction and operation of the facility at SRS. R1

Construction on the site is consistent with other SRS uses and with the industrial land use activity in the surrounding area. It is also consistent with the SRS Land Use Technical Committee's *Discussion Draft SRS Long Range Comprehensive Plan* (DOE 2000a) for land use in the area. R1

Part of the land within F Area has been previously disturbed and is partially developed. The area where the MFFF will be located is mostly evergreen plantation. Some changes in topography have already taken place. The MFFF site will be graded to a mean elevation of 272 ft (83 m) above MSL. The spoils pile currently in the middle of the MFFF site will be moved.

Grading the MFFF site (Figure 5-1) will result in 52 ac (21 ha), including the 41-acre (16.6-ha) MFFF site, being impacted by the site preparation activities. These site preparation activities include grading the site to 272 ft (82.9 m) (msl), reshaping the existing F-Area stormwater basin to 0.6 ac (0.2 ha) and grading a 1.5 ac (0.6 ha) MFFF stormwater basin. Some of the excess MFFF dirt would be used as fill for approximately 17 ac (6.9 ha) on the northeast corner of the PDCF site. The fill area would be logged, removing primarily pine plantations and a few hardwoods. The fill would be graded to blend in with the existing topography. The filled areas would be graded and seeded as part of the construction erosion and sedimentation control measures. Alternately, DOE may direct that a portion of the excess material may be stockpiled in a nearby previously-disturbed area. R1

Based on soil type, some areas of SRS could be considered prime farmlands; however, they are not designated as such because they are depleted from excessive past agricultural uses and are no longer available for agricultural purposes. R2

To support the MFFF activities, DOE will construct the WSB for the processing of liquid high alpha activity waste and stripped uranium waste. This facility, to be located near the MFFF and PDCF, will be connected to the MFFF by two stainless steel double-walled pipelines. The pipelines will be used to convey the liquid high alpha activity waste and stripped uranium waste to the WSB. The WSB will also treat liquid waste from the PDCF. The route for the 2,000-ft (609.6-m) pipeline is projected to be from the southwest corner of the MFFF to an existing utility corridor on the north side of the F-Area perimeter roadway, east and south along the F-Area perimeter road to the WSB. The width of the disturbed area is expected to be less than 25 ft (7.6 m) comprising a total disturbed area less than 1.5 ac (0.6 ha). R1 R2 R1

During construction, utilities and waste pipelines will be put in place. A discussion of these impacts is provided in Section 5.1.11. The industrial nature of the site and absence of critical habitat suggests that sensitive vegetated areas can be avoided in selecting routes, thus minimizing impacts of construction.

5.1.2 Geology

The following discussion of construction impacts to geology and soils is taken from Section 4.26.4.1.1 of the SPD EIS (DOE 1999c). In general, grading and construction results in disturbance of about 52 ac (21 ha) of soils for the MFFF site [Text Deleted]. Soils on the site will be moved, as appropriate, to achieve a uniform elevation. To date, no offsite borrow pits or spoil piles have been identified. R1

Actual creation of foundations and building of structures on the site will be limited to upper geological layers, minimizing impacts to geology and groundwater.

The soils at SRS are considered suitable for standard construction techniques. No economically viable geologic resources have been identified at SRS. While soils at SRS could be classified as prime farmlands, the U.S. Department of Agriculture does not classify them as prime farmlands because all of SRS is removed from public access.

[Text Deleted] R1

5.1.3 Water Use and Quality

Environmental impacts resulting from water use during MFFF construction were discussed in Section 4.26.4.2.1 of the SPD EIS (DOE 1999c) and are addressed in the following paragraphs.

All water for construction activities will be provided from existing SRS utilities. Local surface water would not be used in the construction of proposed facilities at SRS. Thus, there would be no impact on the local surface water availability to downstream users. Sanitary waste will be collected using a combination of portable toilets and semi-permanent facilities connected to the SRS CSWTF. All wastewater would be treated in the sitewide treatment system, which has sufficient hydraulic and organic capacity to treat the flows expected from these activities. No impacts on surface water quality would be expected from the discharge of these flows to the treatment system and, subsequently, to the receiving stream (Sessions 1997a).

The estimated annual average water usage for constructing all the proposed facilities at the MFFF site is 33.0 million gal (125 million L). Current water usage in F Area is 98.8 million gal/yr (374 million L/yr) (DOE 1999c). The DOE decision to close out operations of the F Canyon will reduce water use in F Area. The total construction requirement represents approximately 2% of the A-Area loop groundwater capacity, which includes F Area, of about 1.58 billion gal/yr (6.0 billion L/yr) (Tansky 2002). Therefore, no impact on water availability is anticipated. R2

Proven construction techniques will be used to mitigate the impact of soil erosion on receiving streams. The MFFF construction stormwater pollution prevention plan will be consistent with the existing SRS stormwater and erosion management practices. Because of the effectiveness of these techniques, no long-term impacts from soil erosion due to construction activities would be expected.

Because the construction of the MFFF will involve building structures, parking lots, and roadways, which will increase the impervious surface area, the stormwater runoff quantity at peak discharge would increase accordingly. The area within the boundary of the selected site is estimated to be 41 ac (16.6 ha). The total area of the impervious surfaces (e.g., roofs, roadways, paved parking lots) as a result of construction of the MFFF is estimated to be 17 ac (6.9 ha) or 41.4% of the site area.

To comply with *South Carolina State Standards for Stormwater Management and Sediment Reduction* (SCDHEC 2000b), stormwater ponds designed to control the release of the stormwater runoff at a rate equal to or less than that of the pre-development stage will be built at strategic locations as part of the SRS infrastructure program. A stormwater basin would likely be located southeast of the MFFF and north of the PDCF along the path of the existing discharge to the unnamed tributary of Upper Three Runs upstream of the designated wetlands area. Preliminary design of this basin has a surface area of approximately 1.5 ac (0.6 ha). The existing F-Area basin would be reshaped to 0.6 ac (0.2 ha) and would be located just west of the MFFF basin. R1 R1 R1

[Text deleted]

The stormwater runoff flow from MFFF and PDCF will discharge through the existing SRS stormwater NPDES outfall or new outfalls. If the existing stormwater outfalls are impacted by construction of the surplus plutonium disposition facilities, they will be relocated and/or new outfalls will be constructed.

As discussed in Section 4.4.3.3, any potential groundwater contaminants are approximately 76 to 93 ft (23.2 to 28.3 m) below the surface. Because MFFF grading will only extend to 40 ft (12.2 m) below the surface, any potential groundwater contaminants should not interact with construction activities. R1

5.1.4 Air Quality

Potential impacts to local air quality during construction of the MFFF are presented in Section 4.4.1.1 of the SPD EIS (DOE 1999c).

Potential air quality impacts from construction of new MOX and support facilities at SRS were analyzed using ISCST3 as described in Appendix B. Construction impacts result from diesel fuel emissions from construction equipment, particulate matter emissions from disturbance of soil by construction equipment and other vehicles (i.e., construction fugitive emissions), operation of a concrete batch plant, construction worker vehicles, and trucks moving materials and wastes. Emissions from these sources are summarized in Table 5-1. Maximum air pollutant concentrations from construction activities are summarized in Table 5-2.

The incremental MFFF construction impacts shown in Table 5-2 are trivial compared to the existing ambient concentrations, and the total impacts are well below the most stringent air quality standard or guideline.

5.1.5 Ecology

Construction impacts to ecological systems were discussed in Section 4.26.4.3.1 of the SPD EIS (DOE 1999c). Impacts to the local ecology are not expected to be significantly different from those described in the SPD EIS. The following discussion of construction impacts is derived from the SPD EIS with updated data reflecting the present MFFF design and specific location adjacent to F Area.

5.1.5.1 Non-Sensitive Habitat

Constructing the MFFF at SRS would disturb a total of about 52 ac (21 ha). There should be no direct impacts on non-sensitive aquatic habitats because best-management practices for soil erosion and sediment control will be used to prevent construction runoff to these habitats, and direct construction disturbance would be avoided. It is estimated that approximately 28 ac (11.3 ha) of evergreen woodlands and other vegetation in the construction area would be lost as terrestrial habitat (Figure 4-13). The associated animal populations would be affected. Some of the less-mobile or established animals within the construction zone could perish during land-clearing activities and from increased vehicular traffic. Furthermore, activities and noise associated with construction could cause larger mammals and birds to relocate to similar habitat in the area. Also, 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. The recent survey of the site (DOA 2000) did not reveal any migratory bird nests. Prior to construction, the proposed site will be surveyed for nests of migratory birds. There would be no impacts on aquatic habitat from surface water consumption because water required for construction will be drawn from groundwater by the SRS utilities.

R1
R1

In addition to grading related to the MFFF site, proper infrastructure upgrades for roads and utilities will disturb no more than 26 ac (10.5 ha). Utilities will be routed along existing road rights-of-ways or through existing industrial areas. Road upgrades for ingress and egress to the MFFF site will also be conducted in existing traffic rights-of-ways. Relocation of the SCE&G power line, Supervisory Control and Data Acquisition line, telephone lines, and adjacent survey area includes approximately 11 ac (4.5 ha) of flat sandy uplands, flanking slopes that transition to erosion ditches, and a small stream bottom. Within these topographic areas, the following plant communities are noted: upland longleaf pine, successional mixed pine-hardwood, dry oak-pine slopes, mesic hardwood slope, moist-bottom mixed pine-hardwood forest, and a series of early successional systems. Assessment of the general ecological conditions and potential wetland areas for the proposed plutonium disposition facilities found no wetland areas within the proposed construction site, no endangered or threatened species, and no rare or unique ecological resources.

R1

5.1.5.2 Sensitive Habitat

Wetlands associated with floodplains, streams, and impoundments should not be directly impacted by construction activities. No runoff or sediments are expected to be deposited in these areas because appropriate erosion and sedimentation controls will be used during construction.

No critical habitat for any threatened or endangered species exists on SRS. However, as discussed in Section 4.6.2.1, the bald eagle, red-cockaded woodpecker, wood stork, American alligator, smooth purple coneflower, and Oconee azalea might occur near F Area (DOE 1995b). Surveys conducted in 1998 and 2000 did not find any federally listed threatened, endangered, proposed, or sensitive plant or animal species (DOA 2000). Consultations were initiated by

DOE with the U.S. Fish and Wildlife Service (USFWS) and the South Carolina Department of Natural Resources (SCDNR) to request comments on potential impacts on animal and plant species and to request any additional sensitive species information. The USFWS field office in Charleston, South Carolina, provided a written response indicating that the proposed facilities at SRS do not appear to present a substantial risk to federally listed species or other species of concern. That office also provided additional information concerning listed species and species of concern occurring in the vicinity of SRS (EuDaly 1998). In December 2000, DOE provided specific information to USFWS and SCDNR concerning the MFFF site. In June 2001, the USFWS replied that the MFFF project would not affect protected species or habitats (Appendix A). R1

5.1.6 Noise

MFFF construction impacts on local noise levels were evaluated in Section 4.4.1.1 of the SPD EIS (DOE 1999c).

The location of the MFFF relative to the site boundary and sensitive receptors was examined to evaluate the potential for onsite and offsite noise impacts. Noise sources during construction would include heavy construction equipment, employee vehicles, and truck traffic. Traffic noise associated with the construction of the MFFF would occur on the site and along offsite local and regional transportation routes used to bring construction materials and workers to the site.

Given the distance to the site boundary (about 5.4 mi [8.7 km]), noise emissions from construction equipment would not be expected to annoy the public. These noise sources would be far enough away from offsite areas that the contribution to offsite noise levels would be small. Some noise sources could have onsite impacts, such as the disturbance of wildlife. However, noise would be unlikely to affect federally-listed threatened or endangered species or their critical habitats because none are known to occur in F Area (see Section 4.6.2.2). Noise from traffic associated with the construction of the MFFF would likely produce less than a 1-dB increase in traffic noise levels along roads used to access the site, and thus would not result in any increased annoyance of the public.

Construction workers could be exposed to noise levels higher than the acceptable limits specified by the Occupational Safety and Health Administration (OSHA) in its noise regulations (29 CFR §1926.52). However, DOE has implemented appropriate hearing protection programs to minimize noise impacts on workers. These programs include the use of standard silencing packages on construction equipment, administrative controls, engineering controls, and personal hearing protection equipment.

5.1.7 Regional Historic, Scenic, and Cultural Resources

MFFF construction will not affect historic resources, including those associated with the Cold War Era, nor will construction affect resources of value to Native Americans. Preliminary consultations with appropriate American Indian Tribal Governments and the State Historic

Preservation Office have been performed by DOE. Consultations with Native American groups indicate that it is unlikely that significant Native American resources would be impacted.

Archaeological surveys of F Area in the vicinity of the MFFF site identified four prehistoric sites that could be affected by MFFF construction. As noted in Section 4.8.2, 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 (Green 2000). A data recovery plan for impact mitigation was developed for the two eligible sites and was submitted to the South Carolina State Historic Preservation Office for review and comment in compliance with the SRS PMOA prior to execution[1]. The South Carolina State Historic Preservation Office approved the mitigation plan April 11, 2001. All field mitigation work for site 38AK546/547 was completed in April 2002. Mitigation for Site 38AK757 will be complete in August 2002. Although it is usually preferable to leave sites intact and undisturbed, the mitigation actions should serve to minimize project impacts by recovering sufficient resources and data from the sites to gain whatever information they may contain concerning site use and age. Figure 4-5 illustrates the boundary of the archaeological sites in relation to the proposed MFFF facilities.

Inadvertent 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 PMOA.

The MFFF buildings will have a minimal effect on the scenic character of the surrounding area and are consistent with the VRM Class IV designation for the area. The buildings are low-rise structures of varying heights less than 100 ft (30 m). This height is consistent with the other building heights in the area, which range from 10 to 100 ft (3 to 30 m). The tallest new structure is an exhaust stack, which is located on top of the MFFF building. The stack is 120 ft (37 m) above the existing grade, and its distance from sensitive receptors and screening by trees will minimize its impact as a visual intrusion to the scenic character of the area.

The appearance of MFFF facilities in and adjacent to F Area would remain consistent with the area's industrialized landscape character. In height and size, the proposed facilities will be similar to existing buildings in F Area. Facilities are generally not visible offsite because views are limited by rolling terrain and heavy vegetation. Construction and operation of the MFFF would not effect a major change in any natural features of visual interest in the area. The nearest sensitive viewpoints are those on South Carolina Highway 125 and SRS Road 1, 4.3 mi (6.9 km) and 5.3 mi (8.5 km) away, respectively.

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[1] The SPD EIS ROD (DOE 2000b) anticipated mitigation through avoidance. Subsequent shifts in the MFFF site boundaries made it impossible to avoid impacting the sites, hence the plan for mitigation through data recovery.

5.1.8 Socioeconomics

Construction of the MFFF at SRS would have minor beneficial socioeconomic impacts on the region. Construction employment requirements are listed in Table 5-3.

According to the U.S. Census Bureau (DOC 1997), over 18,000 residents of counties that comprise the 50-mi (80-km) region surrounding the MFFF site were employed in the construction trades in 1997. During a majority of the construction period, labor needs at the site should easily be met within the existing regional construction labor pool. At its peak, MFFF construction activities are expected to employ about 1,050 craft workers. Although the region should directly benefit from MFFF construction employment, the peak employment estimate represents approximately 8% of the total 1997 regional construction workforce and could adversely affect other construction activities in the region as a result of direct competition for labor. Since the 1,050-person peak need for labor is not expected to last for more than a few months, any adverse effects will be temporary and short-lived and should have no long-term impact on the overall economy of the area.

It is anticipated that some construction labor may be hired from counties that are outside of the 50-mi (80-km) region. The Columbia MSA, consisting of Lexington and Richland Counties in South Carolina, contained a total of 12,912 construction workers in 1997 and is a likely source of some of the construction labor. If workers from Richland County are included with those in the region (note that Lexington is partially within the 50-mi [80-km] region and already included as part of the labor pool), a total construction labor pool available to the project will be over 25,000 workers. This total drops the 1,050-person peak employment requirements for the MFFF to less than 4% of the combined regional total construction workforce. Since construction workers often commute considerable distances for short-term work and since a majority of Richland County is within about 65 mi (105 km) of the MFFF site, the inclusion of Richland County's construction labor force in this analysis is reasonable. Given that a majority of MFFF construction workers will be hired from within the existing regional labor pool, no significant relocation of workers is expected and secondary impacts to area businesses, public services, and facilities will be negligible.

Transportation impacts during construction of the MFFF will primarily be associated with construction labor. Currently, one 10-hour shift is planned per day. To minimize conflicts with other SRS activities, the work schedule (i.e., start and stop times) will be coordinated and staggered with other SRS schedules to minimize the number of vehicles entering and exiting the site during peak commuting periods. Table 5-3 lists the anticipated average number of workers that will be onsite each year of construction. Since some workers typically carpool, the number of worker vehicles anticipated each year during construction is assumed to be equivalent to about 60% of the average number of workers. As a result, during the third and fourth years of construction, an average of between 450 and 510 worker vehicles carrying construction workers will make daily round trips to the site; during the peak construction period, an estimated 630 worker vehicles are anticipated. R2

As noted in Section 4.10.3.4, state road improvements, independent of the proposed action, are planned for three of the major roads in the local area, which will increase roadway capacity and help minimize the effect of worker traffic associated with MFFF construction. The widening of South Carolina Highway 302 to South Carolina Highway 19, and the completion of South Carolina Highway 118 around Aiken are scheduled to be completed prior to commencement of MFFF construction. The widening of U.S. Route 25 is scheduled for completion during the first year of MFFF construction.

Construction activities will also require the delivery of materials and equipment. Table 5-4 lists the estimated number of heavy vehicles per year that will be associated with MFFF construction. The largest number is anticipated during the first few years of construction with about 29 heavy vehicles anticipated during the first year, 25 anticipated in the two subsequent years and 15 in the last two years. These heavy vehicles will be scheduled to arrive at the site during "off" hours that do not correspond with SRS commuting times. As a result, delivery of the heavy vehicles, even during the first year, is insufficient to create any significant impacts to traffic flow in the local area.

5.1.9 Environmental Justice

The MFFF is located within SRS and is over 5 mi (8 km) from the nearest minority or low-income community. Impacts from construction activities that could affect public health, such as the generation of noise and dust, will be limited to the construction site area. As presented in Section 4.4.1.6 of the SPD EIS (DOE 1999c), there are no anticipated environmental justice issues associated with construction of the MFFF at SRS. Construction would pose no significant health risks to the public regardless of racial or ethnic composition, or economic status.

Increased traffic during peak commuting hours could cause some slowing of traffic on South Carolina Highways 125 and 19 through the towns of Jackson and New Ellenton, respectively. The effects associated with commuting will be limited to peak periods in the morning and evening and will last only for the duration of the construction period. In addition, staggering of work hours and scheduled roadway improvements should help minimize any adverse impacts. Because construction vendors and delivery routes are not known yet, the exact effect on traffic congestion is unknown. Given the limited nature of transportation changes that will result from MFFF construction, there should be no environmental justice issues associated with construction traffic.

5.1.10 Impacts from Ionizing Radiation

The human health risk from construction is discussed in Section 4.4.1.4 of the SPD EIS (DOE 1999c). No radiological risk would be incurred by members of the public from construction activities. The public is far enough from the MFFF site to be relatively unaffected by any construction emissions.

Construction workers are exposed to radiation as a result of existing F-Area operations and from radiography during construction. The SPD EIS presented a projected dose to construction workers in F Area of 4 mrem/yr. [Text Deleted] In accordance with 10 CFR §20.1502, individual monitoring or badging of workers for potential radiation exposure is required if the worker is likely to receive a dose in excess of 10% of the limits in 10 CFR §20.1201(a). The only workers during construction that are likely to receive a dose in excess of 10% of these limits are radiographers. Radiographers will be monitored or badged. The radiation exposure monitoring program for radiographers will be performed by the radiography contractor in accordance with the contractor's existing NRC or agreement state license(s) to perform this work. R1 R1

5.1.11 Infrastructure

As discussed in the Section 4.26.4.6.1 of the SPD EIS (DOE 1999c), MFFF construction would have negligible impacts on infrastructure resources at SRS.

Construction would require only a fraction of the available resources and thus would not jeopardize the resources required to operate the site. Total construction requirements for diesel fuel might be higher than currently available storage, but the majority of fuel usage would be connected to construction vehicle usage. Therefore, storage would not be limiting. Table 5-5 reflects estimates of the additional infrastructure requirements for construction of the proposed facilities. Site resource availability is also presented.

The MFFF will require a number of minor infrastructure upgrades in the F Area near the MFFF site. These will occur during construction and are discussed in the following paragraphs.

Permanent parking areas for the MFFF will be located within the respective facility site boundary. Temporary construction parking that may be needed will be on the MFFF site and to an area south of the PDCF site along the unpaved road connecting to SRS Road E. R1

The MFFF will require some improvements to the F-Area perimeter connector roadway, the total land area expected to be disturbed in connection with road work is less than 5 ac (2 ha).

Road upgrades for ingress and egress to the MFFF site will be conducted in existing traffic rights-of-ways.

The existing stormwater outfalls and drainage ways that are located between the MFFF and F Area may be relocated. A stormwater basin would likely be located southeast of the MFFF and north of the PDCF along the path of the existing discharge to the unnamed tributary of Upper Three Runs, upstream of the designated wetlands area. Preliminary design of this basin has a surface area of approximately 1.5 ac (0.6 ha). The existing stormwater basin [0.6 ac (0.2 ha)] that accumulates water from F Area, would be resized and located adjacent to the MFFF basin.

In accordance with SCDHEC regulations, the basins will be sized to mitigate any increased runoff impacts by retaining suspended solids and attenuating peak stormwater flows.

As noted in Section 5.1.1, DOE will construct the WSB for processing liquid high alpha activity waste and stripped uranium waste, along with two PDCF waste streams. This facility, to be located south of the PDCF, will be connected to the MFFF by two dedicated stainless steel double-walled pipelines, one for each waste stream. The pipeline will be used to convey the liquid high alpha activity waste and stripped uranium waste to the WSB. The route for the 2,000-ft (609.6-m) pipeline is projected to be from the southwest corner of the MFFF to an existing utility corridor on the north side of the F-Area perimeter roadway, east and then south along the F-Area perimeter roadway to the WSB. The width of the disturbed area is expected to be less than 25 ft (7.6 m) comprising a total disturbed area less than 1.5 ac (0.6 ha), most of which is on land already dedicated to the PDCF. R2

Assessment of the general ecological conditions and potential wetland areas for the proposed plutonium disposition facilities found no wetland areas within the proposed construction site, no endangered or threatened species, and no rare or unique ecological resources (DOA 2000).

General utilities for the MFFF will be routed along the existing F-Area Limited Area perimeter roadway to the east and to the north of the road.

The existing 115-kV transmission line entering F Area from the north crosses the MFFF site and will be rerouted around the facility. The proposed new route for the 115-kV line will parallel the MFFF northern boundary and turn south at the western boundary of the MFFF site. It will rejoin and follow the existing route across the F-Area perimeter road at a point south and west of the closed F-Area seepage basin. The power line relocation is expected to impact approximately 11 ac (4.5 ha) on the north and west sides of the MFFF site. R1

Relocation of the SCE&G power line, digital cable lines, telephone lines, and adjacent survey area includes flat sandy uplands, flanking slopes that transition to erosion ditches, and a small stream bottom. Within these topographic areas, the following plant communities are noted: upland longleaf pine, successional mixed pine-hardwood, dry oak-pine slopes, mesic hardwood slope, moist-bottom mixed pine-hardwood forest, and a series of early successional systems. Assessment of the general ecological conditions and potential wetland areas for the proposed plutonium disposition facilities found no wetland areas within proposed construction site, no endangered or threatened species, and no rare or unique ecological resources (DOA 2000).

5.1.12 Construction Waste

The SPD EIS (DOE 1999c) discusses the impacts of construction waste on SRS waste management resources.

Table 5-6 compares the wastes generated during the construction of the MFFF at SRS with the existing treatment, storage, and disposal capacity for the various waste types. It is anticipated that no TRU waste, LLW, or mixed LLW would be generated during the construction period. In addition, no soil contaminated with hazardous or radioactive constituents should be generated during construction. However, if any were generated, the waste would be managed in accordance with site practice and applicable federal and state regulations.

Hazardous wastes generated during construction would be typical of those generated during the construction of an industrial facility. Any hazardous wastes generated during construction would be packaged in DOT-approved containers and shipped offsite to permitted commercial recycling, treatment, and disposal facilities.

Nonhazardous solid wastes generated during the construction of the MFFF would be packaged in conformance with standard industrial practice and shipped to commercial or municipal facilities for recycling or disposal. The City of North Augusta Regional Material Recovery Facility is available for recycling waste generated during construction. The Three Rivers Landfill is available for wastes that cannot be recycled or recovered. Sanitary waste will be collected using a combination of portable toilets and semi-permanent facilities connected to the SRS CSWTF.

Several areas of SRS were considered as the site for the MFFF before F Area was selected (see Section 5.7.2.3). Indications of contamination on the surface or associated with groundwater were included in considering potential sites, and at least one other possible site was abandoned. In contrast, the area selected does not appear to have contamination to remediate prior to construction, thereby easing construction, speeding up approvals, and limiting potential liability.

5.1.13 Facility Accidents

The impacts of construction accidents were discussed in Section 4.4.1.5 of the SPD EIS (DOE 1999c) but are expected to be less than the projection in the SPD EIS. Recent construction labor projections are for 3,600 person-years. Applying standard U.S. Department of Labor accident rates for construction sites to this projection reduces the potential nonfatal occupational injury or illness to 356 potential cases and only 0.50 potential fatality. R2

Because construction would be in nonradiological areas, no radiological accidents are anticipated.

5.2 EFFECTS OF FACILITY OPERATION

This section describes the effects of facility operation on the environment surrounding the MFFF.

5.2.1 Impacts on Land Use and Site Geology

Operation of the MFFF is not projected to have any impact on land use other than the continued removal of the 41-ac (16.6-ha) site from other uses. The operation of the MFFF should not impact site geology.

5.2.2 Impacts on Surface Water Use and Quality

The MFFF does not discharge any process liquid directly to the environment. Noncontact HVAC condensate and stormwater will discharge through an approved NPDES outfall. All liquid wastes are transferred to SRS for treatment, storage, and ultimate disposal. A description of these wastes is provided in Section 3.3. R1

Liquid LLW will be transferred to the F-Area process sewer system that connects to the SRS Effluent Treatment Facility (ETF). Liquid LLW is estimated to be less than 10% of the remaining capacity of the ETF. Therefore, impacts on the system should not be major. Liquid LLW from MFFF will be discharged to Upper Three Runs after treatment at ETF. The discharge represents less than 0.01% of the Upper Three Runs 7-day 10-year low flow and is therefore, a negligible volume impact to Upper Three Runs. Because the ETF is able to treat these flows adequately to meet SRS NPDES permit limitations, negligible impacts on surface water quality are expected. R1

5.2.3 Impacts on Groundwater Quality

MFFF operations will withdraw approximately 1 gal/min (3.8 L/min) from the SRS groundwater system for process water. During start-up and process transitions, the groundwater withdrawals may increase to 30 gal/min (114 L/min). F area process water system capacity is 2,100 gpm with an average demand of 350 gpm (800 gpm peak). MFFF operations will withdraw approximately 3.7 gal/min (14 L/min) from the SRS groundwater system for domestic water. The domestic water capacity from deep wells supplying the A-area loop, which includes F Area, is 3,000 gpm and that the average domestic water consumption from the A-area domestic water loop in 2000 was 754 gpm (about 1,200 gpm peak). MFFF groundwater withdrawals are not anticipated to have any impact on SRS or local groundwater supplies. R1

The MFFF does not employ settling or holding basins as part of the wastewater treatment system. There will be no direct discharge of wastewater to the groundwater. Therefore, no impacts on groundwater quality are expected.

5.2.4 Impacts on Ambient Air Quality

There are four sources of air emissions from the MFFF operations:

- NO_X emissions from the MFFF stack derived from the aqueous polishing process
- Criteria pollutant emissions from routine testing of the emergency and standby diesel generators
- Fugitive emissions from chemical and fuel storage tanks
- Emissions from employee and site vehicles.

Impacts of the chemical air emissions from the MFFF are presented in Section 4.4.2.1 and Appendix G, Section G.4.2.4.2 of the SPD EIS (DOE 1999c), and are updated in the following discussion.

Potential air quality impacts from operation of the new MOX and support facilities at SRS were analyzed using ISCST3 as described in Appendix B. Emissions from these sources are summarized in Table 5-7. Emergency and standby generators were modeled as a volume source.

Maximum air pollutant concentrations resulting from the emergency and standby diesel generators and process sources, plus the SRS baseline concentrations, are summarized in Table 5-8.

The increased concentrations of nitrogen dioxide, PM_{10}, and sulfur dioxide from the operation of the MFFF would be a small fraction of the PSD Class II area increments, as summarized in Table 5-9.

Total vehicle emissions associated with activities at SRS would likely decrease somewhat from current emissions because of a decrease in overall site employment during this time frame.

The combustion of fossil fuels associated with MFFF operations would result in the emission of carbon dioxide, one of the atmospheric gases that are believed to influence the global climate. Annual carbon dioxide emissions from operations would represent less than 0.0002% of the annual United States emissions of carbon dioxide from fossil fuel combustion and industrial processes, and therefore would not appreciably affect global concentrations of this pollutant.

5.2.5 Ecological Impacts

The environmental impacts of MFFF operations on local ecology are discussed in Section 4.26.4.3.2 of the SPD EIS (DOE 1999c), and updated in the following discussion.

5.2.5.1 Nonsensitive Habitat

Noise disturbance would probably be the most significant impact of routine operation of the MFFF on local wildlife populations. Disturbed individual members of local populations could migrate to adjacent areas of similar habitat. However, impacts associated with airborne releases of criteria pollutants, hazardous and toxic air pollutants, and radionuclides would be unlikely because scrubbers and filters will be used. Impacts on aquatic habitats should be limited because all liquid will be transferred to SRS for disposal in accordance with approved permits and procedures (see Section 7.2).

5.2.5.2 Sensitive Habitat

Operational impacts on wetlands or other sensitive habitats would be unlikely because airborne and aqueous effluents would be controlled through state permits (see Section 7.2).

It is also unlikely that any federally listed threatened or endangered species would be affected, although South Carolina state-classified special-status species (American alligator) could be affected by noise or human activity during operations, as discussed for construction (Section 5.1.5.2).

5.2.6 Impacts from Facility Noise

The location of the MFFF relative to the site boundary and sensitive receptors was examined to evaluate the potential for onsite and offsite noise impacts. Noise sources during operations would include new or existing sources (e.g., cooling systems, vents, motors, material-handling equipment, emergency and standby diesel generators), employee vehicles, and truck traffic. Given the distance to the site boundary (about 5.4 mi [8.7 km]), noise emissions from equipment would not be expected to annoy the public.

Some noise sources could have onsite impacts, such as the disturbance of wildlife. However, noise would be unlikely to affect federally listed threatened or endangered species or their critical habitats because none are known to occur in F Area. Traffic noise associated with operation of the MFFF would occur on the site and along offsite local and regional transportation routes used to bring materials and workers to the site. Noise from traffic associated with operation of the MFFF would likely produce less than a 1-dB increase in traffic noise levels along roads used to access the site, and thus would not result in any increased annoyance of the public.

Operations workers could be exposed to noise levels higher than the acceptable limits specified by OSHA in its noise regulation (29 CFR §1926.52). However, DCS will implement appropriate hearing protection programs to minimize noise impacts on workers. These programs include the use of administrative controls, engineering controls, and personal hearing protection equipment.

5.2.7 Impacts on Historic, Scenic, and Cultural Resources

Once the construction impacts to the archaeological site have been mitigated, operation of the MFFF is not projected to have any impact on site or regional historic or cultural resources.

The MFFF buildings will have a minimal effect on the scenic character of the surrounding area and is consistent with the VRM Class IV designation for the area. The buildings are low-rise structures of varying heights less than 100 ft (30 m). This height is consistent with, and does not exceed, the other building heights in the area, which range from 10 to 100 ft (3 to 30 m). The tallest new structure is an exhaust stack, which is located on top of the MFFF building. The stack is less than 100 ft (30 m) above the existing grade, and its distance from sensitive receptors and screening by trees will minimize its impact as a visual intrusion to the scenic character of the area.

The appearance of MFFF facilities in and adjacent to F Area would remain consistent with the area's industrialized landscape character. In height and size, the proposed facilities will be similar to existing buildings in F Area. Facilities generally are not visible offsite because views are limited by rolling terrain and heavy vegetation. Construction and operation of the surplus plutonium disposition facilities would not effect a major change in any natural features of visual interest in the area. The nearest sensitive viewpoints are those on South Carolina Highway 125 and SRS Road 1, 4.3 mi (6.9 km) and 5.3 mi (8.5 km) away, respectively.

5.2.8 Socioeconomic Impacts

Approximately 400 new permanent jobs will be created in 2006 for MFFF operation. To fill these jobs, some employees may be hired from other regions of the state or country. Over 400,000 people resided within the five-county ROI in 1990. Assuming that any MFFF employees and their families that may move into the area as a direct result of MFFF employment choose to live in one of the five ROI counties, their numbers would represent less than 1% of the total 1990 ROI population. Given the size of the population of the region, and the rate of growth it is already experiencing, no significant socioeconomic impacts are anticipated.

5.2.9 Environmental Justice Impacts

Nuclear Materials Safety and Safeguards policy and procedures[2] specify that a 4-mi (6.4-km) radius should be used as the area of consideration in rural areas or areas that are outside of city limits. The MFFF is located on SRS. There is no resident population within a 5-mi (8-km) radius of the MFFF site, and the nearest minority or low-income community is over 5 mi (8 km) away. As noted in Section 4.9 and shown on Figures 4-15 and 4-16, a disproportionate minority or low-income population does not exist even within a 10-mi (16-km) radius of the MFFF site. As a result, MFFF operation will pose no significant health risks to the public regardless of the racial or ethnic composition or economic status.

MOX fuel fabrication requires uranium dioxide that will be transported to SRS from another location in the United States. The ER evaluates the impacts on environmental justice resulting from this transportation. The SPD EIS (DOE 1999c) identified a DOE enrichment facility near Portsmouth, Ohio, as a representative site for the source of the depleted uranium hexafluoride (UF_6) and a nuclear fuel fabrication facility in Wilmington, North Carolina, as a potential uranium conversion facility. Although the source of depleted uranium hexafluoride has not been selected for the MFFF, this ER analysis assumes transportation of uranium hexafluoride from Portsmouth, Ohio, to Wilmington, North Carolina, and then transport of converted uranium dioxide to the MFFF site. Minority and low-income populations residing along 1-mi (1.6-km) corridors centered on routes that are representative of those that could be used for the transportation of nuclear materials under the proposed action were identified in the SPD EIS (DOE 1999c) and are listed in Table 5-10. Population was calculated using U.S. Census block group data.

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[2] *Environmental Justice in NEPA Documents* (NRC 1999) specifies the guidelines for determining the area for assessment, "If the facility is located outside the city limits or in a rural area, a 4 mile radius (50 square miles) should be used."

Once the MOX fuel is fabricated, it will be transported to one of four operating nuclear power plants: the McGuire Nuclear Station Units 1 & 2 near Huntersville, North Carolina, or the Catawba Nuclear Station Units 1 & 2 near York, South Carolina. Travel from the MFFF to the Catawba Nuclear Station will be through South Carolina and Georgia and to the McGuire Nuclear Station will be through South Carolina, Georgia, and North Carolina. Minority populations (1990) along the corridors between the MFFF and the McGuire and Catawba Nuclear Stations are listed in Table 5-10. The populations were calculated using updated U.S. Census block group data and assume a 0.5-mi (0.8-km) corridor on either side of the roadways.

Potential transportation accidents are discussed in Section 5.4. As noted in that section, the NRC evaluated the environmental impacts of cargo-related accidents resulting from the transport of nuclear materials in NUREG-0170 (NRC 1977c) and concluded the potential impacts to be small. No radiological or nonradiological fatalities would be expected to result from accident-free transportation associated with the MFFF, nor would radiological or nonradiological fatalities be expected to result from transportation accidents. Consequently, transportation of materials associated with the operation of the MFFF would pose no significant risks to the public, including minority and low-income populations.

5.2.10 Impacts from Ionizing Radiation

Normal operations of the MFFF will result in radiological releases to the environment and direct in-plant exposures. Radiation doses to the general public, site workers (i.e., SRS workers not involved with the MFFF), and facility workers due to normal operations of the MFFF are presented below. A site specific analysis including AFS changes for the MFFF including R2
alternative feedstock and the WSB was performed and found to be bounded by the data presented below. R2

5.2.10.1 Radiation Doses to the Public

The estimation of radiological impacts to the public due to incident-free operations of the MFFF is summarized here and described in detail in Appendix D. The dose calculations used the GENII system (the Hanford Environmental Radiation Dosimetry Software System) (Pacific Northwest Laboratory 1988a, 1988b). The GENII model was selected to maintain a consistency with the SPD EIS analysis. The GENII model is also appropriate because it includes isotopes not included in traditional models for power plants and it provides dose estimates consistent with the most recent 10 CFR Part 20 guidance.

The calculated dose is the 50-year committed effective dose equivalent due to internal exposure and the effective dose equivalent due to external exposure resulting from one year of release and one year of uptake. Determination of dose to the maximally exposed individual (MEI) and the general public as a result of normal operations of the MFFF assumed the following:

- Chronic atmospheric releases.

- Exposure pathways of inhalation uptake, external exposure to the airborne plume, ingestion of terrestrial foods and animal products, and inadvertent soil ingestion.
- The entire population within the 50-mi (80-km) assessment area consists of adults (DOE 1988).
- The MEI resides 5 mi (8 km) from the facility in the southwest direction.
- No previous contamination of the ground surface and no previous irrigation with contaminated water.
- A finite plume model (i.e., center of the plume located at ground level) for the calculation of dose.
- The annual external exposure time to the plume and to soil contamination is 0.7 year for the MEI (NRC 1977a).
- The annual external exposure time to the plume and to soil contamination is 0.5 year for the general population (NRC 1977a).
- The annual inhalation exposure time to the plume is 1 year for the MEI and general population (NRC 1977a).
- A stack height equal to the actual stack height rather than the effective stack height to negate plume rise.
- Airborne releases used in the SPD EIS (DOE 1999c), which are about one order of magnitude higher than the releases expected during normal MFFF operations.
- The MEI and the general population consume only food grown within the assessment area and only animal products produced within the assessment area.
- Terrestrial food is irrigated with uncontaminated water.
- All water consumed by animals within the assessment area comes from an uncontaminated source.
- Animal food sources are not irrigated.
- No resuspension of soil particles into the air.
- A general population equal to the estimated population for 2030.

Dose for the MEI and the general population was calculated for a ground level release (1 ft [0.3 m] above grade). As a conservative measure, the airborne release used was identical to that used in the SPD EIS (DOE 1999c). Actual releases are estimated to be an order of magnitude R2 less than those used for this calculation. DCS determined that additional dose to the public from operations of the WSB are bounded by the conservative estimate of public dose for the MFFF (see Appendix G)[3]. Because the MFFF does not discharge any liquid directly to the environment, the liquid/aquatic pathway was not considered in the dose calculations. R2

Table 5-11 summarizes the potential radiological impacts on three individual receptor groups: the population living within 50 mi (80 km) of SRS, the maximally exposed member of the public, and the average exposed member of the public. This table also shows a comparison of the calculated potential doses due to normal operations to the all-pathway standard given in 10 CFR Part 20, Subpart D and the doses from natural background radiation.

Given incident-free operation of the MFFF, the total population dose would be 0.12 person-rem/yr. The annual dose to the maximally exposed member of the public from operation of the MFFF would be 1.5E-03 mrem/yr. The dose to the average individual in the population would be 1.2E-04 mrem/yr. Details regarding calculation of the radiological impact of normal operations of the MFFF on the general public are presented in Appendix D. R2 R2

5.2.10.2 Radiation Doses to Site Workers

Site workers are defined as those that work within the SRS boundaries but are not directly involved in process activities at the MFFF. The doses to site workers presented here were determined using the GENII system (Pacific Northwest Laboratory 1988a, 1988b). The calculated dose is the 50-year committed effective dose equivalent due to internal exposure and the effective dose equivalent due to external exposure resulting from one year of release and one year of uptake. Details related to the dose calculations for site workers can be found in Appendix D. R2

The current spatial distribution of site workers within the SRS boundary is not readily available. Therefore, a population dose for site workers could not be directly determined. Rather, a dose to a site worker located on the MFFF boundary (328 ft [100 m] from the release point) and a dose to a site worker located on the SRS boundary (5 mi [8 km] from the release point) were calculated. Those doses were then multiplied by the total number of site workers to obtain a maximum population dose at the boundary of the MFFF and at the boundary of SRS. These two values provide the maximum and minimum, respectively, estimated population dose for the site workers. Actual dose to SRS site workers is projected to be between these two extremes.

Calculation of the dose due to normal operations of the MFFF for the MEI representing site workers assumed the following:

- Chronic atmospheric releases.

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[3] Using process inventory information and models for release of radionuclides from the MFFF and WSB processes, DCS projected emissions that are an order of magnitude lower than the emissions used in this ER. R2

- Exposure pathways of inhalation uptake, external exposure to the airborne plume, and inadvertent soil ingestion.
- All site workers are adults.
- There are no food products grown within the SRS boundary.
- The MEI is located at a distance of 328 ft (100 m) from the release point. R2
- The MEI is located in the direction from the release point that gives the maximum dose based on dose calculations for the 16 directions considered by GENII (in the east-northeast direction for the elevated release and in the southwest direction for the groundlevel release).
- The population dose can be bounded by a maximum dose calculated as the MEI dose at the MFFF boundary times the total number of site workers and a minimum dose calculated as the MEI dose at the SRS boundary times the total number of workers.
- A total number of site workers equal to the number of site workers in 2000 (approximately 13,616 workers).
- No previous contamination of the ground surface.
- A finite plume model (i.e., center of the plume located at ground level) for the calculation of dose.
- The annual external exposure time to the plume and to soil contamination is 0.7 year for the MEI (NRC 1977a).
- The annual inhalation exposure time to the plume is 1 year for the MEI (NRC 1977a).
- A stack height equal to the actual stack height rather than the effective stack height to negate plume rise.
- Airborne releases used in the SPD EIS (DOE 1999c), which are about one order of magnitude higher than the releases expected during normal MFFF operations.
- No resuspension of soil particles into the air.
- The meteorological data used to determine dose to the public (see Appendix D) were also used to determine dose to the site workers.

The calculation of dose to the site workers was essentially identical to that for the general public with the following exceptions:

1. The distance from the release point.

2. The number of persons exposed.
3. The spatial distribution of persons exposed.

Radiation dose due to the ingestion of food products was not included for the calculation of dose to the site workers because no agriculture occurs within the SRS boundary and, therefore, consumption of food grown within the SRS boundary is impossible. Workers are also assumed to be members of the public (see Section 5.2.10.1).

Doses were calculated for a groundlevel release (1 ft [0.3 m] above grade). The reason for providing dose calculations using a groundlevel release is to bound the calculated dose and provide a buffer in the event that the designed building and/or vent stack heights are modified in the future. R2

Given incident-free operation of the MFFF, the dose to the maximally exposed site worker located at the MFFF boundary from annual operation of the MFFF would be 3.0 mrem/yr. The maximum dose to the site worker population would range from 0.019 person-rem/yr for the site workers located at the SRS boundary to a maximum of 40.8 person-rem/yr for the site workers located at 100 m from the MFFF. As previously indicated, the maximum population dose was calculated as the dose to the MEI times the total number of site workers (i.e., 13,616 workers). The potential radiological impacts on the general public and site workers due to MFFF normal operations are summarized in Table 5-11 and Appendix D, Table D-8. Details regarding calculation of the radiological impact of normal operations of the MFFF on site workers are presented in Appendix D. R2

5.2.10.3 Radiation Doses to Facility Workers

Facility workers are those workers that work on MFFF activities within the MFFF fence. The estimate of average worker dose was calculated based on process and facility design and source term information. Although worker exposures vary, a design objective is to minimize the number of operators submitted to a dose equivalent higher than 500 mrem/yr during normal operation.

The annual dose to facility workers is projected to be 20 person-rem/yr, based on preliminary information concerning facility design and source terms. This dose could increase or decrease as a function of design or operation changes. This dose can also be expressed as an average worker dose of 50 mrem/yr. The dose to facility workers represents a latent cancer fatality (LCF) risk of 8E-03. Doses to individual workers will be kept to a minimum by instituting administrative limits and ALARA programs including worker rotations. R2

5.2.11 Impacts to SRS Infrastructure

SRS infrastructure will be modified and upgraded prior to and during the MFFF construction to accommodate the needs of the MFFF and other surplus plutonium disposition facilities.

Operation of the MFFF is not expected to significantly impact SRS infrastructure other than the impacts to the SRS waste management systems discussed in the next section.

The MFFF will require 130,000 MWh/yr of electricity during operations. SRS has 482,700 MWh of unused capacity. MFFF electrical needs are not anticipated to impact electricity availability for SRS.

The water usage for all mechanical fluid systems during MFFF operation is anticipated to be approximately 322,700 – 485,500 gal/yr (1.8 million L/yr). F area process water system capacity is 2100 gpm with an average demand of 350 gpm (800 gpm peak). The MFFF sanitary water usage is anticipated to be approximately 1.95 million gal/yr (7.4 million L/yr). The domestic water capacity from deep wells supplying the A area loop which includes F Area, is 3,000 gpm and that the average domestic water consumption from the A area domestic water loop in 2000 was 754 gpm (about 1,200 gpm peak). Therefore, no impacts on water availability would be expected. R2 R1

5.2.12 Waste Management Impacts

MFFF operational impacts on SRS waste management activities are discussed in Section 4.4.2.2 of the SPD EIS (DOE 1999c).

The waste management facilities within the MFFF will transfer all wastes generated to SRS waste management facilities. Table 5-12 compares the expected waste generation rates from operating the MFFF with the existing site waste generation rates. R

As described in Section 3.3, the MFFF will not generate any HLW. The aqueous polishing process produces a liquid high alpha activity waste and a stripped uranium waste that will be transferred through two separate double-walled pipes to the WSB. R1

The waste streams that comprise the high alpha liquid waste stream and are to be transferred to SRS for management include the americium stream, the alkaline wash stream, and the excess acid stream. The volume of this combined high alpha waste stream is estimated to be just under 22,000 gallons (83.3 m^3). The composite stream contains approximately 84,000 Curies of americium-241.

The stripped uranium stream will average 42,530 gallons (134 m^3) annually during normal operations and 46,000 gallons (175 m^3) annually during startup. The stripped uranium stream is 1% as uranium-235 to avoid criticality issues.

As described in Section 3.3.2.8, both of these waste streams will be converted to a solid waste suitable for disposal as TRU waste or LLW as appropriate. In addition to the MFFF waste, the WSB will convert approximately 11,000 gallons (41.6 m^3) per year of liquid waste from the PDCF to solid waste.

The MFFF is expected to generate about 385,800 gal (1,460 m^3) per year of low-level liquid waste. The MFFF will include collection tanks with sampling capability for the LLW stream. The waste stream will be verified to meet the acceptance criteria for the SRS Effluent Treatment Facility (ETF). After confirming waste acceptability, it will be pumped on a batch basis to a tie-in with the existing F-Area process sewer. The F-Area process sewer is used to transfer similar low level waste streams from existing operations to the ETF. R1

The WSB will generate a maximum of 235,000 gallons (890 m^3) of liquid LLW annually from the processing of the MFFF and PDCF high radioactivity waste streams. R2

The liquid LLW generated by the MFFF and WSB will be treated at the ETF before release to Upper Three Run. The volume of these wastes [620,800 gal/yr (2,350 m^3/yr)] would be less than 0.1% of the 1,930,000 m^3/yr capacity of the ETF and less than 0.01% of the 7-day, 10-year low flow for Upper Three Run.

The SRS ETF treats low-level radioactive wastewater from the F- and H-Area separations and waste management facilities. The ETF removes chemical and radioactive contaminants before releasing the water in Upper Three Runs, which flows to the Savannah River. Operation of the ETF is approved and permitted by SCDHEC and EPA. R1

The ETF is permitted to treat up to 430,000 gal (1,628 m^3) per day. The ETF includes wastewater collection and treatment operations that were modified for radioactive use. It is designed to remove heavy metals, organic and corrosive chemicals, as well as radiological contaminants.

ETF effluents are discharged within limits of permits issued by SCDHEC. All personnel operating ETF are certified by the South Carolina Environmental Certification Board.

With the proposed addition of 620,800 gal (2,350 m^3/yr) per year of MFFF and WSB low level liquid waste being only a fraction of the facility's design and permit capacity (<0.1%), the additional environmental impacts associated with treatment of this stream will be negligible. The MFFF and WSB contribution to ETF discharges would be 0.000093 m^3/sec compared to the receiving water (Upper Three Runs) 7-day 10-year low flow of 2.8 m^3/sec. R2

Potentially contaminated wastewater will be tested for radiological contaminant levels. If levels are acceptable for discharge, the waste will be discharged to the SRS CSWTF. If contaminant levels are not suitable for discharge, the liquid waste will be discharged to the ETF for processing.

Excess dodecane solvent, contaminated with plutonium, will be transferred to SRS waste management for treatment and disposal as a contaminated solvent waste. This is a very small waste stream of 3,075 gal/yr.

The solid low level and TRU wastes resulting from the MFFF will be processed along with other SRS wastes of the same type in an existing waste infrastructure. This infrastructure is described and the environmental impacts evaluated in the *SRS Waste Management Final Environmental* R1

Impact Statement (DOE 1995b) over a wide range of waste volumes, which could result from SRS and external operations. The MFFF solid TRU waste is estimated to be 248 yd^3 (190 m^3) per year. The WSB would produce an additional 405 yd^3 (310 m^3) of TRU waste per year. Over its lifetime, the MFFF and WSB would expect to generate 6,530yd^3 (5,000 m^3) of TRU waste. The forecast for SRS TRU waste generation over the next 30 years ranges from a minimum estimate of 7,578 yd^3 (5,794 m^3) to 710,648 yd^3 (543,329 m^3), with an expected forecast of 16,433 yd^3 (12,564 m^3) (DOE 1995b, Table A-1). The estimated MFFF lifetime TRU solid waste quantity is about 40% the expected SRS TRU waste forecast but only a small fraction (<1%) of the maximum SRS estimate.

The environmental impacts resulting from the disposal of TRU waste at the Waste Isolation Pilot Plant (WIPP) are discussed in *Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement* (DOE 1997e). The impacts projected in DOE 1997e (Table 2-2 in DOE 1997e) were based on disposal of 170,000 m^3 TRU waste. The additional 5,000 m^3 TRU waste from the WSB represents an increase of 3% in the projected waste disposed. Any increase in impacts resulting from disposing WSB solid TRU waste at WIPP should be within the error associated with any projected impacts of WIPP operation. Furthermore, the *Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement* projected that, "No LCFs would be expected in the population around WIPP from radiation exposure (3 E-4 LCFs). ... no cancer incidence (2 x 10^{-5} cancers) would be expected in the population from hazardous chemical exposure." (DOE 1997e, pg 5-29) The addition of 11,238 m^3 TRU waste from the WSB would not be expected to change this conclusion.

The MFFF solid low level waste (LLW) is estimated to be 134 yd^3 (102 m^3) per year. Assuming that solidification of stripped uranium waste does not result in any volume reduction, the WSB would produce an additional 228 yd^3 (175 m^3) of solid LLW per year. Over its lifetime, the MFFF and WSB would expect to generate 3,620 yd^3 (2,767 m^3) of LLW. The forecast for SRS LLW generation over the next 30 years ranges from a minimum estimate of 480,310 yd^3 (367,223 m^3) to 1,837,068 yd^3 (1,404,539 m^3), with an expected forecast of 620,533 yd^3 (474,431 m^3) (DOE 1995b, Table A-1). The estimated MFFF LLW quantity is only a small fraction of any of the SRS estimates. Consequently, the waste volumes generated from MOX are small in comparison to the annual SRS volumes and impacts to SRS waste management are well within the bounds evaluated in the *SRS Waste Management Final Environmental Impact Statement* (DOE 1995b). R2

R1

All TRU wastes and LLW transferred to SRS waste management facilities would meet the requirements of the applicable Waste Acceptance Criteria (WAC).

Table 5-12 illustrates that the MFFF waste generation rates are generally less than 5% of the SRS generation rates, except for solid TRU waste, which is projected to be about 700% of the SRS annual generation rate. Although the annual MFFF TRU waste generation exceeds the current annual SRS TRU waste generation, the MFFF cumulative TRU waste volumes are well below the maximum projected SRS TRU waste volumes. R1

[Text deleted] R2

5.3 DEACTIVATION

5.3.1 Introduction

The MFFF is owned by DOE and operated by DCS under the terms of the DOE-DCS contract and scope of work. After all of the MOX fuel is fabricated, DCS is required to deactivate the MFFF, terminate the NRC license, and return the facility in its deactivated state back to the DOE. Future use of the facility, including any decision by DOE to decommission or reutilize the facility, will be made after the NRC license is terminated and DCS is no longer involved in this venture. DOE has not determined when and under what circumstances the facility will be decontaminated and either reused or decommissioned (DOE 1999c). As a result, no meaningful alternatives or reasonably foreseeable future impacts of decommissioning can be assessed.

Deactivation is the process of removing a facility from operation and placing the facility in a safe-shutdown condition that is economical to monitor and maintain for an extended period until reuse or decommissioning (DOE 1999d). There are no explicit NRC regulations governing this process other than the requirement to continue compliance with the applicable provisions of 10 CFR Part 20 and 10 CFR Part 70 and any other facility-specific conditions imposed by NRC during MFFF operations. In SECY 99-177 (NRC 1999b), the NRC staff indicated that

> … DOE intends to assume responsibility for decommissioning the MOX fuel fabrication facility and has included in its contract with the consortium a requirement that, following completion of its mission for disposition of excess plutonium by conversion to MOX fuel, the facility will be deactivated and returned to DOE for decommissioning.… NRC licensing and regulatory authority applies to "…any facility under a contract with and for the account of the Department of Energy that is utilized for the express purpose of fabrication of mixed plutonium-uranium oxide nuclear reactor fuel for use in a commercial nuclear reactor…", NRC may interpret that authority to apply only when the facility is being operated under contract with DOE. Therefore the regulatory authority would end and the license could be terminated to return the facility to DOE regulatory oversight when the facility is no longer operated for this purpose.

Deactivation is similar to the restricted release of property allowed by 10 CFR §70.38 for decommissioning of facilities. NRC defines decommissioning as removing a facility or site safely from service and reducing residual radioactivity to a level that permits (1) release of the property for unrestricted use and termination of the license; or (2) release of the property under restricted conditions and termination of the license (10 CFR §70.4). The DOE-DCS contract statement of work describes the state of deactivation as having the following characteristics:

1. All loose surface contamination is removed.
2. The facility is accessible without protective clothing.

3. All gloveboxes and associated ventilation systems are sealed in accordance with applicable standards to enable removal from the facility.

4. All systems are depressurized and/or disabled, as applicable, except as required to enable accessibility as stated in (2) above.

5. All remaining unused plutonium and uranium feed materials are packaged in appropriate containers and provided to DOE for disposition. All nuclear waste products are packaged as required in Option 2 of the contract and provided to DOE for disposition.

6. All processing chemical substances are removed and disposed of in accordance with applicable regulations.

Deactivation of the MFFF must be accomplished in a manner that will support the ultimate decommissioning or reutilization of the facility in compliance with the applicable DOE regulations. 10 CFR §20.1101(b) requires that a licensee shall use, to the extent practicable, procedures and engineering controls based upon sound radiation principles to achieve occupational doses and doses to members of the public that are ALARA. Compliance with the ALARA requirement will be required throughout MFFF operations and will continue throughout the deactivation process by minimizing waste volumes and the spread of radioactive contamination. Upon completion of MFFF deactivation, the following conditions shall apply:

- The whole-body dose (internal and external) shall be less than 100 mrem/yr (less than 0.05 mrem/hr for continuous occupancy) for minors, students, visitors, and the public, resulting in a lower limit than specified in 10 CFR §20.1207 and 10 CFR §20.1301(a)(1).

- The external dose from the deactivated facility in any restricted area shall not exceed 2 mrem in any one hour, as specified in 10 CFR §20.1301(a)(2).

Upon completion of MFFF fuel fabrication activities, a preliminary characterization will be performed to establish a baseline of information concerning the physical, chemical, and radiological condition of the facility. These results will serve as the technical basis for selected preferred deactivation techniques and developing the detailed scope of work for the deactivation.

The following subsections discuss the design and administrative features that will facilitate the deactivation of the MFFF to a state where a fuel fabrication license from the NRC is no longer required. This section also discusses the potential environmental impacts associated with these deactivation activities and the availability of the MFFF and its site for reutilization after deactivation is completed.

5.3.2 Design Features to Facilitate Deactivation

Specific features are incorporated into the MFFF design that will facilitate both deactivation and the eventual decommissioning or reutilization of the facility. Facility design features that result in waste minimization, minimization of the spread of radioactive contamination, and maintenance of occupational and public doses at ALARA levels during MFFF operations will also serve to facilitate deactivation.

Design features that will minimize waste generation include placing only essential process equipment in gloveboxes, using materials that are easily cleaned, and isolating utility systems from plutonium processing equipment to prevent its contamination. These design features will simplify the deactivation approach and result in life-cycle cost reductions.

Six different types of design features are incorporated into the MFFF that will minimize the spread of radioactive contamination and maintain occupational and public doses ALARA:

1. **Plant layout**: All areas of the MFFF are sectioned off into clean areas and potentially contaminated areas with appropriate radiation zone designations to meet 10 CFR Part 20 criteria. Process equipment and systems are situated according to radiation zone designations and have adequate space to facilitate access for required maintenance to permit easy installation of shielding. The plant layout provides for ready removal of equipment and appropriate space for equipment decontamination. Thus, human factors in the design will result in minimal doses during deactivation. In addition, a comprehensive ALARA Report, documenting room-by-room ALARA reviews performed at various stages in the design process, will provide significant input into the deactivation process.

2. **Access control**: In accordance with ALARA design considerations in 10 CFR Part 20, an appropriate entry control program for MFFF radiological areas has been established with associated ingress and egress monitoring. The Access Control Point provides for removal of protective clothing and verification that personnel contamination has not occurred. Step-off pads and locked doors and barriers complete the access control design features, which will be actively used during the deactivation process.

3. **Radiation shielding**: The radiation shielding design is based on conservative estimates of quantity and isotopic materials anticipated during operations. The analyses address both gamma and neutron radiation and include exposures due to scatter and streaming radiation. Therefore, the shielding design will minimize the occupational doses during deactivation.

4. **Ventilation**: The MFFF ventilation system has been designed with the capability of capturing and filtering airborne particulate activity and is continuously maintained under a slight negative pressure. Lastly, gloveboxes and hoods are installed in various rooms to contain and/or move airborne contaminants away from the worker's breathing zone. Each of these design features contributes to meeting ALARA criteria during operations and deactivation.

5. **Structural, mechanical, instrumentation, and electrical components**: Numerous design features of the MFFF (e.g., use of washable epoxy coatings, segregation of waste streams, remote readout for instrumentation, and location of breaker boxes and electrical

cabinets in low-dose-rate areas) facilitate decontamination, minimize the spread of contamination, and maintain doses to facility personnel ALARA.

6. **Radiation monitoring**: The MFFF is designed with a comprehensive array of radiation monitoring systems to monitor working spaces and potential releases to the environment for the purpose of protecting the health and safety of the workforce, the public, and the environment. These systems include area radiation monitoring, airborne radiation monitoring, airborne radioactive effluent monitoring, and alarm monitoring. This protection will be afforded throughout operations and deactivation.

5.3.3 Administrative Features to Facilitate Deactivation

The MFFF design utilizes lessons learned from the operation of the MELOX and La Hague facilities in France to minimize contamination during operations, thereby reducing the effects of contamination on deactivation. Good housekeeping practices are essential in keeping plant surfaces clean. Periodic housekeeping is performed within contaminated areas to minimize the buildup of contamination and contaminated waste. Contaminated gloveboxes and the general work area are decontaminated periodically to minimize removable contamination. Appropriate control zones with limits and action levels to control contamination for those zones will be established. Contamination control will be accomplished through implementation of the many operational programs and practices that will significantly facilitate the eventual deactivation of the facility. These operational programs and practices will continue to be employed throughout facility deactivation and will complement the design features to ensure that the deactivation activities will result in minimal doses.

5.3.4 Projected Environmental Impacts of Deactivation

The design and administrative controls associated with the comprehensive deactivation activities, should maintain occupational and public doses within the ALARA criteria. Therefore, these controls will be well within applicable 10 CFR §20.1207, 10 CFR §20.1301(a)(1) and 10 CFR §20.1301(a)(2) levels. These levels are as follows:

- The whole-body dose (internal and external) shall be less than 100 mrem/yr (less than 0.05 mrem/hr for continuous occupancy) for minors, students, visitors, and the public, resulting in a lower limit than specified in 10 CFR §20.1207 and 10 CFR §20.1301(a)(1).

- The external dose from the deactivated facility in any restricted area shall not exceed 2 mrem in any one hour, as specified in 10 CFR §20.1301(a)(2).

The deactivation plan identifies four processes to deactivate the MFFF. These are radioactive and chemical characterization for the general areas; characterization of the gloveboxes; and remediation of the general areas and gloveboxes. The total occupational radiation exposure associated with these activities is 420 person-rem and is based on occupancy time in a low dose rate area. R1

Deactivation will not involve demolition or removal of buildings. Physical barriers to the release of contamination will continue in place during deactivation. Contaminant releases should be within the levels experienced during operations. Waste generated during deactivation should approximate that generated from routine maintenance activities during the operational phase of the MFFF. Since the ALARA criteria will be met, there will be no meaningful environmental impacts to the workers and the general public.

5.3.5 Projected Environmental Impacts of Decommissioning

The final facility disposition activity is typically decommissioning, where the facility is taken to its ultimate end state through decontamination and/or dismantlement to demolition or entombment. Although a general plan for decommissioning has not yet been developed, NNSA has proposed four options for decommissioning this facility. A conservative approach is to assume that the facility will be decontaminated, dismantled, and the environment restored as presently being implemented at the Rocky Flats Environmental Technology Site (RFETS) near Denver, Colorado. Utilizing recent information from the RFETS decommissioning project, DCS has conservatively established the approximate MFFF decommissioned building area, MFFF glovebox volumes, and MFFF glovebox weights. R1

The values for decommissioning waste volumes for the MFFF were estimated using waste volumes from the decommissioned RFETS facilities. The following assumptions apply to this analysis:

1. The MFFF waste estimate was based on the decommissioning waste estimating method used for similar RFETS plutonium handling facilities. This method used the physical characteristics and waste generated from the decommissioning of the first DOE site plutonium facility that was completed in 2000. Relevant metrics (e.g., cubic meters of glovebox volume, pipe length, process area square feet) were compared against the TRU, low-level, low-level mixed, and construction demolition waste generated during the decontamination, strip-out, and decommissioning of the building. Factors developed from these comparisons were consequently applied to the remaining plutonium facilities at the site. R1

2. The summary estimate methodology identified the RFETS buildings that were most representative of the processes within the MOX and AP facilities. The methodology assumed that the secondary systems (i.e., ventilation, instrumentation and control, power, etc.) were similar. It also assumed that the decommissioning methods used for these facilities would be similar to those that were used for RFETS facilities.

The results of the comparison projected 2,500 yd^3 (1,900 m^3) of TRU waste, 43,000 yd^3 (33,000 m^3) of LLW and 70,000 tons of nonradioactive demolition waste.

5.3.6 Accessibility of Land After Deactivation

Once the MFFF is deactivated and its NRC license terminated, accessibility to the land surrounding the facility will be controlled by DOE and subject to its applicable security requirements. If DOE decides not to reuse the facility and proceeds with decommissioning then further decontamination and dismantlement of the buildings will occur. In either case, a final radiological survey will verify that the radiological endpoint conditions have been satisfied. This survey will be designed and implemented with the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) methodology that will demonstrate compliance with dose- or risk-based regulation (NRC 2000b). Due to these comprehensive deactivation and/or decommissioning activities, no accessibility limitations resulting from radioactive contamination are expected. R1

5.4 TRANSPORTATION

An assessment of the human health risks of the overland transport of radioactive materials is important to a complete appraisal of the environment impacts of the MFFF. Operational transportation impacts may be divided into two parts: impacts due to incident-free transportation and those due to transportation accidents. They may be further subdivided into nonradiological and radiological impacts. Nonradiological impacts are specifically vehicular, such as vehicular emissions and traffic accidents. Radiological impacts are those related to the dose received by transportation workers (e.g., truck crew, inspectors) and the public during normal operations and in the case of accidents in which the radioactive material being shipped may be released. See Appendix E for more detailed information on the transportation analysis performed. The following discussion summarizes the transportation risk results for each of the types of material shipments.

5.4.1 Plutonium Oxide Feedstock

The environmental impacts of plutonium transport from the various DOE site to the SRS was evaluated previously (DOE 1999c). Cumulative dose to transportation workers was estimated at 7.8 person-rem representing a LCF risk of 3.9E-03. Cumulative dose to the public was estimated at 4.1 person-rem representing a LCF risk of 2.0E-03. R1

Plutonium oxide feedstock will be moved by an appropriate means of transport from the adjacent PDCF or the K-Area Material Storage (KAMS) facility to the MFFF. Because the facilities are located on SRS and there is no transport over public roads, there is no need to consider additional environmental impacts associated with plutonium feedstock movement to the MFFF. R2

5.4.2 Uranium Dioxide Feedstock

A specific supplier of uranium dioxide feedstock has not been selected at this time. For purposes of this ER, the assumptions employed in Section 4.4.2.6 of the SPD EIS (DOE 1999c) were used.

A DOE enrichment facility near Portsmouth, Ohio[4], was chosen as a representative site for the source of the depleted uranium hexafluoride (UF_6), and a nuclear fuel fabrication facility in Wilmington, North Carolina, was chosen as representative of a uranium conversion facility. The environmental impacts associated with the transfer and conversion of UF_6 to UO_2 are discussed in the SPD EIS (Section 4.30.3). A total of 110 shipments of up to five 30-in (76-cm) diameter UF_6 cylinders needed for the MOX fuel would be sent via commercial truck to the uranium conversion facility at Wilmington, North Carolina. After conversion into uranium dioxide, the depleted feed material would be shipped in 55-gal (208-L) drum containers via commercial truck from the conversion facility to the MFFF at SRS. A total of 60 shipments of depleted uranium dioxide would be required to supply sufficient feed material to satisfy the mission requirements for the disposition of 37.5 tons (34 metric tons) of plutonium. R1 R2

5.4.2.1 Impacts of Incident-Free Transportation

The total dose for the entire shipping campaign to the transportation workers associated with the UF_6 shipments is estimated to be 1.06 person-rem, corresponding to 4.22E-04 LCFs. The total dose to transportation workers associated with the UO_2 shipments is estimated to be 0.78 person-rem, corresponding to 3.10E-04 LCFs. R1

The dose to the public for the entire shipping campaign associated with the UF_6 shipments is estimated to be 0.21 person-rem, corresponding to 1.05E-04 LCFs. For the UO_2 shipments, the total dose to the public is estimated to be 0.14 person-rem, corresponding to 6.90E-05 LCFs. R2 R2

The estimated number of nonradiological fatalities due to exhaust emissions exceeds the radiological fatalities. The number of nonradiological fatalities associated with the UF_6 shipments is estimated to be 1.03E-02; the corresponding value for the UO_2 shipments is 2.68E-03. See Table E-3 for all incident-free transportation impacts. R2

5.4.2.2 Impacts of Transportation Accidents

The total transportation accident risks were estimated by summing the risks to the affected population from all hypothetical accidents. For the UF_6 shipments, this process resulted in an estimated number of LCFs of 3.11E-03, equivalent in magnitude to the nonradiological physical risk value of 2.24E-03 calculated by applying the historical accident rate by the number of miles shipped for this material. Similarly, for the UO_2 shipments, the estimated number of LCFs is 3.18E-06, well below the nonradiological value of 5.81E-04 calculated by applying the historical accident rate by the number of miles shipped for this material. R1 R1

[4] There is a large stockpile of depleted UF_6 from historical operations that will continue to be stored onsite and should be available for use in the fabrication of MOX fuel. As noted in the SPD EIS (pg 1-9 footnote 20) Portsmouth is the only gaseous diffusion facility capable of transferring UF_6 from the 14-ton storage canisters to the 2.5-ton feed canisters. R2

Biwer et al., in a recent 1997 *Transportation Impact Analyses in Support of the Depleted UF_6 Programmatic Environmental Impact Statement* noted, "The chemical risk associated with UF_6 cylinder transport would be much less than the radiological risk; however, the total risks would be dominated by vehicle-related risks, which would be about 10 times larger than the radiological and chemical risks combined." Consequently, the chemical hazard for UF_6 was not considered for incident-free transport.

The chemical hazard of UF_6 is only a concern in the unlikely event the container is breached during an accident and the UF_6 is released to the atmosphere and subsequently exposes people, primarily through inhalation. UF_6 is not a carcinogen, so latent cancer incidences are not expected.

Acute impacts to human health can range from slight irritation to fatality for the exposed individuals. Two endpoints for acute health effects were assessed in Biwer et al. 1997: potential for irreversible adverse health effects (from permanent organ damage or the impairment of everyday functions up to and including lethality) and potential for adverse effects (effects that occur at lower concentrations and tend to be mild and transient in nature). Using the collective population unit risk factors for the chemical hazards of UF_6 shipped by truck of 1.0E-12 adverse effects/km and 7.1E-13 irreversible adverse effects/km (Biwer et al. 1997) and the shipment distance and number of shipments, the calculated number of adverse effects is 1.0E-07 and the number of irreversible adverse effects is 7.2E-08. These impacts are much less than radiological impacts noted above. The impacts are also well below predicted risk of physical damage to individuals from traffic accidents involving the transport vehicles. See Table E-3 for all transportation accident impacts. R1

5.4.2.3 Maximally Exposed Individuals

The risk to MEIs under incident-free transportation conditions was estimated for four different hypothetical exposure scenarios: (1) an inspector receiving a dose while the vehicle is at a stop, (2) a person stuck in traffic for 30 minutes next to the vehicle, (3) a gas station worker receiving a dose while refueling the truck, and (4) a resident at his or her home located 98 ft (30 m) from the shipment route who is present for all shipments on this route. The maximum dose resulting from these scenarios was obtained for the person stuck in traffic next to a shipment of UO_2, with an estimated dose of 0.33 mrem (see Table E-8). If the exposure duration was longer, the dose would rise proportionately. This dose is minimal and indistinguishable from background radiation levels.

5.4.3 MOX Fuel

After fabrication, the unirradiated MOX fuel assemblies will be shipped via SafeGuards Transporter (SGT) truck (see Appendix E, Section E.3.3) to the selected commercial reactor sites: McGuire Nuclear Station and Catawba Nuclear Station. Much of the routes to both McGuire and Catawba are similar because of the close proximity of the two sites. These two sites, housing four reactors, represent the current contracts for irradiation of MOX fuel. For R2 purposes of this ER DCS has performed transportation analyses to a generic Midwestern mission reactor assumed to be located 1335 miles from the MFFF. This site was selected after considering a variety of distance and population permutations for the eastern United States and is considered to be bounding for any reactor located in the eastern or central United States. Between 2007 and 2021, a total of about 1,748 MOX fuel assemblies will be shipped from the MFFF at SRS to the mission reactors, with 238 shipments to the Catawba Nuclear Station, 212 shipments to the McGuire Nuclear Station, and 148 shipments to the generic mission reactor. Although the plutonium content will average about 4.3% of the total heavy metal per assembly, a maximum value of 6.0% plutonium content was used for the source term in the analysis for conservatism. R2

5.4.3.1 Impacts of Incident-Free Transportation

For all fuel shipments, the total dose to transportation workers, during the entire campaign, is estimated to be 34.1 person-rem, corresponding to 1.36E-02 LCFs (see Table E-3). The dose to the public associated with these shipments is estimated to be 9.98 person-rem, corresponding to 4.99E-03 LCFs (see Table E-3).

The estimated number of nonradiological fatalities (4.70E-02) due to exhaust emissions exceeds the radiological fatalities (4.99-03). The number of nonradiological fatalities associated with the MOX shipments is a function only of the total distance traveled. R2

5.4.3.2 Impacts of Transportation Accidents

The total transportation accident risks were estimated by summing the risks to the affected population from all hypothetical accidents for each of the individual routes and multiplying by the number of shipments to each site. For all MOX shipment routes, the nonradiological risks greatly exceed the radiological risks. The total number of LCFs due to radiological causes for the MOX fuel shipments is estimated to be 6.33E-11. The nonradiological estimate yielded 1.02E-02 fatalities, calculated by applying the historical accident rate by the number of miles shipped for this material. R1

5.4.3.3 Maximally Exposed Individuals

The risk to MEIs under incident-free transportation conditions was estimated for four different hypothetical exposure scenarios: (1) an inspector receiving a dose while the vehicle is at a stop, (2) a person stuck in traffic for 30 minutes next to the vehicle, (3) a gas station worker receiving a dose while refueling the truck, and (4) a resident at his or her home located 98 ft (30 m) from the shipment route who is present for all shipments on this route. However, the dose to the inspector and the gas station worker for the MOX shipments is not considered since these duties are performed by the SGT crew (who are subject to a radiation monitoring program). The maximum dose resulting from these scenarios was obtained for the person stuck in traffic next to a shipment of MOX fuel, with an estimated dose of 2.0 mrem (see Table E-8). If the exposure duration was longer, the dose would rise proportionately. This dose is minimal and indistinguishable from background radiation levels.

5.4.4 Radioactive Wastes

All radioactive wastes will be moved from the MFFF to the SRS facilities for radioactive waste treatment, storage, and disposal. These wastes will be handled in the same manner as other SRS site waste shipments and would not represent a large increase in the amount of waste generated at the site. The environmental impacts of transportation of waste from the SRS facilities to ultimate disposal sites are documented in the *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (DOE 1997a) and the *Savannah River Site Waste Management Final Environmental Impact Statement* (DOE 1995b). R2

Radioactive wastes from MFFF operations will be transferred to the WSB for treatment prior to transport and disposal either onsite at SRS centralized facilities (LLW), offsite LLW facilities or offsite at WIPP for the transuranic (TRU) waste. The *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (DOE 1997a) presents the evaluation of environmental impacts associated with the treatment, storage and disposal of LLW generated on the SRS. As noted in Section 5.2.12, the environmental impacts from the LLW generated by MFFF, PDCF, and WSB would be bounded by the impact estimates in DOE 1997a. In *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste*, DOE projected a 10-year cumulative dose to the offsite MEI of 2.1E-03 rem for transport of 130,030 shipments (Table 11.17-1) or a projected maximum annual dose of 0.21 mrem. Since the MFFF, PDCF, and WSB LLW would be, conservatively, 1% of the annual SRS LLW generation volume, the MFFF, PDCF, and WSB LLW contribution to the annual offsite transportation MEI dose would be less than 0.0025 mrem. R2

Following processing at the WSB to reduce waste volumes[5], and chemical treatment and solidification, the TRU wastes will be loaded into 55-gallon drums and inserted into TRUPACT II shipping containers for transport via truck to WIPP. The environmental impacts of transportation of TRU waste from SRS centralized facilities to WIPP are documented in the *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (DOE 1997a) and the *Savannah River Site Waste Management Final Environmental Impact Statement* (DOE 1995b). R2
Using data provided in these two documents, an estimate of public dose was developed for the shipment of MFFF generated TRU waste to WIPP[6]. For 35 shipments of TRU waste, the total R2

[5] DOE is evaluating two options for processing high alpha waste to solid TRU waste. One option involves volume reduction and the alternative option does not utilize any volume reduction. For conservativism, the number of shipments used (110) reflect the option without volume reduction.

[6] DOE 1997a, Table E-27 projects a dose of 3.6E-04 Rem for 2,370 shipments passing the MEI located at the site entrance for SRS in the decentralized option. This yields an average dose of 1.5E-07 per shipment.

additional dose to the MEI is 5.3 E-03 mrem, which equates to an increase in lifetime cancer risk of 2.6E-09. The consequences from the most severe transportation accidents involving the transport of the TRU waste are also bounded by the evaluation in DOE 1997a. R2

5.4.5 Comparison with NUREG-0170

The NRC analyzed the environmental impacts of the normal routine transportation of radioactive material in NUREG-0170, *Final Environmental Statement on the Transportation of Radioactive Material by Air and Other Modes* (NRC 1977c). This EIS included an evaluation of the impact of fuel cycle shipments in 1975 and a projected estimate of shipments in 1985. The 1985 projections reflected the potential development of plutonium recycle and included an estimate of 41 shipments of MOX fuel assemblies via truck. A total of 598 MOX shipments will be required for the MFFF over a period of 13 1/2 years, an average of about 44 shipments per year. R2

The NRC determined that the environmental impacts of normal transportation of radioactive material and the risk attendant to accidents involving these materials (which includes those fuel cycle activities associated with power production) were sufficiently small to allow continued shipments via the existing federal regulations. The analysis concluded that "The average radiation dose to the population at risk from normal transportation is a small fraction of the limits recommended for members of the general public from all sources of radiation other than natural and medical sources and is a small fraction of natural background dose." This conclusion has been confirmed for the MOX fuel shipments by comparing the dose determined by the NRC in its 1985 projections with a calculated dose from the SRS MFFF to the reactor sites at McGuire and Catawba Nuclear Stations. The incident-free dose per shipment (in person-rem) for the plutonium recycle shipments in NUREG-0170 was calculated to be 0.17, versus a maximum of 0.2 person-rem per shipment for the MOX shipments from the SRS MFFF to the generic mission reactor site (0.03 person-rem for transport to the Catawba and McGuire Nuclear Stations). The dose to the MEI for the person in traffic next to a shipment of MOX fuel is 2.0 mrem. This dose is a small fraction of the dose received from natural background radiation and is consistent with the conclusions of NUREG-0170. R2 R2

5.5 FACILITY ACCIDENTS

This section summarizes the evaluation of potential facility accidents at the MFFF and associated facilities. The evaluation includes internal process-related events, external man-made events, and events associated with natural phenomena. The evaluations of these events show that the environmental risk from a facility accident is low.

The information presented in this section is based on Chapter 5 of the MFFF Construction Authorization Request, Safety Assessment of the Design Basis. The analysis method uses conservative assumptions and produces a comprehensive, bounding analysis. Appendix F provides additional analysis details for the MFFF and Appendix G provides information for the WSB. R1 R2

5.5.1 Environmental Risk Assessment Method

Accidents that could occur as a result of MFFF operations are identified and evaluated in a systematic, comprehensive manner. The general approach includes the following evaluations:

- Internal Hazard Identification – A systematic and comprehensive identification of radioactive, hazardous material, and energy sources throughout the MFFF

- External Hazard Identification – A systematic and comprehensive identification of applicable natural phenomena and events originating from nearby facilities

- Hazard Evaluation – A systematic and comprehensive evaluation to postulate event scenarios involving the information developed in the Hazard Identification

- Accident Analysis – A detailed evaluation of postulated events to determine consequences and frequencies and to identify appropriate prevention and mitigation features. The accident analysis evaluates all credible events as defined in Appendix F. Thus, all internally initiated accidents are evaluated without regard to their initiating frequency, and all natural phenomena hazard and external man-made hazard generated events are evaluated unless their probability of impacting the MFFF is extremely low. The results of the evaluation include events with no or low consequences, design basis events, and severe accidents.

5.5.2 Environmental Risk Assessment Summary

Potential accidents that could occur as a result of MFFF operations have been grouped into one of the following event types:

- Natural phenomena
- Loss of confinement
- Internal fire
- Explosion
- Load handling
- External man-made events
- Criticality
- Direct radiation exposure
- Chemical releases.

The environmental risk assessment addresses the consequences associated with accidents in each event type up to and including design basis accidents. The environmental impacts of beyond design basis events are remote and speculative and do not warrant consideration under NEPA. While beyond design basis events are theoretically possible, their likelihood of occurrence is so low as to not result in any significant, additional risk from MFFF operations.

Design basis events for each event type are discussed in the following sections.

5.5.2.1 Natural Phenomena

A screening process was performed on a comprehensive list of natural phenomena to identify those credible natural phenomena that have the potential to affect the MFFF during the period of facility operation. Credible natural phenomena that could have an impact on MFFF operations include the following:

- Extreme winds
- External flooding
- Earthquakes
- Tornadoes
- External fires
- Rain, snow, and ice
- Lightning.

Natural phenomena could result in either the dispersion of radioactive material and hazardous chemicals or a loss of subcritical conditions. Natural phenomena events are discussed in the following sections.

5.5.2.1.1 Extreme Winds

Extreme winds are straight-line winds associated with thunderstorms or hurricanes. The design basis extreme wind has an annual exceedance probability of 1E-04. Extreme wind loads include loads from wind pressure and wind-driven missiles.

The associated wind load criteria are based on a basic wind speed of 130 mph. The wind-driven missile considered in the design is a 2- by 4-in (5.1- by 10.2-cm) timber plank, 15 lb (6.8 kg), at 50 mph (horizontal), at a maximum height of 50 ft (15.2 m).

The MFFF is designed to withstand the effects of the design basis extreme wind and the associated missiles. The design and associated margin reduce the likelihood of significant damage to the MFFF to Highly Unlikely. The likelihood definition is provided in Appendix F. Thus, no significant radioactive or hazardous material release or loss of subcritical conditions at the MFFF is postulated to occur for extreme wind events.

5.5.2.1.2 External Flooding

External flooding includes floods associated with rising rivers or lakes. The design basis flood has an annual exceedance probability of 1E-05 and would be expected to reach an elevation of less than 210 ft (64 m) above msl at SRS.

The MFFF site elevation is greater than 260 ft (79 m) above msl. Thus, no radioactive or hazardous material release or loss of subcritical conditions at the MFFF is postulated to occur for external floods.

5.5.2.1.3 Earthquakes

Earthquakes may result from movement of the earth's tectonic plates or volcanic activity. The design basis earthquake for the MFFF site is selected to have a 0.20g maximum ground acceleration applied at grade and a Regulatory Guide 1.60 spectral shape in the horizontal and vertical directions. This represents accelerations with an annual exceedance probability of approximately 1E-04 for frequencies of practical structural interest.. The possibility of soil liquefaction during an earthquake is also evaluated. R1

The MFFF 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 MFFF to Highly Unlikely. Thus, no significant radioactive or hazardous material release or loss of subcritical conditions at the MFFF is postulated to occur for earthquakes.

5.5.2.1.4 Tornadoes

Tornadoes may occur in extreme weather such as thunderstorms or hurricanes. The design basis tornado has an annual exceedance probability of 2E-06. Tornado loads include loads due to tornado wind pressure, loads created by the tornado-created differential pressure, and loads resulting from tornado-generated missiles.

The associated wind load criteria and differential pressure load criteria for the MFFF site are based on the following:

- Maximum tornado wind speed: 240 mph
- Pressure drop across tornado: 150 psf
- Rate of pressure drop: 55 psf/sec.

The associated tornado-generated missile load criteria are based on the following:

Missile Description	Mass (lb)	Horizontal Impact Speed (mph)	Maximum Height (ft)	Vertical Impact Speed (mph)
3-in (7.6-cm) diameter steel pipe	75	75	100	50
2- by 4-in (5.1- by 10.2-cm) timber plank	15	150	200	100
Automobile	3,000	25	rolls and tumbles	not applicable

R1

The MFFF is designed to withstand the effects of the design basis tornado, and missile barriers are provided at building openings as necessary. The design and the associated design margin reduce the likelihood of significant damage to the MFFF to Highly Unlikely. Thus, no significant radioactive or hazardous material release or loss of subcritical conditions at the MFFF is postulated to occur for tornadoes.

5.5.2.1.5 External Fires

External fires are those fires associated with nearby forests or vegetation. Fires associated with nearby facilities are discussed in Section 5.5.2.6. The design basis external fire assumes a forest fire occurs in the forest nearby the MFFF site.

The MFFF is designed to withstand the design basis external fire. Thus, no radioactive or hazardous material release or loss of subcritical conditions at the MFFF is postulated to occur for external fires.

5.5.2.1.6 Rain, Snow, and Ice

Rain, snow, and ice are postulated to occur at the MFFF site several times during operation of the facility. The design basis rainfall has an annual exceedance probability of 1E-05, which corresponds to a peak rainfall of 7.4 in (18.8 cm) in one hour, or 3.9 in (9.9 cm) in 15 minutes. The design basis snow and ice events have an annual exceedance probability of 1E-02. The loads associated with these events are less than 10 psf. The effects of snow and ice loads associated with events that have a lower annual exceedance probability are bounded by the design for other live loads.

The MFFF is designed to withstand the effects of rain, snow, and ice. Thus, no radioactive or hazardous material release or loss of subcritical conditions at the MFFF is postulated to occur during or following these conditions.

5.5.2.1.7 Lightning

Lightning occurs during extreme weather (e.g., thunderstorms) and is postulated to occur on or near the MFFF site several times per year. Protection is provided in accordance with NFPA 780 (NFPA 1997). Thus, no radioactive or hazardous material release or loss of subcritical conditions at the MFFF is postulated to occur during or following these conditions.

5.5.2.2 Loss of Confinement

Within the MFFF, radioactive material is confined within one or more confinement barriers. Primary confinement barriers include gloveboxes and the associated ventilation systems; welded vessels, tanks, and piping; plutonium storage (inner can) containers; fuel rod cladding; ventilation system ducts and filters; and some process equipment. Secondary confinement barriers include plutonium storage containers (outer can), process rooms and the associated ventilation systems, and process cells and the associated ventilation systems. Tertiary confinement systems include the MFFF building and the associated ventilation systems.

The loss or damage of the primary confinement barrier may result in either the dispersion of radioactive materials and hazardous chemicals or a loss of subcritical conditions. Criticality events and the effects of hazardous chemicals are discussed in Sections 5.5.2.7 and 5.5.2.9, respectively. The loss at each level of confinement is necessary for a non-negligible release from the MFFF site to occur.

Damage to or failure of the confinement barriers can be caused by human error or equipment failure resulting in the following:

- Failure of negative pressure or a flow perturbation causing flow reversals between some confinement zones
- Breaches of container or rod confinement boundaries due to crushing, shearing, grinding, cutting, and handling errors
- Backflow into lines that penetrate primary and secondary confinement boundaries
- Corrosion-induced confinement failures
- Pipe or vessel breaks or leaks
- Clogging of filters
- Failure of filters
- Glove or seal failures during normal or maintenance operations
- Thermal excursions leading to failure of gloves, seals, and/or cladding.

Loss-of-confinement events caused by fires, explosions, load-handling events, natural phenomena, and external events are covered in their respective event discussions. Loss-of-confinement events are postulated to occur and are evaluated for each primary confinement within the MFFF without regard to the probability of the initiating event. Postulated loss-of-confinement events include the following:

- Loss of confinement from a glovebox containing powders, pellets, solutions, or fuel rods
- Loss of confinement from aqueous polishing process equipment containing plutonium or americium in solution form R2
- Loss of confinement from canisters, fuel rods, fuel assemblies, HEPA filters, or waste drums
- Loss of confinement from transportation packages or UO_2 drums.

The loss-of-confinement event postulated to produce the largest radiological consequences (See Appendix F for a definition of bounding events) is an event caused by a load handling accident of the Jars Storage and Handling Unit. See Section 5.5.2.5 for a description of this event. The bounding radiological consequences associated with this event are provided in Table 5-13. Appendix F provides assumptions associated with this event. The frequency associated with this event is estimated to be unlikely or lower since multiple failures are required for this event to occur. R2 R2

The bounding low consequence event consequence is a spill involving a silver recovery tank. Consequences are presented in Table 5-13b. The frequency of this event is estimated to be not unlikely or lower. R2

The MFFF utilizes many features to reduce the likelihood and consequences of these events as well as other loss-of-confinement events. Key features include reliable and redundant confinement systems; process temperature, pressure, and flow controls; radiation monitoring systems; redundant control systems; emergency procedures; and worker training.

As shown in Tables 5-13a and 5-13b, the radiological consequences at the SRS site boundary are low. Such impacts would not be sufficient to warrant evacuation of the public or interdiction or decontamination of land or food supplies. Tables 5-13a and 5-13b also show that the radiological consequences to the nearest site worker are low. Appendix F provides assumptions associated with this event. R2

Given the low consequences and or low likelihood of this type of accident, the radiological risk from the loss-of-confinement events is low. R1

5.5.2.3 Internal Fire

A fire hazard arises from the simultaneous presence of combustible materials, an oxygen source, and a sufficient ignition source. A fire can spread from one point to another by conduction, convection, or radiation. The immediate consequence of a fire is the destruction, by combustion or by thermal damage, of elements in contact with the fire. A fire can lead to either the dispersion of radioactive materials and hazardous chemicals or a loss of subcritical conditions. Criticality events and the effects of hazardous chemicals are discussed in Sections 5.5.2.7 and 5.5.2.9, respectively.

Fires can be caused by human error, electrical equipment failures, equipment that operates at high temperatures, uncontrolled chemical reactions, or static electricity.

Fires are postulated to occur and are evaluated for each fire area within the MFFF without regard to the probability of the fire occurring. Fire areas and the associated fire boundary limit the size of the fire and contain the fire within the fire area. MFFF fire areas often correspond, but are not limited, to existing room boundaries. Thus, a facility-wide fire or a fire involving two or more fire areas simultaneously is a remote and speculative event. Postulated fires include the following: R2

- Fires within a fire area involving gloveboxes containing plutonium powder, pellets, solutions, or fuel rods R2
- Fires within a fire area involving aqueous polishing process equipment containing plutonium and/or americium in solution form R2
- Fires within a fire area involving fuel rods, fuel assemblies, canisters of plutonium, HEPA filters, or waste drums
- Fires within a fire area involving plutonium in transportation packages or uranium in drums.

The bounding fire event is a fire in the fire area containing the Final Dosing Unit. This unit contains polished plutonium powder for the purpose of down blending the mixed oxide powder to the desired blend for fuel rod fabrication. The evaluation conservatively assumes that a fire occurs in this fire area and impacts the powder stored in this area, resulting in a release of radioactive material. The bounding radiological consequences associated with this event are provided in Table 5-13a. The frequency associated with this event is estimated to be unlikely or lower since multiple failures are required for this event to occur. R2

The bounding low consequence fire event is a fire in a waste drum located in the truck bay. The frequency of this event is estimated to be not unlikely or lower as a fire could occur following the ignition of combustible material due to an electrical short or an unknown ignition source. Consequences of the event are presented in Table 5-13b. R2

The MFFF utilizes many features to reduce the likelihood and consequences of these events as well as other fire-related events. Key features include fire barriers, minimization of combustibles and ignition sources, ventilation systems with fire dampers and HEPA filters, nitrogen blanket systems, qualified canisters and containers, fire suppression and detection systems, emergency procedures, worker training, and local fire brigades. R1

As shown in Tables 5-13a and 5-13b, the radiological consequences at the SRS site boundary are low. Such impacts would not be sufficient to warrant evacuation of the public or interdiction or decontamination of land or food supplies. Tables 5-13a and 5-13b also show that the radiological consequences to the nearest site worker are low. R2 R2

Given the low consequences and/or low likelihood of this type of accident, the radiological risk from fire events is low.

5.5.2.4 Explosion

Internal explosion events within the MFFF result from the presence of potentially explosive mixtures and potential overpressurization events. These events may result in either the dispersion of radioactive materials and hazardous chemicals or a loss of subcritical conditions. Criticality events and the effects of hazardous chemicals are discussed in Sections 5.5.2.7 and

5.5.2.9, respectively. Explosions may be caused by human error or equipment failure and include the following:

- Loss of instrument air or offgas exhaust flow in units where radiolysis is possible
- High flow of fluids into tanks or vessels
- Pressurizing chemical reactions in vessels or tanks
- Increase in temperature beyond the safety limit in tanks and vessels
- Incorrect chemical addition/reagent preparation
- Excessive introduction of hydrogen into furnace
- Hydrogen accumulation
- Oxygen leaks
- Organic liquid vapor/methane reactions.

Postulated explosions include explosions involving flammable gases, chemical interactions, and overpressurization events.

The MFFF processes are designed to preclude explosions through the use of reliable engineering features and administrative controls. Key features include scavenging air systems, hydrogen monitoring systems, temperature control systems, chemical addition and concentration control systems, sampling systems, process shutdown controls, operator training, and operations and maintenance procedures. Simultaneous failure of the design features and administrative controls resulting in an explosion and the subsequent release of radioactive materials is highly unlikely. Thus, explosions at the MFFF resulting in a radioactive material release are remote and speculative and need not be considered under NEPA.

Explosions are prevented by design features and administrative controls except in the laboratory. The radiological consequences of an explosion in the laboratory will not exceed regulatory limits. Although explosion events resulting in a radioactive material release at the MFFF are remote and speculative events, a hypothetical explosion event is evaluated. The evaluation conservatively assumes that an explosion occurs in an aqueous polishing process cell and involves the maximum material at risk in any process cell. The radiological consequences of this hypothetical event are presented in Table 5-13. As shown, the impacts to the public and the SRS workers are low. R2

Given the low consequences and/or low likelihood of this type of accident, the radiological risk from explosion events is low.

5.5.2.5 Load Handling

A load-handling hazard arises from the presence of lifting or hoisting equipment used during either normal operations or maintenance activities. A load-handling event occurs when either the lifted load is dropped or the lifted load or the lifting equipment impacts other nearby items. A load-handling event may result in either the dispersion of radioactive materials and hazardous chemicals or a loss of subcritical conditions. Criticality events and the effects of hazardous chemicals are discussed in Sections 5.5.2.7 and 5.5.2.9, respectively.

Load-handling events can be caused by equipment failure or human error.

Load-handling events are postulated to occur and are evaluated for all primary confinements throughout the MFFF without regard to the probability of the initiating event. Postulated load-handling events include the following:

- Drops impacting a glovebox containing powders, pellets, solutions or fuel rods
- Drops impacting aqueous polishing process equipment containing plutonium and/or americium in solution form R2
- Drops involving plutonium in canisters, fuel rods, fuel assemblies, HEPA filters, or waste drums
- Drops involving plutonium in transportation packages or uranium in drums.

The bounding load-handling event is a drop event involving the glovebox in the Jar Storage and Handling Unit. R2 This glovebox contains jars of plutonium powder. The glovebox is postulated to be impacted during maintenance operations by either a lifting device or a lifted load outside of the glovebox, damaging a portion of the glovebox causing some of its contents to drop to the floor, resulting in a release of radioactive material. The bounding radiological consequences associated with this event are provided in Table 5-13. The frequency associated with this event is estimated to be unlikely or lower since multiple failures are required for this event to occur. R2

The bounding low consequence load handing event is associated with the spill of a silver recovery tank postulated to occur during maintenance operations in the process cell. The frequency of this event is estimated to be not unlikely or lower as a tank spill could occur due to human error or equipment failure during maintenance activities. R2 Consequences are provided in Table 5-13b.

The MFFF utilizes many features to reduce the likelihood and consequences of this event as well as other load-handling events. Key features include loadpath restrictions, crane-operating procedures, maintenance procedures, operator training, qualified canisters, reliable load-handling equipment, and ventilation systems with HEPA filters.

As shown in Tables 5-13a and 5-13b, the radiological consequences at the SRS site boundary are R2 low. Such impacts would not be sufficient to warrant evacuation of the public or interdiction or decontamination of land or food supplies. Tables 5-13a and 5-13b also show that the radiological consequences to the nearest site worker are low. Appendix F provides assumptions R2 associated with this event.

Given the low consequences and low likelihood of this type of accident, the radiological risk from load-handling events is low.

5.5.2.6 External Man-Made Events

External man-made events originate from the operations of facilities or vehicles nearby the MFFF site. These events could then initiate events at the MFFF. The categories of nearby facilities and vehicles considered include the following: industrial facilities, military facilities, chemical facilities, SRS facilities, pipelines, automobiles, trucks, aircraft, helicopters, trains, and ships/barges. Events from these facilities and vehicles that could impact the MFFF are radiological releases, chemical releases, explosions, fires, and direct impact on the MFFF (i.e., airplane crash).

A screening evaluation was performed to determine if any credible external man-made events could impact MFFF operations. The screening evaluation determined that credible external man-made events will not significantly impact MFFF operations. The effects on the MFFF or the consequences from any potential MFFF event initiated by a credible external man-made event are bounded by the effects and consequences of events initiated by natural phenomena or MFFF internal hazards. Details of this evaluation are provided in MFFF CAR Chapter 5. R1

The screening evaluation did not include the effects of two nearby SRS facilities, PDCF and the WSB, due to their early design stage. These facilities will be evaluated as their safety analyses R2 become available. It is expected that the effects on the MFFF from credible events at these facilities are bounded by the effects of the natural phenomenon hazards and internal events currently evaluated. If necessary, additional features will be incorporated into the MFFF design and operations to account for potential accidents at these facilities.

Given the low consequences and low likelihood of this type of accident, the radiological risk from external man made events is low.

5.5.2.7 Criticality

Criticality is a physical phenomenon characterized by the attainment of a self-sustaining fission chain reaction. Criticality accidents can potentially release a large amount of energy over a short period of time. A criticality hazard arises whenever fissionable materials (e.g., uranium-235 or plutonium-239) are present in sufficient quantities to attain a self-sustaining fission chain reaction under optimal conditions.

The immediate consequence of a criticality accident is a rapid increase in system thermal power and radiation as a "fission spike" that is generally terminated by heating and thermal expansion of the system. Subsequent spikes of less intensity may be expected. Direct radiation and dispersion of radioactive materials occur during and following a criticality accident. However, the direct radiation hazard to the public and the site worker is negligible since the radiation shielding afforded by facility structural features and the distances to these receptors inherently mitigate the direct radiation.

Criticality events are prevented by design features and administrative controls; however, criticality events can be caused by human error or equipment failure. R1

The MFFF processes are evaluated to determine where criticality events are possible. Further evaluations are performed, and prevention controls and measures are identified. Key controls include Geometry, Mass, and Moderation. These controls provide the primary means of protection against nuclear criticality events at the MFFF. Adherence to the double contingency principle, as specified in ANSI/ANS-8.1 (ANSI/ANS 1983b), ensures that a criticality event is Highly Unlikely. Thus, a criticality event at the MFFF is a remote and speculative event.

Although criticality events at the MFFF are remote and speculative, a generic hypothetical criticality event is evaluated. Regulatory Guides 3.71 (NRC 1998c) and 3.35 (NRC 1979) provide guidance for developing source terms for direct radiation and airborne releases resulting from a criticality accident. The radiological consequences of this hypothetical event are presented in Table 5-13a. In addition to the consequences shown in Table 5-13a, the radiological R2 consequences to a nearby MFFF worker (within meters of the event) could be severe.

Given the low likelihood of a criticality event occurring, and the low potential consequences to the site worker and public, the overall radiological risk from a criticality event is low.

5.5.2.8 Direct Radiation Exposure

A direct radiation hazard arises from the presence of radioactive material within the MFFF. Direct radiation exposure events include those events that result in a radiation dose from radiation sources external to the body. Due to the nature of the radioactive material present in the MFFF and the distance to the SRS site boundary, there are no accidents at the MFFF that R1 produce a direct radiation exposure hazard to the public from MFFF operations. Furthermore, there are no accidents (other than criticality) that produce a significant direct radiation hazard to the site workers. R1

5.5.2.9 Chemical Releases

A chemical hazard arises mainly from the use of chemicals in the aqueous polishing process and, to a much lesser extent, from chemicals used in the fuel fabrication process. Chemicals evaluated include those used during all modes of operation, those produced as a byproduct of operations, and those potentially produced by inadvertent chemical mixing and interactions. Chemical releases are postulated to occur from human error and equipment failures.

Consequences of chemical releases were determined for a potential release of each chemical. For evaporative releases, the chemical consequence analysis modeling for public consequences used R1 the ALOHA code (EPA 1999), the ARCON96 code (NRC 1997), and the MACCS2 code (NRC 1998a) to calculate the maximum airborne chemical concentration at the SRS boundary (5.0 mi

[8 km] from the MFFF). Calculated concentrations were compared to Emergency Response Planning Guidelines (ERPGs) or to Temporary Emergency Exposure Limits (TEELs). TEELs describe temporary or equivalent exposure limits for chemicals for which official ERPGs have not yet been developed. R1

An evaporation model extracted from the ALOHA code was used to calculate a release from a spilled or leaked chemical, which is assumed to form a puddle one-centimeter deep. A spill or leak from the largest tank or container holding the chemical was modeled.

Consideration for spill size, location, container integrity, and chemical concentration was included in the evaluation.

Based on the results, DCS concludes that the concentration of all chemicals at the SRS boundary following a release from the MFFF is low. The results also indicate that the maximum chemical concentrations for the site workers are low. The frequency of significant chemical releases at the MFFF is conservatively estimated to be unlikely. Appendix F provides additional information related to the chemical evaluation.

MFFF features to reduce the frequency and magnitude of a chemical release include the following: reagent preparation controls, separation and segregation of incompatible reagents, process temperature controls, ventilation controls, vessel level indications, drip trays, leak detection, sumps, drains, operating procedures, emergency procedures, operator training, hazardous material control, toxic gas exhaust systems, and an emergency control room.

Given the low consequences and/or low likelihood of this type of accident, the risk from chemical releases is low.

5.5.3 Evaluation of Facility Workers

The risk to workers is qualitatively evaluated for all MFFF events. Sufficient engineering design features and administrative controls have been incorporated into the MFFF design to ensure that any unacceptable consequence is highly unlikely.

Key design features include shielding, confinement systems, criticality and explosion prevention structures, systems, and components (SSCs), radiation monitoring systems, and fire protection systems. Key administrative controls include operator training, criticality safety, radiation protection, fire safety, and industrial hygiene programs. In addition, workers are trained and qualified and perform their work in accordance with approved procedures.

Given the low consequences and/or low likelihood of events, the overall radiological risk to the MFFF worker is low.

5.5.4 Conclusions

The environmental impacts that have been considered include potential radiation and chemical exposures to individuals and to the population as a whole, and the risk of near- and long-term adverse health effects that such exposures could entail. The evaluation demonstrates that the environmental risk is low. R1

5.6 CUMULATIVE IMPACTS

Cumulative impacts are the impacts on the environment which result from the incremental impact of the proposed action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes those other actions. In the case of the MFFF, the cumulative impacts are divided into the following groupings:

1. **Impacts from SRS activities**: These are other activities in geographic proximity to the MFFF that combine with the MFFF to produce a larger impact to the environment than the MFFF alone. Included in these impacts are those related to construction, operation, and deactivation of the PDCF and PIP.

2. **Impacts of other actions near the MFFF and SRS**: These are impacts from activities of other federal or state agencies or private industry that may combine with the MFFF and SRS impacts to produce a larger impact to the environment than the MFFF alone.

3. **Transportation impacts**: These are impacts that the proposed action causes to the environment beyond the geographic bounds of the MFFF or SRS.

4. **Impacts at mission reactors**: These are impacts related to the proposed MFFF but not directly connected to MFFF operations.

Each of these impacts is discussed in the following sections.

5.6.1 Impacts from SRS Activities

The SPD EIS (DOE 1999c) discussed the impacts from constructing the PDCF [Text Deleted]. Appendix G of this ER presents environmental impact information for the proposed WSB. Environmental impacts of the proposed WSB are, in most cases, projected to be bounded by the impacts of the now cancelled immobilization plant. Consequently, for many of the WSB environmental impacts, the impacts projected in the SPD EIS for the immobilization plant are reported. Data presented in Appendices G, H, and J of the SPD EIS and Appendix G of this ER are summarized in Table 5-14. R2

In SPD EIS Section 4.32.2 and Appendix F of that document, DOE provided an extensive discussion of the cumulative impacts of the plutonium disposition activities. Environmental impacts of other current and reasonably foreseeable future SRS activities are combined with the impacts of the surplus plutonium disposition activities in Tables 5-15a through 5-15d. The R1 impacts of the PDCF and WSB reflect the impacts listed in the SPD EIS appendices for "other plutonium disposition facilities" at SRS. Impacts for other SRS activities reflect the impacts projected in various EISs prepared for SRS.

Impacts of the MFFF and the other surplus plutonium disposition facilities on land use, not illustrated in Tables 5-15a through 5-15d, are predominately from the grading of the land for the facility and the land used to bring utility services to the MFFF and remove waste. Current use of this land is either as a forest plantation or as existing right-of-way. All of the industrial land use on the SRS site is small compared to the amount of land devoted to forestry. R1

The overall effect of the projects on stormwater will be to increase total runoff in any given storm event. In accordance with SCDHEC regulations, the detention/retention basins will be sized to mitigate these impacts by retaining suspended solids and dampening peak stormwater flows.

As illustrated in Table 5-15a, increases in nonradiological airborne pollutants are dominated by other current and planned SRS activities. Because the MFFF only uses diesel generators as standby and emergency power sources, emissions of conventional pollutants are very small compared to other SRS activities. SRS is currently in substantial compliance with applicable federal, state, and local air quality requirements, and compliance would be maintained even with the consideration of the cumulative effects of all the surplus plutonium disposition activities.

Table 5-15b provides a comparison of radiological impacts from the MFFF to impacts from current and projected SRS activities. The MFFF is a small contributor to public dose. Projected MFFF radiological impacts would be less than 1% of the dose from the SRS baseline reported by Arnett and Mamatey in 1998. A review of recently released data for 2000 (Arnett and Mamatey 2001) confirms that projected MFFF doses to the maximally exposed member of the public would remain a small fraction of the dose from other SRS activities. R1

The liquid high alpha waste generated by the MFFF operations is largely a liquid americium waste with some acid recovery residues, and traces of unrecovered silver. This waste, along with the stripped uranium waste, will be solidified in the WSB. The solidified high alpha waste will be disposed as TRU waste and the solidified uranium waste will be disposed as LLW. R2

The volumes of TRU waste, LLW, and nonradioactive wastes expected to be generated by the MFFF will be minor contributions to the current waste inventories. Table 5-15c illustrates that anticipated MFFF waste generation is 1% to 10% of all anticipated SRS waste generation.

5.6.2 Impacts from Other Nearby Actions

Nuclear facilities within a 50-mi (80-km) radius of SRS include the following:

- Georgia Power Company's Vogtle Electric Generating Plant in Sardis, Georgia, across the river from D Area of SRS

- Chem-Nuclear Services LLW disposal facility, several miles east of SRS
- Starmet CMI, Inc., located southeast of SRS, which processes uranium-contaminated metals.

Radiological impacts from operation of Vogtle Electric Generating Plant, a two-unit commercial nuclear power plant, are minimal. However, DOE factored them into the human health risk analysis for the SRS activities. The SCDHEC Annual Report (SCDHEC 1996) indicated that operation of the Chem-Nuclear Services facility and the Starmet CMI facility does not noticeably impact radiation levels in air or liquid pathways in the vicinity of SRS. Therefore, they are not included in this assessment.

The counties surrounding SRS have numerous existing and planned industrial facilities with permitted air emissions and discharges to surface water. Because of the large distances between SRS and the private industrial facilities (e.g., more than 20 mi [32.2 km] from Augusta-Richmond County industrial complex), there is little opportunity for interactions of facility emissions, and no major cumulative impact on air or water quality.

The planned federal and state highway projects in the vicinity of SRS, discussed in Section 4.10.3, are all expected to be completed before construction of the MFFF and do not represent a cumulative impact.

5.6.3 Transportation Impacts

The cumulative impacts of plutonium disposition program transportation activities and other SRS transportation activities were discussed in Section 4.32.4.5 of the SPD EIS. The SPD EIS projected 2,557 truck shipments for the plutonium disposition activities compared to 115,187 truck shipments for other SRS activities during the same period. Annual dose to the MEI was projected to increase by 12 % from 0.59 mrem/yr to 0.66 mrem/yr. This would result in a LCF risk of 4.9 E-06, which does not significantly increase the risk to the public. R2

5.6.4 Impacts Related to Fuel Irradiation at Mission Reactor Sites

The irradiation of MOX fuel is a related action that was evaluated in the SPD EIS (DOE 1999c). In the SPD EIS, DOE reported information about the mission reactors concerning the projected irradiation of MOX fuel. DOE used this information to project the impacts that might be expected from irradiating MOX fuel. DOE, in the S&D PEIS evaluated environmental impacts of irradiating fuel in generic mission reactors. In the SPD EIS, DOE evaluated the impacts of irradiating MOX fuel at six specific mission reactors. Although the North Anna Units 1 and 2 are no longer being considered for MOX fuel irradiation, the analyses of environmental impacts at mission reactors presented in the S&D PEIS and SPD EIS is still considered typical for any future mission reactors. More detailed information for the environmental impacts at selected mission reactors would be presented as part of the documents prepared for the mission reactor license amendments. R2

As discussed in Section 4.28 of the SPD EIS, there are no anticipated construction impacts because the irradiation of MOX fuel will not require any construction at the mission reactors. The SPD EIS discussed impacts to air quality, water quality, waste management, socioeconomics, human health, ecological resources, cultural resources, land use, and infrastructure. The SPD EIS determined that there should be no change in impacts to the environment during normal operations at the mission reactors resulting from the irradiation of MOX fuel. This conclusion is reinforced by a communication from Electricite de France, which operates several MOX fuel power plants in France. Electricite de France (Provost 1998) noted that average dose to the public at operating MOX fueled plants was not sensitive to low enriched uranium or MOX fuel and approximated 1 μSv/yr (0.1 mrem/yr), compared to natural exposure of 2,500 μSv/yr (250 mrem/yr).

The SPD EIS (Section 4.28.2.5) also determined that the impacts on the public of the design basis and beyond design basis accidents for the mission reactors involving MOX fuel were not significantly different from the impact of accidents involving low enriched uranium fuel. The analysis results reported by DOE were obtained using somewhat different methodology than would be used for NRC safety analyses. However, the results still support the conclusion that the environmental impacts related to the use of MOX fuel at the mission reactors are not significantly different from the impacts related to using uranium fuel. Safety and environmental impacts of design basis and beyond-design basis accidents will be analyzed by the mission reactor licensee as part of the 10 CFR Part 50 reactor license amendment process.

5.6.5 Impacts to Commercial Fuel Fabrication

The amount of MOX fuel that will be produced by the MFFF represents less than 1% of the domestic commercial fuel used (Clark 2000). Consequently, financial impacts to commercial fuel fabrication should be minimal.

5.7 ALTERNATIVES TO THE PROPOSED ACTION

Alternatives to the MFFF facility were evaluated as part of the SPD EIS (DOE 1999c). The SPD EIS ROD (DOE 2000b) announced the decisions regarding alternatives. It should be emphasized that the alternatives considered in the SPD EIS are not alternatives to the proposed action in this ER and therefore will not be presented is this ER. The No Action Alternative for this ER is denial of a license to possess and use SNM. This No Action Alternative, however, does not meet the "need" for the facility as described in the SPD EIS ROD or the joint U.S.-Russian Federation Agreement signed in September 2000 (White House 2000). The consequences of the No Action Alternative, continued long-term storage of surplus plutonium, are identical to the consequences for the No Action Alternative described in the SPD EIS. The impacts of this alternative are described in Section 5.7.1. The Preferred Alternative presented in the SPD EIS, and chosen in the SPD EIS ROD, included the location of the MFFF in F Area at SRS. Accordingly, the guidance in Appendix F of NUREG-1718 (NRC 2000a) regarding siting alternatives are not deemed relevant, and only siting alternatives for the MFFF within F Area are considered in this

ER. This evaluation is discussed in Section 5.7.2. Design alternatives that may impact the environment are discussed in Section 5.7.3.

5.7.1 No Action Alternative

As discussed in Section 1.3, the No Action Alternative is denial of a license to possess and use SNM. This No Action Alternative, however, does not meet the "need" for the facility as described in the SPD EIS ROD (DOE 2000b) or the joint United States-Russian Federation Agreement signed in September 2000 (White House 2000). The consequences of the No Action Alternative are continued storage of surplus plutonium. Surplus plutonium is currently stored at (1) the Hanford Reservation in Washington, (2) INEEL in Idaho, (3) the Pantex Site in Texas, (4) SRS in South Carolina, (5) Rocky Flats Environmental Technology Site (RFETS) in Colorado, (6) LANL in New Mexico, and (7) LLNL in California. The environmental impacts of continued surplus plutonium storage at these sites were discussed in the S&D PEIS (DOE 1996b) and the SPD EIS (DOE 1999c). The information presented in this section is a summary of the information from these two DOE NEPA documents.

The environmental impacts of continued plutonium storage at each of these sites are summarized in Table 5-16 and discussed in the following sections.

5.7.1.1 Air Quality

Continued storage of surplus plutonium would generate air pollutants associated with operation of boilers, diesel generators, vehicles, and other emission sources required to maintain the storage facilities in a stable configuration. The estimates of air pollutant impacts presented in Table 5-16 were extracted from Tables 4-1 through 4-7 of the SPD EIS (DOE 1999c). These estimates are based on emission rates reported in the S&D PEIS (DOE 1996b). The emission rates were based on actual air quality records for the various sites. For the No Action Alternative, the emissions data were converted to ambient concentrations using the EPA-recommended Industrial Source Complex Short-Term Model Version 2 (EPA 1992). A full discussion of the process used to generate these air quality impact estimates is provided in Appendix F of the S&D PEIS.

For most storage sites, with the exception of LLNL, the impact of continued surplus plutonium storage on ambient air quality concentrations is projected to be below the most stringent federal or state standard. At LLNL, continued storage of surplus plutonium is expected to result in an exceedance of the one-hour standard for nitrogen dioxide.

5.7.1.2 Human Health

For all sites, continued surplus plutonium storage would result in population doses within 50 mi (80 km) ranging from 6.3E-06 person-rem at Pantex to 2.7 person-rem at LANL. Dose to the MEI (public) would range from 1.8E-08 mrem at Pantex to 6.5 mrem at LANL. Potential LCFs, over the 50-year period examined in the SPD EIS (DOE 1999c), resulting from these doses to the population ranged from 0.36 at INEEL to 1.3 at SRS.

Health impacts to the public from exposure to hazardous chemicals would not change appreciably from existing impacts.

5.7.1.3 Facility Accidents

Facility accidents associated with continued surplus plutonium storage were evaluated in the S&D PEIS (DOE 1996b). The accident scenarios evaluated in the S&D PEIS are summarized in Table 5-17. The accident consequences evaluated are summarized in Table 5-18. Based on the analyses, for the sites evaluated, the beyond evaluation basis earthquake was the facility accident of greatest consequence. The population dose and associated potential LCFs for the beyond evaluation basis earthquake are summarized in Table 5-16.

5.7.1.4 Radioactive Waste Generation

Wastes generated by activities associated with the storage of surplus plutonium at each of the existing sites are a portion of the existing site generation rates. Waste generation rates should not appreciably change at these sites; therefore, impacts are not expected to change from those currently experienced from other site activities at each of these sites.

5.7.1.5 Transportation

Continued storage of surplus plutonium at existing sites would not involve intersite transportation of radioactive materials.

5.7.1.6 Ecological Resources

The No Action Alternative involves continued surplus plutonium storage in existing facilities. Under this alternative, there would not be any construction of new buildings or demolition of existing buildings. Consequently, there are no expected impacts to ecological resources.

5.7.2 Site Selection

The selection of a site for the MFFF involved evaluations included in the S&D PEIS (DOE 1996b), the SPD EIS (DOE 1999c), and the MFFF ER. At each stage of the selection process, the range of site alternatives was narrowed by using increasing detail in the evaluation of environmental and engineering impacts. The following is a summary of the processes used to select the final location of the MFFF.

5.7.2.1 Storage and Disposition Programmatic Environmental Impact Statement

In the S&D PEIS (DOE 1996b), DOE considered only sites that already possessed weapons-usable fissile material as candidate sites for the surplus plutonium disposition facilities. This criterion allowed for the utilization of existing security and facilities that were already adapted to weapons-usable fissile material. The Summary for the S&D PEIS notes the following:

> The Storage and Disposition PEIS analyzes six candidate sites for long-term storage of weapons-usable fissile material. These sites are Hanford, NTS [Nevada Test Site], INEL [Idaho National Engineering Laboratory now named the Idaho National Engineering and Environmental Laboratory], Pantex, ORR [Oak Ridge Reservation], and SRS. These same sites were also used to evaluate the construction and operation of various facilities required for the disposition alternatives.

The S&D PEIS did not select a site for the disposition facilities. The impacts of the surplus plutonium disposition facilities were considered for all the candidate sites as part of the evaluation of the generic impacts of the alternatives. Consequently, DOE did not conduct a separate siting study. As a result of the S&D PEIS evaluation, DOE issued a ROD. The following decision concerning the siting of the MFFF is found in the S&D PEIS ROD (DOE 1997c):

> The exact locations for disposition facilities will be determined pursuant to a follow-on, site-specific disposition environmental impact statement (EIS) as well as cost, technical and nonproliferation studies. However, DOE has decided to narrow the field of candidate disposition sites. DOE has decided that a vitrification or immobilization facility (collocated with a plutonium conversion facility) will be located at either Hanford or SRS, that a potential MOX fuel fabrication facility will be located at Hanford, INEL, Pantex, or SRS (only one site), and that a "pit" disassembly and conversion facility will be located at Hanford, INEL, Pantex, or SRS (only one site).

This decision is further discussed in Section V.B (p. 21) of the ROD:

> [DOE will] construct and operate a domestic, government-owned, limited-purpose MOX fuel fabrication facility at Hanford, INEL, Pantex, or SRS (only one site). As noted above, NTS and ORR will not be considered further for plutonium disposition activities. In follow-on NEPA review, DOE will analyze alternative locations at Hanford, INEL, Pantex, and SRS, for constructing new buildings or using modified existing buildings. The MOX fuel fabrication facility will serve only the limited mission of fabricating MOX fuel from plutonium declared surplus to U.S. defense needs, with shut-down and decontamination and decommissioning of the facility upon completion of this mission. [DCS is contractually responsible for deactivation of the MFFF. DOE will perform any required decommissioning after the license is terminated and the MFFF is turned over to DOE.]

5.7.2.2 Surplus Plutonium Disposition Environmental Impact Statement

In the SPD EIS (DOE 1999c), the selection of a site for the MFFF was integral to the selection of a preferred alternative. Consequently, DOE did not conduct a site selection separate from the environmental evaluation of the various alternatives.

The four potential sites selected in the S&D PEIS ROD (DOE 1997c) were combined with the three facilities (PDCF, MFFF, and PIP) to yield 64 possible alternatives. These alternatives were narrowed, as described in Section S.4 of the SPD EIS (DOE 1999c).

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

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

- Worker and public exposure to radiation
- Proliferation concerns due to transportation of materials
- Infrastructure.

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

Using the data provided in the SPD EIS, DOE issued the following decision in the SPD EIS ROD (DOE 2000b).

> The Department has decided to implement a program to provide for the safe and secure disposition of up to 50 metric tons of surplus plutonium as specified in the Preferred Alternative in the *Surplus Plutonium Disposition Final Environmental Impact Statement*. The fundamental purpose of the program is to ensure that

plutonium produced for nuclear weapons and declared excess to national security needs (now and in the future) is never again used for nuclear weapons. Specifically, the Department has decided to use a hybrid approach for the disposition of surplus plutonium. This approach allows for the immobilization of approximately 17 metric tons of surplus plutonium and the use of up to 33 metric tons of surplus plutonium as MOX fuel. The Department has selected the Savannah River Site in South Carolina as the location for all three disposition facilities. Based upon this selection, the Department will authorize DCS to fully implement the base contract.

The Preferred Alternative presented in the SPD EIS (DOE 1999c), and chosen in the SPD EIS ROD (DOE 2000b), included the location of the MFFF in F Area at SRS. Accordingly, only siting alternatives for the MFFF within F Area are considered in this ER. There are five potential plots within F Area that could be used for the MFFF. DOE determined the exact location of the MFFF subsequent to the SPD EIS ROD. The following section describes how the exact plot for the MFFF was selected.

5.7.2.3 Site Selection within SRS F Area

The site selection process considered the guidance in DOE Good Practice Guide GPG-FM-024, *Site Selection Process* (DOE 1996c), and NRC Regulatory Guide 4.7, *General Site Suitability Criteria for Nuclear Power Stations* (NRC 1998b). Figure 5-2 illustrates the location of the five potential plots (labeled 1 through 5) for the MFFF. The plot between locations 2 and 5 was previously selected by DOE for the PDCF. Area 1 was also designated for another use. After a preliminary evaluation, DOE identified four options:

- Option 1 – Locate the MFFF in Area 2
- Option 2 – Reconfigure and re-orient the PDCF and MFFF as far north as possible in Areas 4 and 5
- Option 3 – Locate the MFFF in Area 3 or some combination of Areas 3 and 4
- Option 4 – Locate the MFFF in Area 5.

5.7.2.4 Siting Qualification Criteria

The following criteria were chosen as the most significant challenges to successful licensing of the MFFF and represent the selection criteria that the site must meet:

- **Free from subsurface contamination**: There are no plumes of substances possibly requiring remediation or resulting in increased costs, delays, licensing difficulties, or health hazards.

- **Adequate terrain and area**: The site option provides sufficient level terrain and is generally suitable for the footprint of the MFFF without adverse impact to the facility function.

- **Free from RCRA/CERCLA features**: No features governed by RCRA or CERCLA are known to be present. The presence of such features poses an issue with as yet indeterminate and potentially significant liabilities for removal/remediation.

5.7.2.5 Siting Evaluation Criteria

Evaluation criteria are more qualitative in nature and are based on technical, environmental, and economic factors. The perceived relative importance of each of these criteria is determined and assigned a weight from 1 (least important) to 3 (most important). The ability of each site to meet each criterion is assessed, and a rating is assigned from 1 (marginal) to 3 (more than adequate). The product of the weights and ratings for each site criterion is determined and added for each site. The qualitative evaluation criteria chosen are as follows:

- **Protected species**: No known protected flora or fauna species.

- **Water table**: The water table must lie significantly below the MFFF substructure to ensure economical design and construction and to avoid nuclear design issues.

- **Topography**: Balancing of cut and fill, with a high site option being preferred for security purposes. Relatively level with a minimum of steep grades. It is impractical for an MFFF site to block natural drainage.

- **Accessibility**: Proximity to existing roads and to the planned PDCF site.

- **Soft zones**: Site differences in potential for subsurface soft zones.

- **Utilities/infrastructure**: A measure of availability of water, sewer, electricity, waste disposal, and related services.

- **Wetlands**: Low-lying areas where compensatory measures are required if the wetlands are altered or destroyed.

- **Archaeological features**: Indicates that historical artifacts requiring further investigation have been found.

- **Interference with existing SSCs**: Existing SSCs would have to be relocated or removed.

5.7.2.6 Summary of Siting Evaluation

Table 5-19 summarizes the evaluation scores for the four options considered by DOE to locate the MFFF within the SRS F Area.

Only Area F-2 (Option 1) actually met all the qualification criteria. Additionally, Area F-2 also had the best score among the evaluation criteria. Therefore, Area F-2 was selected as the plot for the MFFF.

5.7.3 Design Alternatives

As part of the consideration of reasonable alternatives to the proposed action, DCS considered several design alternatives for the MFFF in addition to the No Action and siting alternatives discussed earlier. In selecting design alternatives for review, DCS focused on possible alternatives that could have some potential impact or significance from an environmental perspective. Changes in the MFFF design that would not have any significant environmental impact (e.g., modifications to the size or construction of administrative buildings) were not considered in detail.

In 1999, while the SPD EIS (DOE 1999c) was in preparation, DOE selected DCS to execute the design, construction, operation, and deactivation of the MFFF. The Request for Proposals required the submission of a general facility and process design to accomplish the fabrication of MOX fuel. One of the bases for selection of DCS as the contractor was the DCS proposal to use a proven design (the COGEMA process) based on actual operations of similar facilities (MELOX and La Hague) in France. The COGEMA design represents the results of several iterations of process design and operating experience over several years of MOX fuel production in France. This design optimizes both production and safety. The selection of DCS and the contractual arrangements with DOE established the basic design of the facility and process.

In particular, the SPD EIS covered the throughput and support facilities for the MFFF. The MFFF maximum throughput was established at 3.9 tons (3.5 metric tons) of plutonium (DOE 1999c). The general design of the MFFF building is provided in the SPD EIS. The MFFF would be a hardened, reinforced-concrete structure. Areas of the facility in which plutonium would be processed or stored would be designed to survive natural phenomena and potential accidents. Ancillary buildings would be required for support activities. Facility operations would require a staff of about 385 personnel[7].

The SPD EIS identified the fuel fabrication areas as two parallel process lines with room for a third line to accommodate the potential for fabricating a different type of fuel. The process would be in batch operations conducted in continually monitored, negative-pressure, inert atmosphere gloveboxes. The building ventilation system would be designed to maintain

[7] Although the SPD EIS projected a staff level of 385, current projections are for a staff level of about 400 personnel.

confinement and include HEPA filters for both internal systems and building exhausts. Both intake and exhaust air would be filtered, and exhaust gases would be monitored for radioactivity. Power would be supplied to the MFFF by two independent offsite power supplies and backed up by an onsite uninterruptible power supply and standby generators.

The SPD EIS also indicated that the MFFF would contain areas for support activities including SNM vault areas, shipping and receiving, emergency generators, and process gas waste treatment. Support areas for access control, office space, and some warehouse space would be located outside the protective fence.

In selecting the SRS F Area as the location for the MFFF, DOE took advantage of the existing SRS infrastructure for providing security, emergency, and utility support services including existing waste management facilities. This decision, contained in the SPD EIS, eliminated the need for a new waste treatment system for the MFFF wastes. This decision reduces the environmental impacts associated with the construction and operation of a waste treatment system for the MFFF.

In the process of converting the COGEMA design, based on the MELOX and La Hague facilities, to meet United States regulations, codes, and standards, DCS considered the design alternatives discussed in the following sections.

The basic design of the MOX fuel fabrication building consists of an aqueous polishing process area, a MOX fuel fabrication process area, and a shipping and receiving area. The MOX fuel fabrication process area utilizes essentially two parallel process lines that maximize automation while performing batch operations in continually monitored, negative-pressure, and in many cases, inert atmosphere gloveboxes. The building ventilation system is designed to maintain dynamic confinement and includes two HEPA filters at the supply and exhaust of all gloveboxes, an intermediate supply and exhaust room filter in rooms that contain gloveboxes, and two final HEPA filters in all ductwork prior to discharge into a common stack. Exhaust gases are monitored for radioactivity. Power to the MFFF is supplied by two independent offsite power supplies and backed up for selective operations by redundant emergency and standby diesel generators and an onsite redundant emergency uninterruptible power supply. Support areas include office space, gas storage, portions of access control, and warehouse space.

This design is consistent with the design described in the SPD EIS and implements the COGEMA design, based on the MELOX and La Hague facilities. In implementing the COGEMA design, DCS also considered lessons learned based on past operating experience and Americanization to meet United States regulations, codes, and standards. During design development for the MFFF, DCS considered various design alternatives that involved auxiliary processes, support systems, and services that could potentially impact or have significance from an environmental perspective. Nine design alternatives are discussed in the following sections.

5.7.3.1 Reagent Process Building

DCS considered two options for locating the aqueous polishing reagent process. One option was to locate the preparation of reagents within the same area as the aqueous polishing area. The second option was to locate the reagent process in a separate building and pump mixed reagents to the aqueous polishing area.

The reagent preparation process involves an exothermic reaction that presents a potential explosion hazard. DCS decided to separate the preparation of material presenting the potential chemical explosion hazard from the SNM. The reagent preparation process was moved to a separate building adjacent to the aqueous polishing area. The mixed reagents will be pumped to the aqueous polishing area on an as-needed basis. The relocation of these processes reduces the potential of a chemical accident resulting in a release of radioactivity to the environment.

In the design of the Reagent Process Building, DCS considered the use of underground storage tanks to contain any overflows and spills from the reagent storage and mixing tanks. Because of the environmental risk associated with underground waste storage tanks, DCS decided to eliminate the underground tanks. Any overflows and spills from the reagent storage and mixing tanks will be contained in a curbed area and will be manually pumped to an above-ground waste collection vessel within the Reagent Process Building.

5.7.3.2 Recycling of Acid Recovery Distillates in the Aqueous Polishing Process

DCS selected a design alternative for the acid recovery process that consists of adding an evaporation step to lower the activity of these distillates and to recycle half of the volume of the distillates in place of fresh demineralized water. The reduced volume of evaporator concentrates is transferred to the F-Area Outside Facility as a liquid high alpha activity waste. The addition of this evaporator reduces the volume of liquid for processing at the F-Area Outside Facility and reduces the volume of demineralized water required for the process.

5.7.3.3 Reduction in TRU Waste Volume Due to Lower Glovebox Cooling Flow Rates

Glovebox internal cooling flow rates at MELOX are dependent on the heat release of reactor-grade plutonium. The heat release of weapons-grade plutonium is significantly lower than that of reactor-grade plutonium. Because of the lower heat release, the glovebox internals can be cooled by natural convective cooling, which results in a reduced airflow, filter size, and TRU solid waste volume during periodic filter replacement.

5.7.3.4 Recycling of Laboratory Effluents Using Aqueous Polishing Capability

Aqueous laboratory wastes at MELOX are precipitated and solidified, resulting in TRU wastes. In the MFFF, the plutonium is removed from the laboratory waste and recycled into the aqueous polishing process. The resulting laboratory wastes are LLW.

5.7.3.5 Decloggable Metallic Pre-filter in Powder Grinding Glovebox

Based on operating experience, DCS replaced a two-stage cyclone separator in the MOX powder processing with a decloggable metallic filter. This design results in an overall reduction of TRU waste volume during periodic filter replacement downstream of these components.

5.7.3.6 Sand Filters Compared to Multiple Fire Areas

DCS compared the advantages of sand filters and HEPA filters on the design, licensing, construction, and operation of the MFFF. The comparison was based, in part, on a recent study R1 by the DOE (Washington Group 2001). Both alternatives can provide an adequate confinement for prevention for releases. The sand filter decontamination factor is slightly less than that for the HEPA filter system, but both systems provide adequate decontamination efficiency (i.e., the change in decontamination factors is insignificant). The capital cost of the HEPA filter option is slightly ($4M) lower than the sand filter, while the life cycle cost of the sand filter option is slightly ($4M) lower than the HEPA filter configuration presented in this study. Overall, cost is not a significant distinguishing factor between the two alternatives. The D&D costs are not significantly different for either alternative, assuming all wastes are LLW (no TRU), and that sand filters will be entombed in place[8]. If complete site remediation is required, the costs for sand filter decommissioning would be large.

The differences in environmental impacts were not significant enough to influence the alternatives selection. The sand filter would inundate more land area. The sand filter is not as efficient as the HEPA filter at controlling facility releases, but the difference is minor (both systems meet environmental requirements). Since the HEPA filter alternative provides complete site remediation, there is no post-closure care unlike the sand filter alternative. The sand filter option will produce less LLW during the operation phase.

DCS selected HEPA filters for the following reasons:

- HEPA filters are used in the MELOX facility, which is the technical baseline for the MFFF.
- The MFFF HEPA filter system incorporates prefilters and spark arrestors. The MFFF building design limits the propagation of fires to small fire areas within the facility, eliminating the possibility of a facility-wide fire. This design maintains dynamic confinement during postulated fire. The design eliminates the need for sand filters to mitigate a facilitywide fire. R1
- Environmental impacts from the additional land requirements for the sand filters are eliminated.

[8] Although prefilters are not credited for the facility safety basis, they are expected to capture most or all particulates during both normal and off-normal operations and therefore the final HEPAs are anticipated to be LLW. R1

- HEPA filters are the nuclear industry standard for high-efficiency air cleaning, 99.97% for particulate matter.

- HEPA filters are identified in NRC Regulatory Guide 3.12 as being acceptable to the Regulatory staff for the design of ventilation systems for plutonium processing and fuel fabrication plants and, therefore, are considered "adequate to protect health and minimize danger to life and property." R1

- Sand filters have an increased design, cost, and operation risks because actual filter performance will not be known until the filters have been constructed and tested, while HEPA filters are factory tested before delivery and will have known performance characteristics.

5.7.3.7 Facility Heat Exchangers

Because the MFFF has a relatively small heat load, DCS evaluated both water-cooled (cooling tower) and air-cooled heat exchangers to dissipate the building and process heat loads. The engineering evaluation recommended the use of air-cooled heat exchangers for the MFFF. This decision eliminated any potential environmental impacts normally associated with water-cooled heat exchangers such as impacts from cooling tower drift or blowdown.

5.7.3.8 Physical Security Barriers

DCS evaluated a number of options for the creation of security barriers for the facility. One option included the construction of an engineered berm around the facility. This option, which would have required a larger site and impacted land resources, was eliminated in favor of other security barrier options, which resulted in less land disturbance.

5.7.3.9 Material Transfer From the PDCF and MFFF

Plutonium that has been converted to plutonium oxide must be transferred from the PDCF to the MFFF. DCS evaluated several different options for this transfer including a tunnel and a closed transfer trench. The engineering evaluation discarded both of these options in favor of transfer using an overland vehicle. Both the tunnel and trench options would have had minor impacts to land resources. The vehicle option requires no additional land and moves the material over relatively short distances within F Area.

5.8 SHORT-TERM USES AND LONG-TERM ENVIRONMENTAL PRODUCTIVITY

The use of land on SRS for the MFFF would be a short-term use of the environment; on completion of the disposition activities, such land could be returned to other uses, including other long-term productive uses.

Losses of the natural productivity of terrestrial and aquatic habitats due to construction and operation of the MFFF are possible. Land clearing and construction and operational activities could disperse wildlife and eliminate habitat. Because this land is managed by the U.S. Forest

Service, periodic habitat loss would normally occur. Although some destruction would occur during and after construction, losses will be minimized by careful siting of facilities and incorporation of mitigation measures into all construction activities. In addition, consultation and coordination with state and federal natural resource and wildlife agencies prior to any site disturbances will ensure that all potential sensitive species, candidate or listed, are protected to the maximum extent possible.

There are no other activities that would affect long-term productivity of environmental resources.

5.9 RESOURCES COMMITTED

Site preparation, construction, and operation of the MFFF commit both onsite and offsite resources, some of which are irreversibly committed and irretrievably lost. Irreversible and irretrievable commitments of resources include those resources consumed during facility operation and those that are not expected to revert to a natural state if the structures are removed at the end of the station life. Section 5.9.1 discusses the commitment of resources during construction, while Section 5.9.2 discusses the commitment of resources during operation.

5.9.1 Resources Committed During Construction

Construction of the MFFF will disturb 106 ac (42 ha), most of which will be returned to original use once construction is complete. Once constructed, the MFFF will occupy 41 ac (16.6 ha) of land as shown in Table 5-20. Approximately 28 ac (11.3 ha) of this land is currently managed as a timber crop by the U.S. Forest Service that could be harvested independent of the MFFF's construction. Although removal of this timber represents a resource loss, as part of a managed forest, the resource is normally considered replaceable. Part of the land is also currently used as a spoils area for soil excavated for the APSF. This soil will be used as fill for the PDCF and relocated to an SRS landfill prior to construction of the MFFF. Because the area is utilized by DOE as an industrial site, continued industrial use after completion of the MFFF mission is possible.

Water used during construction will be treated in the SRS waste treatment system and returned to the environment. Waste disposal capacity will be provided by the current SRS infrastructure.

During construction, the heavy equipment onsite will consume diesel fuel and electricity. Major materials required during facility construction include concrete aggregate and cement, reinforcing steel, aluminum, lumber, piping materials, and electric wire and cable.

Concrete and steel constitute the bulk of construction materials; however, there are numerous other minor resources incorporated into the physical plant. Some materials (e.g., copper wire and cable and aluminum) are valuable enough to be recycled, whereas the value of others does not encourage recycling.

5.9.2 Resources Committed During Operation

Water used during operation will be treated in the SRS waste treatment system and returned to the environment.

During operations, the MFFF will nominally convert 3.9 tons (3.5 metric tons) of surplus plutonium and 73.3 tons (66.5 metric tons) of surplus depleted uranium annually. The MFFF will also consume various chemicals as reagents. Consumption of chemicals is kept at a minimum through extensive recovery and recycling as feedstock. Estimated commitment of resources during MFFF operation is provided in Table 5-21.

5.10 ENVIRONMENTAL MONITORING PROGRAM

As provided in guidance for the ER (NRC 2000a), details of the preoperational and operational environmental monitoring programs are provided in the *Construction Authorization Request* and will be updated in the *License Application*. This section of the ER provides an overview of the environmental monitoring program and its objectives.

An environmental monitoring program is established to evaluate the impacts of facility construction, operation, and deactivation on the facility environs for chemical and radiological releases during normal operations, anticipated operational occurrences, and from postulated accidents. The environmental monitoring program will be established prior to construction and continue through deactivation. Since the MFFF will be located adjacent to other F-Area facilities, there may be areas of historical contamination that should be characterized prior to operation. Chemicals released from F-Area facilities include ammonia, nitrate, cadmium, chromium, hydrazine, mercury, manganese, nitric acid, and oxides of nitrogen. Major radiological contaminants released from F-Area facilities include moderate- to long-lived fission products such as Cs-137, Sr-89 and Sr-90; isotopes of uranium and plutonium, and other actinides (Fledderman 2000). The objectives of the preoperational environmental monitoring program are to:

- Establish a baseline of existing radiological, chemical, physical, and biological conditions in the area of the site and develop an understanding of the critical pathways that could transport contaminants to human and other receptors.
- Determine the presence of any contaminants that could be a safety concern for construction personnel.
- Evaluate procedures, equipment, and techniques used in the collection and analysis of environmental data and train personnel in their use.

The objective of the operational environmental monitoring program is to determine whether or not there are adverse impacts from operations that result in radiological, chemical, physical, and biological effects to the facility site and environs.

The SRS maintains an extensive environmental monitoring program for all activities conducted on the SRS including in the F Area (Fledderman 2000). DCS plans to make full use of the data provided from this monitoring to measure any construction or operational impacts of the MFFF in the vicinity of the SRS. DCS will augment the SRS environmental studies with additional sample collections as necessary based on the evaluations in this ER and operating experience.

As discussed in this chapter and summarized in Chapter 6, non-radiological impacts to the environment from the construction and operation of the MFFF are expected to be minimal. Consequently, non-radiological environmental monitoring prescribed through the various environmental permits for the construction and operation of the MFFF are expected to be sufficient to evaluate any non-radiological environmental impacts.

As discussed in this chapter and summarized in Chapter 6, radiological impacts to the environment from construction and operation of the MFFF are expected to be minimal. The radiological environmental monitoring program measures radiation levels and radioactivity in the facility environs due to radioactive effluent releases to the environment. Routine radioactive releases from the MFFF are limited to a single radioactive airborne release through a stack located on the roof of the MOX Fuel Fabrication Building. The transport of contaminants from the stack to the receptor can result in exposure by immersion, inhalation, and ingestion of foodstuffs on which contaminants have been deposited by either wet or dry deposition processes. Direction radiation measurements, air sampling, soil sampling, and vegetation sampling will be performed with analyses for uranium and plutonium, MFFF radionuclides of interest.

The MFFF will not be designed to routinely discharge any radioactive liquid directly to the environment. Process liquids are transferred to appropriate SRS treatment facilities. The non-radioactive liquid effluent is uncontaminated HVAC condensate and stormwater runoff. R1
Therefore, the radiological monitoring program will focus on the environmental media impacted by the airborne pathway for the anticipated types and quantities of radionuclides release from the facility. Although stormwater runoff is not expected to be contaminated, confirmatory measurements will be performed. Stormwater runoff drains to an unnamed tributary of Upper Three Runs (Fledderman 2000). Surface water sampling and sediment sampling will be performed with analyses for uranium and plutonium.

Data obtained from the radiological environmental monitoring program will be used to show that levels of radiation and radioactivity in the environment are consistent with those determined by the radioactive effluent monitoring and sampling program.

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Figures

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R1

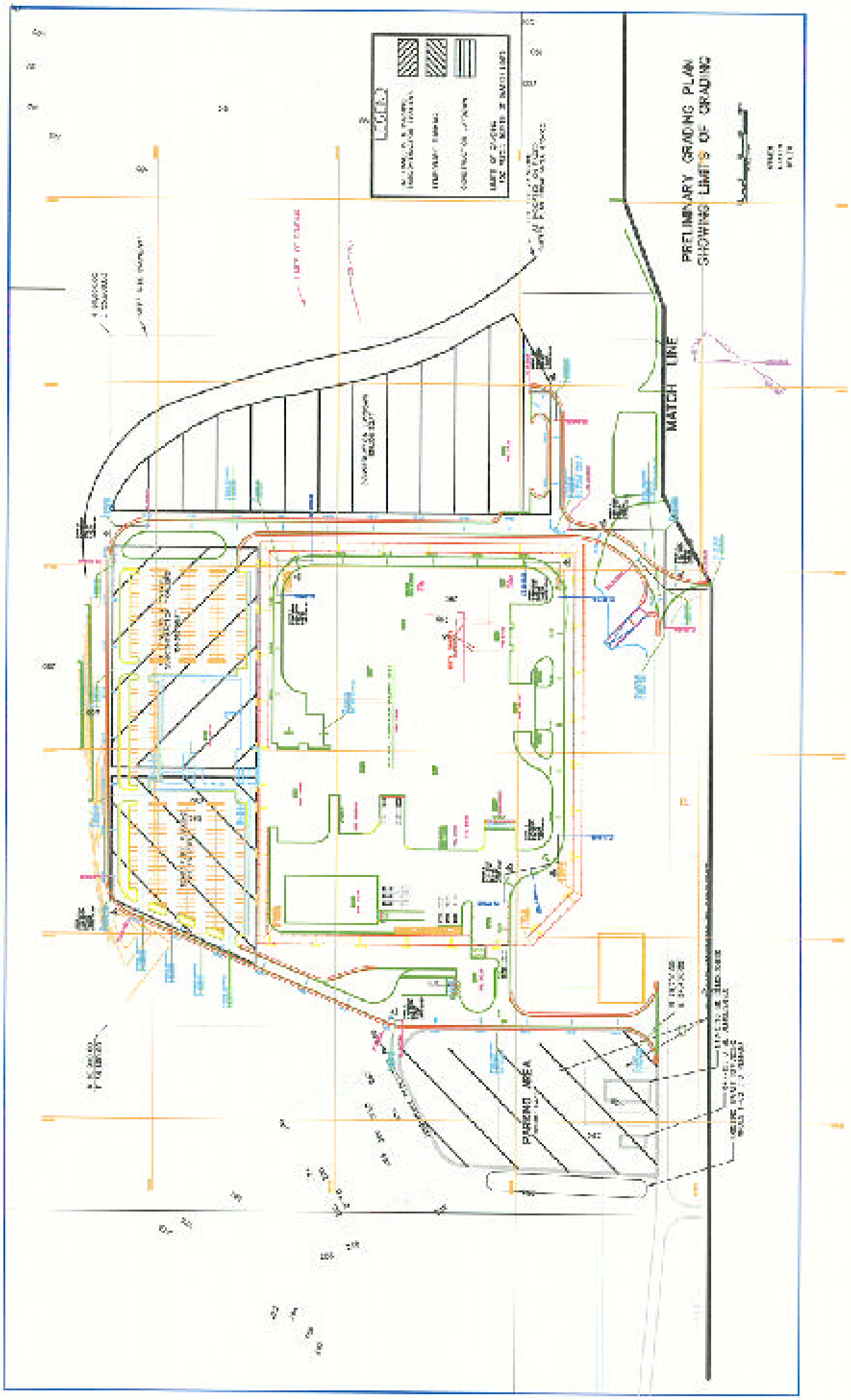

Figure 5-1. Preliminary Site Contour Map

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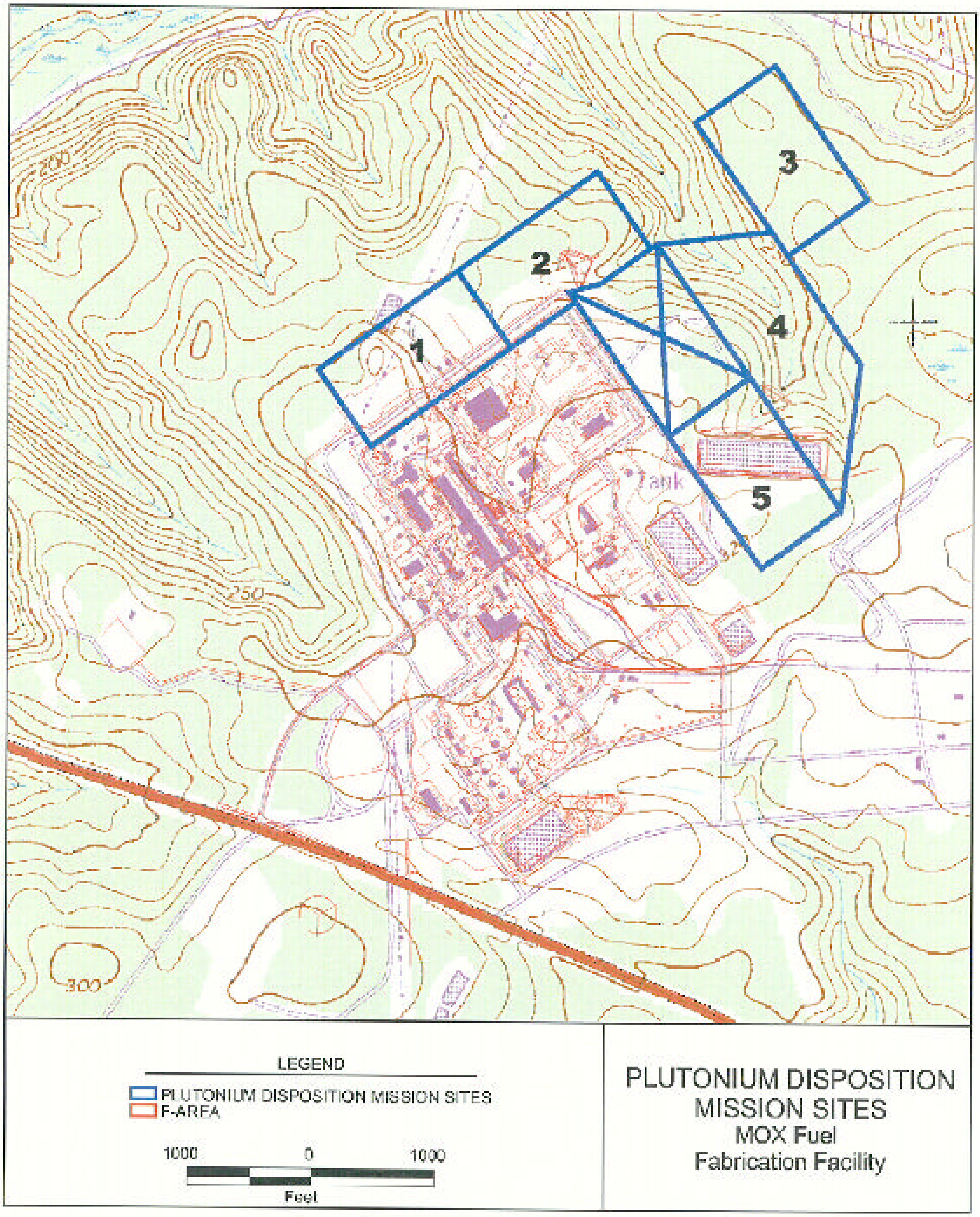

Figure 5-2. Location of Potential MFFF Sites

C02

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Tables

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Table 5-1. Emissions (kg/yr) from MFFF Construction

(update of Table G-65 of the SPD EIS, p. G-40)

Pollutant	Diesel Equipment	Construction Fugitive Emissions[a]	Concrete Batch Plant	Vehicles[d]
Carbon monoxide	28,481	0	0	33,574
Nitrogen dioxide	71,204	0	0	9,738
PM_{10}	10,743[b]	104,036	1,973[b]	34,359
Sulfur dioxide	6,371	0	0	0
Volatile organic compounds	10,743	0	0	4,494
Total suspended particulates	10,743	221,989	6,804	34,359
Air toxics[c]	0	<1	0	0

R2

[a] Does not include fugitive emissions from potential concrete batch plant.

[b] PM_{10} emissions were assumed to be the same as total suspended particulate emissions for this analysis resulting in some overestimate of PM_{10} concentrations.

[c] Various toxic air pollutants (e.g., lead, benzene, hexane) could be emitted during construction.

[d] Vehicle emissions based on construction worker, construction material, and waste shipment mileage.

Table 5-2. Increments to Ambient Concentrations (μg/m^3) at the SRS Site Boundary from MFFF Construction

(update of Table G-66 of the SPD EIS, p. G-40)

Pollutant	Averaging Period	Most Stringent Standard or Guideline[a]	SRS Maximum Concentration[b]	MFFF Contribution	Total
Carbon monoxide	8 hours	10,000	66	16.7	82.7
	1 hour	40,000	254	54.8	308.8
Nitrogen dioxide	Annual	100	17.2	0.17	17.4
PM_{10}	Annual	50	7	0.29	7.29
	24 hours	150	97	23.5	120.5
Sulfur dioxide	Annual	80	24	0.015	24
	24 hours	365	337	1.3	338.3
	3 hours	1,300	1,171	5.6	1,176
Total suspended particulates	Annual	75	46	0.53	46.5
Air toxics[b]	24 hours	150	20.7	0.0002	20.7

R2

[a] The more stringent of the federal and state standards is presented if both exist for the averaging period.

[b] Hunter (2001), Includes background plus SRS emissions

[c] Various toxic air pollutants (e.g., lead, benzene, hexane) could be emitted during construction.

Table 5-3. Construction Employment Requirements for the MFFF

Year	Average Number of Workers
2003	550
2004	850
2005	950
2006	650
2007	600

R2

Table 5-4. Estimate of Heavy Vehicles[a] on Site for Each Year of Construction

Year	Number of Vehicles
2003	29
2004	25
2005	25
2006	15
2007	15

[a] Heavy vehicles include earthmoving equipment and large delivery trucks.

R2

Table 5-5. Maximum Additional Site Infrastructure Requirements for MFFF Construction in F Area at SRS

Resource	MFFF	Availability[a]
Transportation		
Roads (mi)	2.0	142
Electricity (MWh/yr)	16	482,700
Diesel Fuel (gal/yr)	330,000	NA[b]
Water (gal/yr)	33,000,000	730,000,000

[a] Capacity minus current usage

[b] Not applicable due to the ability to procure additional resources.

R2

Table 5-6. Wastes Generated During Construction

Waste Type	Estimated Additional Waste Generation (yd^3/yr)	Disposal Capacity (yd^3/yr)
Hazardous	100	NA [a]
Nonhazardous		
Liquid	47,000	1,352,000 [b]
Solid	11,000	NA [a]

[a] Not Applicable; shipped offsite.

[b] Capacity of CSWTF.

Table 5-7. Emissions (kg/yr) from MFFF Operation

(update of Table G-67 of the SPD EIS, p. G-41)

Pollutant	Emergency/Standby Generators	Process	Vehicles
Carbon monoxide	1,855	0	32,658
Nitrogen dioxide	19,355	1,303[a]	9,472
PM_{10}	182[b]	0	33,422[b]
Sulfur dioxide	1,125	0	0
Volatile organic compounds	831	0.9[c]	4,372
Total suspended particulates	182	0	33,422
Chlorine	0	15[d]	0

[a]Process NO_x emissions are from the MFFF stack due to the aqueous polishing process.
[b]PM_{10} emissions were assumed to be the same as total suspended particulate emissions for this analysis resulting in some overestimate of PM_{10} concentrations.
[c]Process VOC emissions are from the emergency and standby diesel generator fuel oil storage tanks.
[d]Process chlorine emissions are from the MFFF stack due to the chloride content of the Pu feedstock.

R2

Table 5-8. Increments to Ambient Concentrations (μg/m³) from MFFF Operation [a]

(update of Table G-68 of the SPD EIS, p. G-41)

Pollutant	Averaging Period	Most Stringent Standard or Guideline[b]	SRS Maximum Concentration[c]	MFFF Contribution	Total
Carbon monoxide	8 hours	10,000	66	22.7	88.7
	1 hour	40,000	254	78.8	332.8
Nitrogen dioxide	Annual	100	17.2	0.048	17.2
PM_{10}	Annual	50	7	0.0004	7
	24 hours	150	97	0.78	97
Sulfur dioxide	Annual	80	24	0.002	24
	24 hours	365	337	4.8	342
	3 hours	1,300	1,171	22.4	1,193
Total suspended particulates	Annual	75	46	0.0004	46
Chlorine	24 hours	75	0.04	0.0004	0.04

R2

[a] Concentrations are the maximum occurring at or beyond the SRS boundary or a public access road.

[b] The more stringent of the federal and state standards is presented if both exists for the averaging period.

[c] Hunter (2001), Includes background plus SRS emissions.

Table 5-9. Comparison of MFFF Impacts to PSD Class II Limits

Pollutant	Averaging Period	Increase in Concentration (µg/m^3)	PSD Class II Area Allowable Increment (µg/m^3)	Percent of Increment
Nitrogen dioxide	Annual	0.0127	25	0.051
PM_{10}	Annual	0.00089	17	0.0052
	24 hours	0.0220	30	0.0073
Sulfur dioxide	Annual	0.00083	20	0.0042
	24 hours	0.0205	91	0.023
	3 hours	0.123	512	0.024

Table 5-10. Minority and Low Income Populations Along Transportation Corridors

	Portsmouth, OH to Fuel Fabrication	Fuel Fabrication to MFFF	MFFF to Catawba Nuclear Station	MFFF to McGuire Nuclear Station
Distance (km)	977	578	298	339
Estimated total population along route	239,221	75,050	74,531	102,182
Estimated minority population along route	40,636	30,702	29,010	53,094
% minority population along route	17.0	40.9	38.9	51.9
Estimated low income population along route	33,268	10,673	Not available	Not available
% low income population along route	13.9	14.2	Not available	Not available

Table 5-11. Potential Radiological Impacts on the General Public and Site Workers Due to Normal Operations of the MFFF

RADIATION DOSE TO THE GENERAL PUBLIC	Impact
Maximally Exposed Individual	
Annual Dose (mrem/yr)[a]	1.5E-03
Percentage of 10 CFR Part 20, Subpart D Standard[b]	1.5E-03
Percentage of Natural Background Radiation[c]	5.1E-04
Annual LCF Risk[d]	7.5E-10
General Population Within 50 mi (80 km)	
Annual Dose (person-rem/yr)[a]	0.12
Percentage of Natural Background Radiation[e]	3.9E-05
Annual LCF Risk[d]	6.0E-05
Average Exposed Individual Within 50 mi (80 km)	
Annual Dose (mrem/yr)[f]	1.2E-04
Percentage of 10 CFR Part 20, Subpart D Standard[b]	1.2E-04
Percentage of Natural Background Radiation[e]	4.1E-05
Annual LCF Risk[d]	6.0E-11

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RADIATION DOSE TO SITE WORKERS	Impact	
Maximally Exposed Site Worker		
Annual Dose (mrem/yr)[g]	3.0	
Percentage of 10 CFR Part 20, Subpart C Standard[h]	6.0E-02	
Percentage of Natural Background Radiation[c]	1.0	
Annual LCF Risk[i]	1.2E-06	
General Site Worker Population	**Minimum[j]**	**Maximum[k]**
Maximum Annual Dose (person-rem/yr)[l]	0.019	40.8
Percentage of Natural Background Radiation[m]	4.7E-04	1.0
Annual LCF Risk[i]	7.6E-06	1.6E-02
RADIATION DOSE TO FACILITY WORKERS	**Impact**	
Average Worker Dose (mrem/yr)[n]	50	
Percentage of 10 CFR Part 20, Subpart C Standard[h]	1	
Percentage of Natural Background Radiation[c]	17	
Annual LCF Risk[i]	2.0E-05	

Table 5-11. Potential Radiological Impacts on the General Public and Site Workers Due to Normal Operations of the MFFF (continued)

[a] Source is GENII model results for general public (see Appendix D).

[b] 10 CFR Part 20, Subpart D standard is an annual dose of 100 mrem.

[c] Natural background radiation is 295 mrem/yr (see Table 4-23).

[d] Calculated using a cancer risk factor of 0.0005 per rem (500 cancers/10^6 person-rem).

[e] Natural background radiation for the public was calculated as the individual background radiation (295 mrem/yr) times the number of people projected to live in the 50-mi (80-km) assessment area in 2030 (1,042,483 people). The calculated value is 307,532 person-rem/yr.

[f] Calculated as the population dose divided by the number of people projected to live in the 50-mi (80-km) assessment area in 2030 (1,042,483 people).

[g] Source is GENII model results for site workers (see Appendix D).

[h] 10 CFR Part 20, Subpart C standard is an annual dose of 5,000 mrem.

[i] Calculated using a cancer risk factor of 0.0004 per rem (400 cancers/10^6 person-rem).

[j] Minimum values based on a distance of 5 mi (8 km) from the release point (i.e., at the SRS boundary).

[k] Maximum values based on a distance of 328 ft (100 m) from the release point (i.e., at the MFFF boundary).

[l] Dose for the site worker population was determined by multiplying the MEI dose at the respective distance from the release point by the total number of site workers (13,616 workers). The MEI doses are as follows:

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MEI dose at the MFFF boundary for a groundlevel release = 3.0 mrem/yr

MEI dose at the SRS boundary for a groundlevel release = 1.4E-03 mrem/yr

[m] Natural background radiation for the site workers was calculated as the individual background radiation (295 mrem/yr) times the number of site workers in 2000 (13,616 workers). The calculated value is 4,017 person-rem/yr.

[n] Based on preliminary dose analyses for the MFFF.

Table 5-12. Potential Waste Management Impacts from MFFF Operation

Waste Type	Maximum Estimated MFFF Waste Generation		Annual Site Waste Generation [c] (yd^3/yr)	Percent of Annual Site Waste Generation
	Liquids[a] (gal/yr)	Solid [b] (yd^3/yr)		
Liquid LLW	385,800	Disposed as Liquid LLW at ETF	Not available	Not available
Solid LLW		134	10,615	4
Stripped Uranium (solidified and added to LLW)	46,000	228		
Liquid High Alpha Activity Waste (solidified and added to TRU waste)	21,841	405	93	700[d]
Solid TRU Waste		248		
Excess Low-Level Radioactive Solvent Waste	3,075	Disposed as Mixed LLW	NA	NA
Liquid Nonhazardous Waste	4,389,710	Disposed Through Approved NPDES Facilities	90,867,868	5
Solid Nonhazardous Waste		1,754	40,000	4

[a] From Table 3-3

[b] From Table 3-4. Values for Stripped Uranium and High Alpha Waste represent conversion to solid as discussed in Appendix G.

[c] From Table 4-27.

[d] Annual MFFF TRU waste generation exceeds current annual SRS generation but the MFFF cumulative volume is well below the maximum projected SRS cumulative volume.

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Table 5-13a. Summary of Bounding MFFF Events

Bounding Accident [a]	Meteorology [b]	Maximum Impact to Site Worker (mrem)	Maximum Impact to Site Worker (probability of cancer deaths)	Maximum Impact to Public at SRS Boundary (mrem)	Maximum Impact at SRS Boundary (probability of cancer deaths)	Impact on Population within 80 km (person-rem)	Impact on Population within 80 km (LCFs)
Internal Fire	bounding – 95% percentile	<100	<4E-5	<0.5	<3E-7	<3E-2	<2E-5
Load Handling	bounding – 95% percentile	<150	<6E-5	<1.0	<5E-7	<3E-2	<2E-5
Hypothetical Explosion Event	bounding – 95% percentile	<500	<3E-4	<3.0	<2E-6	<9E-2	<5E-5
Hypothetical Criticality Event	bounding – 95% percentile	<2200	<9E-4	<12	<6E-6	<6	<3E-3

[a] The bounding loss of confinement event is bounded by the load-handling event.

[b] Values calculated for 50[th] percentile indicate that median meteorology is at least three times lower than the bounding values.

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Table 5-13b. Summary of Bounding Consequences for MFFF Postulated Non-Mitigated Events

Bounding Accident	Meteorology[a]	Maximum Impact to Site Worker (rem)	Maximum Impact to Site Worker (probability of cancer deaths)	Maximum Impact to Public at SRS Boundary (rem)	Maximum Impact to Public at SRS Boundary (probability of cancer deaths)	Impact on Population within 80 km (person-rem)	Impact on Population within 80 km (LCFs)
Loss of Confinement	bounding – 95% percentile	<7	<4E-3	<.05	<3E-5	<8E-4	<4E-7
Internal Fire	bounding – 95% percentile	<0.5	<9E-5	<3E-3	<7E-7	<5E-3	<3E-6
Load Handling	bounding – 95% percentile	<7	<4E-3	<0.05	<3E-5	<8E-4	<4E-7
Hypothetical Explosion Event	bounding – 95% percentile	N/A	N/A	N/A	N/A	N/A	N/A
Hypothetical Criticality Event	bounding – 95% percentile	N/A	N/A	N/A	N/A	N/A	N/A

[a] Values calculated for 50th percentile indicate that median meteorology is at least three times lower than the bounding values

Table 5-14. Potential Impacts from Construction of the PDCF and WSB Facilities in the SRS F Area

Pollutant	Impact from PDCF and WSB Construction[a]
8-hr Carbon Monoxide Increase ($\mu g/m^3$)[b]	3.8
Annual Nitrogen Dioxide Increase ($\mu g/m^3$)[b]	0.17
Annual PM_{10} Increase ($\mu g/m^3$)[b]	0.078
Annual Sulfur Dioxide Increase ($\mu g/m^3$)[b]	0.054
Annual Total Suspended Particulate Increase ($\mu g/m^3$)[b]	0.156
Dose to Workers[c] (person-rem/yr)	2.8
Average Worker Dose[c] (mrem/yr)	4
Hazardous waste[d] (m^3/yr)	85
Nonhazardous Waste[d]	
Liquid[d] (m^3/yr)	26,300
Solid[d] (m^3/yr)	2,320

[a] Source: MFFF ER Appendix G; SPD EIS (DOE 1999c)
[b] Table G-70 of the SPD EIS (DOE 1999c)
[c] Table J-55 of the SPD EIS (DOE 1999c)
[d] Table H-33 of the SPD EIS (DOE 1999c)

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Table 5-15a. Estimated Maximum Cumulative Ground-level Concentrations of Nonradiological Pollutants (micrograms per cubic meter) at SRS Boundary

Pollutant	Averaging Time	SCDHEC Ambient Standard ($\mu g/m^3$)	SRS Maximum Concentration ($\mu g/m^3$)[a]	MFFF ($\mu g/m^3$)[b]	PDCF and WSB [c]	SNF [d]	Tank Closure ($\mu g/m^3$)[e]	Salt Processing Alternative [f]	Other Foreseeable Planned SRS Activities ($\mu g/m^3$)[a]
Carbon monoxide	1 hour	40,000	254			9,760	3.4	18.0	36.63
	8 hours	10,000	66	22.7	0.25	1.31	0.8	2.3	5.15
Oxides of Nitrogen	Annual	100	17.2	0.048	10.02	3.36	0.07	0.03	4.38
Sulfur dioxide	3 hours	1,300	1,171			0.98	0.6	0.4	8.71
	24 hours	365	337			0.13	0.12	0.05	2.48
	Annual	80	24	0.002	0.083	0.02	0.006	5.0×10^{-4}	0.17
Ozone	1 hour	235	NA	NA	NA	0.80	2.0	2	0.71
Lead	Max.quarter	1.5	0.0003			NA	4.1×10^{-6}	4.0×10^{-7}	0.00
Particulate matter (≤10 microns aerodynamic diameter)	24 hours	150	97			0.13	0.06	0.07	3.24
	Annual	50	7	0.0004	0.0036	0.02	0.03	1.0×10^{-3}	0.13
Total suspended particulates ($\mu g/m^3$)	Annual	75	46	0.0004	0.0036	0.02	0.005	1.0×10^{-3}	0.06

[a] Hunter, 2001, *Memorandum from C.H. Hunter to D.C. Carroll, Clean Air Act Title V Dispersion Modeling for SRS (Revision 2)*, SRT-NTS-980189, March 15

[b] MFFF ER, Table 5-8

[c] MFFF ER, Appendix G; DOE 1999, *Surplus Plutonium Disposition Final Environmental Impact Statement*, DOE/EIS-0283, Table G-72

[d] DOE 2000, *Savannah River Site Spent Nuclear Fuel Management Final Environmental Impact Statement*, DOE/EIS-0279

[e] DOE 2000, *High-Level Waste Tank Closure Draft Environmental Impact Statement*, DOE/EIS-0303D

[f] DOE 2001, *Savannah River Site Salt Processing Alternatives Draft Supplemental Environmental Impact Statement*, DOE/EIS-0082-S2D

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Table 5-15b. Estimated Average Annual Cumulative Radiological Doses and Resulting Health Effects to Offsite Population and Facility Workers

Activity	Maximally exposed individual: Dose from airborne releases (rem)	Maximally exposed individual: Dose from liquid releases (rem)	Maximally exposed individual: Total dose (rem)	Maximally exposed individual: Probability of fatal cancer risk	Offsite Population: Collective dose from airborne releases (person-rem)	Offsite Population: Collective dose from liquid releases (person-rem)	Offsite Population: Total collective dose (person-rem)	Offsite Population: Excess latent cancer fatalities	Facility Workers: Collective dose (person-rem)	Facility Workers: Excess latent cancer fatalities
SRS Baseline [a]	5.0×10^{-5}	1.3×10^{-4}	1.8×10^{-4}	9.0×10^{-8}	2.2	2.4	4.6	2.3×10^{-3}	165	0.066
MFFF [b]	1.5×10^{-6}	(n)	1.5×10^{-6}	7.5×10^{-10}	0.12	(n)	0.12	6.0×10^{-5}	20	8×10^{-3}
PDCF and WSB [c]	3.7×10^{-6}	(n)	3.7×10^{-6}	1.9×10^{-9}	1.6	(n)	1.6	8.0×10^{-4}	446	0.18
Management of Spent Nuclear Fuel [d]	1.5×10^{-5}	5.7×10^{-5}	7.2×10^{-5}	3.6×10^{-8}	0.56	0.19	0.75	3.8×10^{-4}	55	0.022
Surplus HEU Disposition [e]	2.5×10^{-6}	(o)	2.5×10^{-6}	1.3×10^{-9}	0.16	(o)	0.16	8.0×10^{-5}	11	4.4×10^{-3}
Tritium Extraction Facility [f]	2.0×10^{-5}	(o)	2.0×10^{-5}	1.0×10^{-8}	0.77	(o)	0.77	3.9×10^{-4}	4	1.6×10^{-3}
Defense Waste Processing Facility [g]	1.0×10^{-6}	(o)	1.0×10^{-6}	5.0×10^{-11}	0.71	(o)	0.71	3.6×10^{-5}	120	0.048
Management Plutonium Residues/Scrub Alloy [h]	5.7×10^{-7}	(o)	5.7×10^{-7}	2.9×10^{-10}	6.2×10^{-3}	(o)	6.2×10^{-3}	3.1×10^{-6}	7.6	3×10^{-3}
DOE complex miscellaneous components [i]	4.4×10^{-6}	4.2×10^{-8}	4.4×10^{-6}	2.2×10^{-9}	7.0×10^{-3}	2.4×10^{-4}	7.2×10^{-3}	3.6×10^{-6}	2	0.001
Sodium-Bonded Spent Nuclear Fuel [j]	3.9×10^{-7}	1.2×10^{-7}	5.1×10^{-7}	2.6×10^{-11}	1.9×10^{-2}	6.8×10^{-4}	2.0×10^{-2}	9.8×10^{-6}	38	0.015
Tank Closure [k]	5.2×10^{-8}	(o)	5.2×10^{-8}	2.6×10^{-11}	3.0×10^{-3}	(o)	3.0×10^{-3}	1.5×10^{-6}	490	0.20
Salt Processing [l]	3.1×10^{-4}	(o)	3.1×10^{-4}	1.6×10^{-7}	18.1	(o)	18.1	9.1×10^{-3}	29	0.12
Plant Vogtle [m]	5.4×10^{-7}	5.4×10^{-5}	5.5×10^{-5}	2.7×10^{-8}	0.042	2.5×10^{-3}	0.045	2.2×10^{-5}	NA	NA

a Arnett and Mamatey, 1998, *Savannah River Site Environmental Data for 1997*, WSRC-TR-97-00322 as cited in DOE 2000, *Savannah River Site Spent Nuclear Fuel Management Final Environmental Impact Statement*, DOE/EIS-0279

b MFFF ER; Table 5-11

c MFFF ER Appendix G; DOE 1999, *Surplus Plutonium Disposition Final Environmental Impact Statement*, DOE/EIA-0283; Tables J-56 and J-57

d DOE 2000, *Savannah River Site Spent Nuclear Fuel Management Final Environmental Impact Statement*, DOE/EIS-0279

e DOE 1996, *Disposition of Highly Enriched Uranium Final Environmental Impact Statement*, DOE/EIS-0240

f DOE 1999, *Final Environmental Impact Statement for the Construction and Operation of a Tritium Extraction Facility at the Savannah River Site*, DOE/EIS-0271

g DOE 1994, *Final Defense Waste Processing Facility Supplemental Environmental Impact Statement*, DOE/EIS-0082-S

h DOE 1998, *Final Environmental Impact Statement on Management of Certain Plutonium Residues and Scrub Alloy at the Rocky Flats Environmental Technology Site*, DOE/EIS-0277F

i DOE 2000, *Savannah River Site Spent Nuclear Fuel Management Final Environmental Impact Statement*, DOE/EIS-0279

j DOE 1999, *Draft Environmental Impact Statement for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel*, DOE/EIS-0306D

k DOE 2000, *High-Level Waste Tank Closure Draft Environmental Impact Statement*, DOE/EIS-0303D

l DOE 2001, *Savannah River Site Salt Processing Alternatives Draft Supplemental Environmental Impact Statement*, DOE/EIS-0082-S2D

m NRC 1996, *Dose Commitments Due to Radioactive Releases from Nuclear Power Plant Sites in 1992.* NUREG/CR 2850

n All radioactive liquids are transferred to SRS waste management facilities.

o Cited in originals as less than minimum reportable levels

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Table 5-15c. Estimated Cumulative Waste Generation from SRS Concurrent Activities (cubic meters)

Waste Type	SRS Operations [a,b]	MFFF [c]	PDCF and WSB [d]	SNF Management [e]	Tank Closure [f]	Salt Processing [g]	Environmental Restoration/ D&D [d]	Other Waste Volume [d]
High-level	14,129	0		11,000	97,000	45,000	0	69,552
Low-level	118,669	16,900	9,500	140,000	19,260	920	61,630	110,102
Hazardous/mixed	3,856	120	910	270	470	56	6,178	4,441
Transuranic	6,012	11,560	3,280	3,700	0	0	0	8,820
Nonhazardous Liquid	416,000	166,170	800,000	Not Reported	Not Reported	Not Reported	Not Reported	Not Reported
Nonhazardous Solid	6,670	13,410	26,500	Not Reported	Not Reported	Not Reported	Not Reported	Not Reported

NOTE: LLW and TRU waste are liquid plus solid

[a] DOE 2000, *Savannah River Site Spent Nuclear Fuel Management Final Environmental Impact Statement*, DOE/EIS-0279

[b] Based on total 30-year expected waste forecast, which includes previously generated waste

[c] MFFF ER, Tables 3-3, 3-4, and 5-12

[d] MFFF ER, Appendix G; DOE 1999, *Surplus Plutonium Disposition Final Environmental Impact Statement*, DOE/EIS-0283; Table H-34

[e] DOE 2000, *Savannah River Site Spent Nuclear Fuel Management Final Environmental Impact Statement*, DOE/EIS-0279

[f] DOE 2000, *High-Level Waste Tank Closure Draft Environmental Impact Statement*, DOE/EIS-0303D

[g] DOE 2001, *Savannah River Sit Salt Processing Alternatives Draft Supplemental Environmental Impact Statement*, DOE/EIS-0082-S2D

Table 5-15d. Estimated Average Annual Cumulative Utility Consumption

Activity	Electricity (megawatt-hours)	Water usage (liter)
SRS baseline [a]	$4.11x10^5$	$1.70x10^{10}$
MFFF [b]	$1.3x10^5$	$9.2x10^6$
PDCF and WSB[c]	$4.8x10^5$	$1.42x10^8$
SNF management [a]	$1.58x10^4$	$2.11x10^8$
Tank closure [d]	Not Available	$8.65x10^6$
Salt processing [e]	$2.4x10^4$	$1.2x10^7$
Other SRS foreseeable activities [a]	$1.51x10^3$	$6.73x10^8$

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[a] DOE 2000, *Savannah River Site Spent Nuclear Fuel Management Final Environmental Impact Statement*, DOE/EIS-0279

[b] MFFF ER

[c] MFFF ER, Appendix G; DOE 1999, *Surplus Plutonium Disposition Final Environmental Impact Statement*, DOE/EIS-0283; Table E-7 and E-17

[d] DOE 2000, *High-Level Waste Tank Closure Draft Environmental Impact Statement*, DOE/EIS-0303D

[e] DOE 2001, *Savannah River Site Salt Processing Alternatives Draft Supplemental Environmental Impact Statement*, DOE/EIS-0082-S2D

Table 5-16. Summary of Impacts for the No Action Alternative

Impact	Hanford	INEEL	Pantex	SRS	LLNL	LANL	RFETS
Air Quality							
Carbon Monoxide Emissions ($\mu g/m^3$)	8 hrs: 34.1 1 hr: 48.3	8 hrs: 302 1 hr: 1220	8 hrs: 620 1 hr: 2990	8 hrs: 671 1 hr: 5100	8 hrs: 69.69 1 hr: 235.5	8 hrs: 3000 1 hr: 5060	8 hrs: 145 1 hr: 534
Percent of State or Federal Standard (%)	8 hrs: 0.34 1 hr: 0.12	8 hrs: 3.0 1 hr: 3.1	8 hrs: 6.2 1 hr: 7.5	8 hrs: 6.7 1 hr: 13	8 hrs: 0.7 1 hr: 1	8 hrs: 38 1 hr: 43	8 hrs: 1.5 1 hr: 1.3
Nitrogen Dioxide ($\mu g/m^3$)	Annual: 0.25	Annual: 11	Annual: 1.94	Annual: 11.4	Annual: 6.08	Annual: 24 24 hrs: 119	Annual: 4.14
Percent of State or Federal Standard (%)	Annual: 0.25	Annual: 11	Annual: 1.9	Annual: 11	Annual: 6.1 1 hr: 1205.75	Annual: 32 24 hrs: 81	Annual: 4.1
Particulate Matter (10 µm) ($\mu g/m^3$)	Annual: 0.0179 24 hrs: 0.77	Annual: 3 24 hrs: 39	Annual: 8.79 24 hrs: 89.4	Annual: 4.94 24 hrs: 85.7	Annual: 0.83 24 hrs: 16.18	Annual: 11 24 hrs: 39	Annual: 0.235 24 hrs: 17.4
Percent of State or Federal Standard (%)	Annual: 0.036 24 hrs: 0.51	Annual: 6 24 hrs: 26	Annual: 18 24 hrs: 60	Annual: 9.9 24 hrs: 57	Annual: 2.8 24 hrs: 32	Annual: 22 24 hrs: 26	Annual: 0.5 24 hrs: 12

Table 5-16. Summary of Impacts for the No Action Alternative (continued)

Impact	Hanford	INEEL	Pantex	SRS	LLNL	LANL	RFETS
Sulfur Dioxide ($\mu g/m^3$)	Annual: 1.63 24 hrs: 8.91 3 hrs: 29.6 1 hr: 32.9	Annual: 6 24 hrs: 137 3 hrs: 591	Annual: 0 24 hrs: 2.0E-05 3 hrs: 8.0E-05 0.5 hr: 1.6E-04	Annual: 16.7 24 hrs: 222 3 hrs: 725	Annual: 0.08 24 hrs: 1.59 3 hrs: 10.44 1 hr: 16.01	Annual: 26 24 hrs: 171 3 hrs: 459	Annual: 0.295 24 hrs: 21.8 3 hrs: 64.6
Percent of State or Federal Standard (%)	Annual: 3.1 24 hrs: 3.4 3 hrs: 2.3 1 hrs: 5.0	Annual: 7.5 24 hrs: 38 3 hrs: 45	Annual: 0 24 hrs: <.001 3 hrs: <.001 0.5 hr: <.001	Annual: 21 24 hrs: 61 3 hrs: 56	Annual: 0.1 24 hrs: 1.5 3 hrs: 0.8 1 hrs: 2.4	Annual: 63 24 hrs: 83 3 hrs: 45	Annual: 0.37 24 hrs: 6 3 hrs: 9.2
Total Suspended Particulates ($\mu g/m^3$)	Annual: 0.0179 24 hrs: 0.77	(a)	(b)	Annual: 45.4	(a)	Annual: 14 24 hrs: 48	Annual: 0.284 24 hrs: 21
Percent of State or Federal Standard (%)	Annual: 0.036 24 hrs: 0.51	(a)	(b)	Annual: 61	(a)	Annual: 23 24 hrs: 32	Annual: 0.38 24 hrs: 14
Benzene ($\mu g/m^3$)	Annual: 6.0E-06	Annual: 2.9E-02	Annual: 5.47E-02 1 hr: 19.4	24 hrs: 20.7	(a)	(a)	(a)
Percent of State or Federal Standard (%)	Annual: 0.01	Annual: 24	Annual: 1.8 1 hr: 26	24 hrs: 14	(a)	(a)	(a)

Table 5-16. Summary of Impacts for the No Action Alternative (continued)

Impact	Hanford	INEEL	Pantex	SRS	LLNL	LANL	RFETS
Human Health							
Public Population Dose 50 mi (80 km) in 2030 (person-rem)	4.7 E-02	7.6E-05	6.3E-06	2.9E-04	6.7E-03	2.7	1.0E-01
50-year Fatal Cancers	1.2E-03	1.9E-06	1.6E-07	7.2E-06	1.7E-04	6.8E-02	2.5E-03
Maximally Exposed Public Individual in 2030 (mrem)	4.1E-04	1.4E-05	1.8E-08	6.8E-06	3.1E-04	6.5	4.8E-01
50-year Fatal Cancer Risk	1.0E-08	3.5E-10	4.5E-13	1.7E-10	7.8E-09	1.6E-04	1.2E-05
Facility Accident Type[c]	Beyond Evaluation Basis Earthquake	Beyond Evaluation Basis Earthquake	Beyond Evaluation Basis Earthquake	Beyond Evaluation Basis Earthquake	(b)	(b)	(b)
Frequency Estimate[c]	1.0E-07	1.0E-07	1.0E-07	1.0E-07	(b)	(b)	(b)
Public Population Dose Within 50 mi (80 km)[c] (person-rem)	2,410	723	821	2,590	(b)	(b)	(b)
LCFs [c]	1.2	0.36	0.41	1.3	(b)	(b)	(b)
Ecological Resource							
Surface Water	None	None	None	None	None	None	None
Surface Water Quality	None	None	None	None	None	None	None
Groundwater	None	None	None	None	None	None	None

Table 5-16. Summary of Impacts for the No Action Alternative (continued)

Impact	Hanford	INEEL	Pantex	SRS	LLNL	LANL	RFETS
Groundwater Quality	None	None	None	None	None	None	None
Endangered Species	None	None	None	None	None	None	None
Wetlands	None	None	None	None	None	None	None
Cultural, Historic and Archaeological	None	None	None	None	None	None	None
Land Use	None	None	None	None	None	None	None

Key: INEEL – Idaho National Engineering & Environmental Laboratory; SRS – Savannah River Site; LLNL – Lawrence Livermore National Laboratory; LANL – Los Alamos National Laboratory; RFETS – Rocky Flats Environmental Technology Site

[a] No state standards were presented in the SPD EIS (DOE 1999c) for the location.

[b] Information was not included in the SPD EIS (DOE 1999c)

[c] Information on facility accidents obtained from the S&D PEIS (DOE 1996b)

Table 5-17. Accident Scenarios for Plutonium Storage Under the No Action Alternative[a]

Accident Scenario	Accident Frequency	Source Term at Risk[b] (No. of PCV)	Source Term Related to the Environment (g Pu)
PCV puncture by forklift	6.0E-04	2	0.0387
PCV breach by firearms discharge	3.5E-04	1	3.87E-03
PCV penetration by corrosion	0.064	1	0.158
Vault fire	1.0E-07	120	81.3
Truck bay fire	1.0E-07	12	5.40
Spontaneous combustion	7.0E-07	2	7.75E-03
Explosion in vault	1.0E-07	45	12.7
Explosion outside vault	1.0E-07	1	0.058
Nuclear criticality	1.0E-07	Not Applicable	1.0E+19 fissions
Beyond evaluation basis earthquake	1.0E-07	194	146

[a] Source: S&D PEIS (DOE 1996b)

[b] Primary Containment Vessel (PCV) is assumed to contain up to 4,500 g of weapons-grade plutonium as a bounding case.

Table 5-18. Summary of Accident Dose (rem) for Plutonium Storage Under the No Action Alternative[a]

Accident Scenario	Hanford		INEEL		Pantex		SRS	
	MEI Dose	Population Dose	MEI Dose	Population Dose	MEI Dose	Population Dose	MEI Dose	Population Dose
PCV puncture by forklift	8.8E-05	0.64	8.8E-05	0.19	1.4E-03	0.22	1.4E-04	0.068
PCV breach by firearms discharge	8.8E-06	0.064	8.8E-06	0.19	1.4E-03	0.022	1.4E-05	0.068
PCV penetration by corrosion	3.6E-04	2.6	3.6E-04	0.78	5.8E-03	0.89	5.8E-04	2.8
Vault fire	0.18	1,340	0.19	402	3.0	456	0.3	1,440
Truck bay fire	0.012	89	0.012	26.7	0.20	303	0.020	95.5
Spontaneous combustion	1.8E-05	0.13	1.8E-05	0.038	2.8E-04	0.044	2.8E-05	0.14
Explosion in vault	0.029	209	0.029	62.7	0.46	71.2	0.046	224
Explosion outside vault	1.3E-04	0.96	1.3E-04	0.29	2.1E-03	0.33	2.1E-04	1.0
Nuclear criticality	6.5E-05	0.07	7.7E-05	0.018	1.9E-03	0.046	1.1E-04	0.094
Beyond evaluation basis earthquake	0.33	2,410	0.34	723	5.34	821	0.53	2,590

[a] Source: S&D PEIS (DOE 1996b).

PCV – Primary Containment Vessel

Table 5-19. F-Area Site Evaluation Matrix

Qualification Criteria	Area 3	Area 2	Area 4	Area 5
Free from Subsurface Contamination	No		No	No
Adequate Terrain and Area			No	
Free from RCRA / CERCLA Features				No

Evaluation Criteria	Weight	Rating			
Protected Species	3	2	2	2	2
Water Table	3	2	2	1	3
Topography	3	3	3	1	2
Accessibility	2	1	3	2	3
Soft Zones	2	2	2	2	2
Utilities / Infrastructure	2	1	3	2	2
Wetlands	1	2	2	1	2
Archaeological Features	1	1	1	2	2
Interference with Existing SSCs	1	1	2	2	1
Sum of the (weights) x (ratings)		33	42	29	40

Rating:

3 = More than Adequate

2 = Adequate

1 = Marginal

Table 5-20. Irreversible and Irretrievable Commitments of Construction Resources for the MOX Fuel Fabrication Facility

Resource	Commitment	Comments
Land	106 acres	Land will be returned to industrial use after completion of the MFFF mission
Electricity (MWh)	16	
Fuel (gal)	330,000	
Water (gal)	33,000,000	Water will be treated and returned to the environment
Concrete (yd^3)	156,000	
Steel (tons)	38,000	

R2

Table 5-21. Irreversible and Irretrievable Commitments of Operations Resources for the MOX Fuel Fabrication Facility

Resource	Annual Resource Commitment	Comments
Electricity	130,000 MWh	
Water	2,438,410 gal (max)	Water will be treated and returned to the environment
Fuel Oil	111,000 gal	Used for emergency and standby diesels
Plutonium	3.5 metric tons (Pu)	
Depleted Uranium	66.5 metric tons (U)	
Argon	12,900,000 ft^3	
Argon-Methane	367,000 ft^3	
Dodecane	770 gal	
Helium	341,000 ft^3	
Hydrazine (35%)	400 gal	
Hydrogen	371,000 ft^3	
Hydrogen Peroxide (35%)	530 gal	
Hydroxylamine Nitrate	9,200 gal	
Manganese Nitrate	10 lb	
Nitric Acid	1,300 gal	95% of acid is recovered and recycled
Nitrogen	160,000,000 ft^3	
Nitrogen Tetroxide	132,000 ft^3	
Oxalic Acid Dehydrate	8,900 lb	
Oxygen	71,000 ft^3	
Porogen	660 lb	
Silver Nitrate	240 lb	96% of silver is recovered and recycled
Sodium Carbonate	440 lb	
Sodium Hydroxide (10M)	5 gal	
Tri-Butyl Phosphate	740 gal	
Zinc Stearate	617 lb	

R2

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6. ANALYSIS OF ENVIRONMENTAL IMPACTS OF PROPOSED ACTION AND ALTERNATIVES

This chapter summarizes each alternative examined in this ER, considering both the benefits and environmental costs of each alternative. The conclusion of the environmental analysis conducted in this ER is that the proposed action is the appropriate course of action.

6.1 PROPOSED ACTION

6.1.1 Benefits of the Proposed Action R2

As discussed previously, the proposed action is the issuance of an NRC license to possess and use SNM in an MFFF at SRS. The primary benefit of the proposed action is that it meets the purpose and need for action discussed in Chapter 2. The proposed action provides the mechanism to implement the joint United States and Russian Federation Agreement (White House 2000) [Text Deleted]. R2

In addition to the significant national security benefit of implementing the joint United States and Russian Federation Agreement, the proposed action also results in additional benefits to the local community around SRS by providing approximately 500 to 900 construction jobs and 400 full-time jobs over the lifetime of the project. This increase in jobs will partially offset the planned job reductions as the SRS mission changes. The process of converting the surplus plutonium to MOX fuel will also consume up to 728 tons (660 metric tons) of surplus depleted uranium. R2

6.1.2 Monetary Costs of the Proposed Action

In February 2002, DOE submitted *Report to Congress: Disposition of Surplus Defense Plutonium at Savannah River Site* (NNSA 2002). This report provided updated cost estimates for various program alternatives requested by Congress. DOE estimated the budget cost of the MFFF (Table 6-1) to be $2.1 billion with the added cost of the PDCF and WSB at $1.7 billion yielding a total cost $3.8 billion (NNSA 2002). R1

6.1.3 Environmental Costs of the Proposed Action

The direct environmental impacts of the proposed action are summarized in Table 6-2. Construction of the MFFF will disturb 106 ac (43 ha), most of which will be returned to original use once construction is finished. Once constructed, the MFFF will occupy 41 ac (16.6 ha) of land in the SRS F Area. All liquid and solid wastes will be transferred to the appropriate SRS waste treatment facility. Because the MFFF does not have any process liquid effluent, there are no expected impacts on surface water or groundwater. The MFFF site will have a stormwater collection and routing system that will discharge through the existing SRS stormwater NPDES outfall or new outfalls. There may be slight temporary impacts from construction runoff, but these should disappear once construction is completed.

The MFFF will have emergency and standby diesel generators that will be tested periodically, resulting in criteria pollutant emissions during the testing periods. Incremental increases in ambient concentrations of these criteria pollutants will be well below the ambient air quality standards for southwestern South Carolina. The MOX fuel fabrication process also will release small quantities of NO_X. The annual releases are accounted for in the nitrogen dioxide projections for the facility.

Dose to the public from normal MFFF operations (0.12 person-rem/yr population dose; 1.5E-03 mrem/yr for the MEI) will be well below NRC and EPA criteria and also below background radiation levels. R1

Although the construction and operation of the MFFF will disturb approximately 106 ac (43 ha) of SRS land, some of this land is already designated the site of the PDCF. There will be no impacts to sensitive ecological areas because no such areas were identified on the MFFF site. R1 The construction of the MFFF will require the excavation and recovery of two archaeological sites. Mitigation of one of these sites was completed in April 2002 and mitigation completion for the second site is anticipated for August 2002. R1 The archaeological site is not expected to contain any human or sacred artifacts and so the excavation and recovery of the artifacts may represent a benefit through the preservation of the artifacts.

[Text Deleted] With the exception of the solid TRU waste, the amounts of waste generated are a small fraction of annual SRS waste generation and will therefore have minimal impacts on SRS waste management resources. R1 The liquid high alpha activity waste generated by the MFFF will be solidified and disposed as 405 yd^3/yr solid TRU waste at WIPP. R2 This additional waste represents a < 1% increase in waste disposed at WIPP. The *Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement* projected no latent cancer fatalities to the public from disposal activities. Addition of an insignificant amount of MFFF solid TRU waste is not expected to change this projection. [Text Deleted]

Cumulative impacts in the geographic vicinity of the MFFF and SRS are dominated by the impacts of existing SRS activities. SRS is currently in substantial compliance with applicable federal, state, and local air quality regulations, and compliance would be maintained even with the cumulative effects of all surplus plutonium disposition activities. Cumulative dose to the maximally exposed member of the public from all SRS activities would increase by 1.5E-03 mrem/yr or about 0.2% over the current SRS dose of 0.18 mrem/yr (Arnett and Mamatey 2001). R1
[Text Deleted]

Dose to the public and workers from the transportation of plutonium feedstock to SRS was evaluated in the SPD EIS (DOE 1999c) R2

The total dose to transportation workers associated with the UF_6 shipments is estimated to be 1.06 person-rem, corresponding to 4.22E-04 LCFs. The total dose to transportation workers associated with the UO_2 shipments is estimated to be 0.78 person-rem, corresponding to 3.10E-04 LCFs. R2

The dose to the public associated with the UF_6 shipments is estimated to be 0.21 person-rem, corresponding to 1.05E-04 LCFs. For the UO_2 shipments, the total dose to the public is estimated to be 0.14 person-rem, corresponding to 6.90E-05 LCFs. R2

The cumulative dose to the transportation workers associated with the MOX fuel shipments to the mission reactors is estimated to be 34.1 person-rem, corresponding to 1.36E-02 LCFs. The dose to the public associated with these shipments is estimated to be 9.98 person-rem, corresponding to 1.06E-03 LCFs. R2

The incident-free dose per shipment (in person-rem) for the plutonium recycle shipments in NUREG-0170 (NRC 1977c) was calculated to be 0.17, versus a maximum of 0.2 person-rem per shipment for the MOX shipments from the SRS MFFF to the mission reactor sites. The dose to the MEI for the person in traffic next to a shipment of MOX fuel is 2.0 mrem. This dose is a small fraction of the dose received from natural background radiation and is consistent with the conclusions of NUREG-0170 (NRC 1977c). R2

This ER relied on the mission reactor impacts analysis provided in the SPD EIS (DOE 1999c). The SPD EIS determined that there should be no change in impacts to the environment during normal operations at the mission reactors resulting from the irradiation of MOX fuel. This conclusion is reinforced by operating experience from Electricite de France, which operates MOX fuel power plants in France.

Because the MOX fuel that will be produced by the MFFF represents less than 1% of the domestic commercial nuclear fuel use, financial impacts to commercial fuel facilities should be minimal.

Although the proposed action does have environmental impacts, the impacts are small and consequently acceptable. The environmental impacts are outweighed by the benefit of enhancing nuclear weapons reductions both in the United States and in Russia.

6.2 NO ACTION ALTERNATIVE

6.2.1 Benefits of the No Action Alternative R2

The No Action Alternative is the denial of a license to possess and use SNM in an MFFF at SRS. Because of previous DOE decisions in the SPD EIS ROD (DOE 2000b), the consequence of the No Action Alternative is continued storage of surplus plutonium. The No Action Alternative does not meet the need for implementing the joint United States and Russian Federation Agreement (White House 2000).

The primary benefit of the No Action Alternative is the avoidance of impacts associated with the proposed action. This avoidance is generally in the area of waste generation. R2

6.2.2 Monetary Costs of the No Action Alternative

DOE estimated the budget cost of continued storage as $4.6 billion, over the same period as the proposed alternative. Additionally, the No-Action Alternative would incur a $246 million annual cost indefinitely for as long as the material continued to be stored (NNSA 2002). R1

6.2.3 Environmental Costs of the No Action Alternative

Because the impacts of the No Action Alternative are spread over seven different locations, as reported in the SPD EIS (DOE 1999c), the range of impacts is summarized in Table 6-2. R1 Because the No Action Alternative uses existing storage facilities, there is minimal impact on land or water use.

For the No Action Alternative, emissions include not only emergency generators but also emissions from vehicles and maintenance activities. As with the proposed action, the impacts to ambient air quality under the No Action Alternative represent a small percentage of the state or federal standard. However, the emissions under the No Action Alternative would occur indefinitely, since storage would be required indefinitely.

For the No Action Alternative, all storage occurs in existing facilities with no ecological impacts for continued use of these facilities. Storage activities do not generate significant amounts of waste.

6.3 SITING ALTERNATIVES

R2

In the SPD EIS (DOE 1999c), DOE evaluated several combinations of facilities and sites and chose as its Preferred Alternative to site the MFFF (along with the PDCF) in F Area at SRS. In the subsequent ROD (DOE 2000b), DOE confirmed the SPD EIS Preferred Alternative. Subsequent to the ROD, DOE investigated several sites within F Area for the MFFF and other surplus plutonium disposition facilities. The results of this investigation are summarized in Section 5.7.2.

As discussed in Section 5.7.2, selection was based primarily on adequate area for construction, presence of any protected species, depth to water table, and avoidance of RCRA/CERCLA designated remediation area. Cost was not considered a significant discriminator in the selection of sites within the F Area. The cost of locating in any of the F-Area sites was considered to be similar for all of these sites because of the proximity to existing infrastructure. R2

Environmental impacts associated with facility operations (i.e., land use, water use, radiological and nonradiological emissions, and waste generation) are unaffected by the selection of any site within F Area. The selected site does not have wetlands or critical habitat; some alternative sites included wetlands. [Text Deleted] The selected site, however, required mitigation of an R2 archaeological site; most of the alternative sites would have avoided the archaeological site. In the final evaluation, none of the alternative sites were obviously superior to the selected site.

6.4 DESIGN ALTERNATIVES R2

One of the bases for selection of DCS as the contractor for the MFFF was the DCS proposal to use a proven design (the COGEMA process) based on actual operations of similar facilities (MELOX and La Hague) in France. The COGEMA design represents the results of several iterations of process design and operating experience over more than 25 years of MOX fuel R2 production in France. This design optimizes both production and safety. The selection of DCS and the contractual arrangements with DOE established the basic design of the facility and process. In the process of converting the COGEMA design, based on the MELOX and La Hague facilities, to meet United States regulations, codes, and standards, DCS considered several design alternatives (see Section 5.7.3). In each case, the design alternatives selected resulted in a lower environmental impact.

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Tables

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Table 6-1. MFFF implementation costs (Thousands of 2001 dollars)[a]

Facility	R&D and Pre-Capital Costs	Design and Construction and Capital Equipment Costs	Operations Costs	Deactivation Costs	Contingency Costs	Total Costs
PDCF	249,300	440,900	718,200	9,100	267,700	$1,695,200
MFFF	326,800	1,058,200	1,226,800	9,100	497,800	$2,154,500
Total	**$576,100**	**$1,509,100**	**$1,945,000**	**$18,200**	**$765,500**	**$3,849,700**

R1

[a] Source: NNSA 2002

R2

Table 6-2. Comparison of Environmental Impacts for the Proposed Action and the No Action Alternative

Environmental Impact	Proposed Action[a]	No Action Alternative[b]
Land Use (acres)	106 (Disturbed in Construction) 41 (Occupied during Operation)	0
Surface Water Quality	No Impact	No Impact
Groundwater Quality	No Impact	No Impact
Ambient Carbon Monoxide Increment (μg/m^3) 8-hour average	22.7	34.1 – 3000
Ambient Nitrogen Dioxide Increment (μg/m^3) Annual average	0.048	0.25 – 24
Ambient Particulate Matter – PM_{10} Increment (μg/m^3) 24-hour average	0.78	0.77 – 89
Ambient Sulfur Dioxide Increment (μg/m^3) 24-hour average	4.8	2.0E-05 – 171
Public Population Dose – 50 mi (80 km) in 2030 (person-rem)	0.12	6.3E-06 – 2.9E-04
Maximally Exposed Public Individual (mrem)	1.5E-03	6.8E-06 – 6.5
Bounding Accident Public Population Dose Within 50 mi (80 km) (person-rem)	< 6	723 – 2,590
Wetlands Affected (acres)	None	None
Critical Habitat Lost (acres)	None	None
Cultural Resources Disturbed	Excavation of archaeological site[c]	None
Liquid LLW (gal/yr)	359,672	No change
Solid LLW (yd^3/yr)	362	No change
[Text Deleted]		
Solid TRU Waste (yd^3/yr)	653	No change
Excess Low-Level Radioactive Solvent Waste (gal/yr)	3,075	No change
Liquid Nonhazardous Waste (gal/yr)[d]	4,389,710	No change
Solid Nonhazardous Waste (yd^3/yr)	1,754	No change
Cost ($ Billion)	3.8[e]	4.6

R2

R2

R1

Table 6-2. Comparison of Environmental Impacts for the Proposed Action and the No Action Alternative (continued)

Source for No Action Impacts: S&D PEIS (DOE 1996b) and SPD EIS (DOE 1999c)
Source for Mission Reactor Impacts: SPD EIS (DOE 1999c)

[a] Projected impacts are based on preliminary design and assumed to be bounding. Impacts of the proposed action are expected to occur for a 10-year period at design capacity of 3.5 metric tons plutonium converted per year.
[b] Impacts for the No Action Alternative are expected to occur indefinitely.
[c] Mitigation of the archaeological site may result in a positive environmental impact due to recovery of archaeological artifacts.
[d] Includes sanitary waste and HVAC condensate from external air intake system. R2
[e] Includes PDCF and WSB

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7. STATUS OF COMPLIANCE WITH FEDERAL AND STATE ENVIRONMENTAL REGULATIONS

Several environmental permits and plans required by federal and state agencies need to be developed and approved in order to construct and operate the MFFF. In addition, under NEPA rules and the enabling regulations of the NRC (10 CFR Part 51), consultations may be required with other federal agencies, as appropriate. Comments and recommendations made by these agencies are part of the review process for NRC project approvals. The status of these permits and their approvals is summarized in Table 7-1. R1

7.1 UNITED STATES GOVERNMENT

The following is a summary of federal agencies that will be involved in the environmental permit and plan approvals and the consultation process for MFFF project construction and operations activities.

7.1.1 U.S. Nuclear Regulatory Commission (NRC)

The NRC is responsible for the review and licensing of fuel fabrication facilities. The federal guidelines for licensing a fuel fabrication facility are identified in 10 CFR Part 70. Under 10 CFR Part 70, a comprehensive Construction Authorization Request, License Application, and R1 an Integrated Safety Analysis Summary must be submitted to NRC. An ER is submitted to meet the requirements of 10 CFR Part 51. NRC is responsible for establishing limits on radiological releases from the MFFF.

7.1.2 U.S. Environmental Protection Agency (EPA)

Permitting of the MFFF is governed by federal and state environmental laws and enabling regulations. SRS F Area has been an established industrial area for approximately 50 years. The area surrounding F Area has been impacted previously by F-Area construction and operations activities and is presently undergoing environmental restoration activities.

EPA Region IV in Atlanta, Georgia, has delegated regulatory jurisdiction to SCDHEC for virtually all aspects of permitting, monitoring, and reporting activities. Therefore, all activities associated with compliance to the Clean Air Act (CAA), Clean Water Act (CWA), Safe Drinking Water Act (SDWA), and Resource Conservation and Recovery Act (RCRA) will be undertaken with SCDHEC. This is addressed in Section 7.2.1.

R1

The projected quantities of all MFFF chemicals will not be greater than the threshold level in 40 CFR §68.130. Accordingly, compliance with 40 CFR Part 68, the Risk Management Rule, is not invoked, and a Risk Management Plan does not have to be developed.

7.1.3 U.S. Army Corps of Engineers (COE)

An Individual or General 404 Permit is not required from the COE since there are no plans to dredge and fill jurisdictional wetlands during the construction of the MFFF.

A Floodplain Assessment (WSRC 1999a) that addresses the flood history of the Savannah River and Upper Three Runs, and the effects of local intense precipitation at F Area, indicates that the MFFF site is situated well above the design basis flood level. The MFFF site is not located in a floodplain, nor is there any wetlands present within the MFFF site. R1

7.1.4 U.S. Department of Energy (DOE)

The MFFF will be an NNSA-owned, NRC-licensed facility located at SRS. The National Nuclear Security Administration (NNSA) is the owner, while DOE-SR is providing the host site. R1 Accordingly, environmental and site utility permits and plans are needed from DOE-SR for MFFF construction and operation. In addition, SRS site-wide permits will serve as a platform for some of the MFFF environmental permits. R1

7.1.5 U.S. Department of Transportation (DOT)

Transport of the MFFF fuel to the mission reactors requires compliance with the following DOT enabling regulations:

- 49 CFR Part 107, "Hazardous Materials Program Procedures," Subpart G: Registration and fee to DOT as a person who offers or transports hazardous materials
- 49 CFR Part 171, "General Information, Regulations, and Definitions"
- 49 CFR Part 173, "Shippers – General Requirements for Shipments and Packages," Subpart I: Radioactive materials
- 49 CFR Part 177, "Carriage by Public Highway"
- 49 CFR Part 178, "Specification for Packagings."

All provisions of these enabling regulations will be met prior to the transport of MFFF fuel assemblies from the MFFF to the mission reactors.

7.1.6 U.S. Department of Interior (DOI)

The U.S. Fish and Wildlife Services (USFWS) bureau of DOI is responsible for the protection of threatened and endangered species. Since there are no threatened or endangered species on the MFFF site, a negative declaration on endangered species has been received from the USFWS. R1

7.1.7 U.S. Department of Agriculture (USDA)

The U.S. Natural Resources Conservation Service (USNRCS) branch of the USDA is responsible for the preservation of prime or unique farmlands. However, the USNRCS does not identify SRS land as prime farmlands because the land is not available for agricultural production (DOE 1996b:3-230).

7.2 STATE OF SOUTH CAROLINA

With the exception of the NRC license, MFFF permitting is under the jurisdiction of South Carolina state agencies. The following is a summary of environmental permitting activities to be undertaken with the appropriate state agencies.

7.2.1 South Carolina Department of Health and Environmental Control (SCDHEC)

7.2.1.1 Preservation of Air Quality

MFFF construction and operations activities are not expected to have any measurable impact on the local air quality since no significant criteria or hazardous air pollutant emissions will result.

Any potential air quality-related impacts associated with the construction of the MFFF result from diesel fuel emissions from construction equipment, particulate matter emissions from disturbance of soil by construction equipment, if used, and other vehicles (i.e., construction fugitive dust emissions), operation of a concrete batch plant, operation of employee vehicles, and trucks moving materials and wastes. There are no SCDHEC regulations governing the generation of fugitive dust resulting from construction activities. However, for a project of this size, steps need to be taken to minimize fugitive dust emissions. Accordingly, a Construction Emissions Control Plan will be developed to provide assurance that fugitive dust emissions will be effectively managed and minimized throughout MFFF construction. This plan will include dust control techniques, such as watering of unpaved surfaces, chemical stabilization of potential dust sources, the use of portable wind screens and fences, and other equivalent mitigation measures. R1

During operations, MFFF gaseous emissions are limited to NOx and chlorine from aqueous polishing process offgas through the MFFF stack, criteria pollutants from intermittent usage of standby and emergency diesel generators and from the evaporation of a very small amount of VOCs from the ventilation stack on the diesel fuel storage tanks. These minor sources will not trigger 40 CFR Part 60 New Source Performance Standards or 40 CFR Part 52 Prevention of Significant Deterioration permitting requirements. In addition, small space heating sources of air pollutants (i.e., less than 1 million Btu/hr heat input) are exempt from applicable SCDHEC air quality regulations. Moreover, the diesel generators are non-construction stationary sources of air pollutants greater than 150 kW in size but are not expected to operate more than 250 hours per year. As long as diesel generator usage is appropriately documented, the diesel generators are exempted from permitting requirements in accordance with South Carolina Regulation 61-61.2, Section II.F.(2).(e). Finally, the quantity of criteria and hazardous air pollutants expected R2 R1 to be emitted during MFFF operations is not of sufficient magnitude to trigger any CAA Title V (40 CFR Part 71) permitting requirements. The MFFF sintering furnace, aqueous polishing screw calciner, and package boiler are all electrically fired and therefore will not generate any criteria pollutant emissions.

Although NRC-licensed facilities are exempted from National Emissions Standards for Hazardous Air Pollutants (NESHAP) requirements governing radiological releases, DOE-owned facilities are not exempted under 40 CFR 61 Subpart H. EPA Region IV and SCDHEC approved an alternate calculation methodology, which exempted MFFF from preparing a NESHAPS Construction Permit. Compliance with applicable enabling regulations and other guidance on radiological releases is addressed in the *Construction Authorization Request* and *License Application.* R1

Emissions of hazardous air pollutants from the Reagent Process Building will be under the triggers of 10 tons (9.1 metric tons) per year for a single hazardous air pollutant and 25 tons (22.7 metric tons) per year for all hazardous air pollutants. Refrigerants used for air conditioning at the MFFF will consist of Class II refrigerants (i.e., non-ozone-depleting substances). Therefore, permitting for CAA Title VI, "Stratospheric Ozone Protection" (40 CFR Part 82), relative to the usage and storage of refrigerants, will not be required.

Although the criteria and hazardous air pollutant emissions during MFFF operation are minimal, SCDHEC does require the development of Bureau of Air Quality permit forms (i.e., Permit Forms I IIA, IIB, and IIF) to obtain exemptions. Moreover, prior to operations, permit forms need to be submitted to augment the SRS Title V Operating Permit. The appropriate forms for emissions from the MFFF stack, diesel generators, and diesel fuel storage vault will be prepared, and the SRS Title V Permit will be augmented appropriately. R1

7.2.1.2 Surface Water Protection

To protect jurisdictional waters from pollutants that could be conveyed in construction-related stormwater runoff, EPA enabling regulations require construction projects disturbing 5 ac (2 ha) or more of soil to secure coverage under an NPDES permit authorizing the construction-related stormwater discharges. Since a concrete batch plant is employed as part of the construction activities, its runoff would also need to be addressed within this permitting structure (i.e., filing an NPDES Permit for no discharge basin). EPA regulates the proper disposition of stormwater from these larger construction sites through an NPDES permit program (i.e., 40 CFR §122.26(b)(14)) pursuant to Section 402 of the CWA. With respect to MFFF construction activities at SRS, a sitewide Construction NPDES General Permit (i.e., SCR100000) is available to cover construction projects disturbing 5 ac (2 ha) or more of soil. R1 R1

Coverage under the SRS General Permit will be secured by filing an application form with SCDHEC (i.e., Notice Of Intent [NOI]) at least 48 hours prior to initiating any construction activities. The scope of construction will need to comply with applicable terms and conditions identified in the Storm Water General Permit. R1

Soil-disturbing activities associated with construction of the MFFF include the following:

- Site grading, clearing, and grubbing R1
- Berms that will function as diversion ditches
- Stormwater detention basin
- Construction of the site access road
- Construction laydown area.

Once the NOI is filed with SCDHEC, coverage under the SRS General Permit is received by default 48 hours after filing. However, several activities must be conducted prior to filing an NOI. These activities include the preparation and approval of a Stormwater Pollution Prevention R1 Plan (SWPPP).

The NOI will provide general information about the site, such as name, location, dates, and other general information relevant to the nature of the construction activities. Within the SWPPP, there will be provisions outlining erosion and sediment controls, soil stabilization practices, structural controls, and other Best Management Practices (BMPs) that will be employed during construction to protect offsite waters from adverse impacts from construction-related stormwater runoff. The SWPPP will also outline maintenance and inspection requirements and identify BMPs for the effective management of stormwater runoff from a concrete batch plant, if one is employed. If a detention basin is required, it will also be appropriately sized to meet the applicable criteria in the General Permit. BMPs include schedules of activities, prohibition of practices, maintenance procedures, and other management practices designed to prevent or reduce the pollution of waters of the United States from erosion and sedimentation. BMPs also R1 include treatment requirements, operating procedures, and practices to control plant site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.

The SWPPP will be maintained onsite throughout the construction process and will be updated as appropriate. The SWPPP will also be made available for review, upon request, by the cognizant regulators.

Grading Permits, which are required by SRS, will be developed and filed, as appropriate.

Once construction has been completed, the existing SRS Industrial NPDES General Permit for stormwater that is exposed to pollutants in an industrial activity will be modified to accommodate the MFFF. The existing SRS (i.e., SC0000175) NPDES Permit for process water R1 discharges will not require modification since there are no expected MFFF process water discharges.

Prior to operations, a Spill Prevention Control and Countermeasures (SPCC) Plan will be developed. A SPCC is required since more than 42,000 gallons of fuel will be stored R2 underground.

7.2.1.3 Drinking Water and Groundwater Protection

Drinking water requirements for construction and operation of the MFFF will be satisfied by a tie-in to the available drinking water from the SRS domestic water system. This system complies with applicable SDWA enabling regulations associated with the delivery of safe and reliable drinking water for SRS employees. A Domestic Water Distribution Construction Permit will be obtained prior to construction. Approval from the SRS Water Services Department and Environmental Protection Department will be sought by providing static and residual pressure at the tie-in and design calculations of head loss, interior flows, and fire fighting flow requirements. SCDHEC has delegated permitting authority for domestic water permits to the Environmental Protection Department. Prior to operations, a Domestic Water Distribution Operating Permit will be obtained following the same protocol.

Sanitary wastewater from MFFF construction and operations activities will be disposed of through a tie-in with the CSWTF. Influent quality requirements have to be met by each CSWTF contributor. The amount of sanitary waste generated during MFFF operations will result in a trivial increase to the CSWTF. Prior to MFFF construction, an Engineering Report that identifies all liquid waste streams, influent quality parameters (i.e., pre-treatment requirements), facilities, and lift stations will be developed, and a SCDHEC Sanitary Wastewater Construction Permit will be obtained prior to the tie-in. Prior to operations, a SCDHEC Sanitary Wastewater Operating Permit will be obtained following the same protocol.

Contaminated wastewater will be collected in a series of wastewater tanks to ensure zero liquid radioactive liquid discharges from MFFF operation. The wastewater will be transported periodically to a disposal facility in F Area for disposition.

[Text Deleted] R1

7.2.1.4 Pollution Prevention, Waste Minimization and Waste Management

The MFFF project is committed to pollution prevention and waste minimization practices and will incorporate RCRA pollution prevention goals, as identified in 40 CFR Part 261. A Pollution Prevention Waste Minimization Plan will be developed to meet the waste minimization criteria R1 of both NRC and EPA regulations. The Pollution Prevention Waste Minimization Plan will describe how the MFFF design procedures for operation will minimize (to the extent practicable) contamination of the facility and the environment and minimize (to the extent practicable) the generation of radioactive, mixed, hazardous, and nonhazardous solid waste.

Nonhazardous RCRA wastes from construction activities will be appropriately disposed at an offsite permitted landfill.

Throughout operations, the small quantities of waste generated will be appropriately handled and disposed. The small quantities of hazardous wastes that would be generated are expected to be much less than 100 kg/month. Thus, the MFFF should qualify as a Small Quantity Hazardous R1 Waste Generator. The MFFF-generated wastes will be transported to a satellite accumulation area and later relocated to a staging area or existing SRS-permitted RCRA storage area. Since there will be no treatment or long-term storage of MFFF RCRA wastes in MFFF facilities, there will be no need for an MFFF RCRA Part B Permit.

The MFFF design includes the storage of diesel fuel for the standby diesel generators in a double-walled tank and the storage of diesel fuel for emergency diesel generators in a tank within a vault. Only the double-walled tanks have to meet the design requirements of 40 CFR Part 280 and SCDHEC Regulation 61-92 Part 280 for underground storage tanks (USTs). The tank within a vault is exempted from UST regulations. Therefore, prior to construction, a UST Construction Permit will be obtained, and prior to operations, a UST Operating Permit will be obtained for the double-walled tanks. R1

MFFF-generated wastes will be treated, stored, and disposed through the existing SRS waste management infrastructure.

7.2.2 South Carolina Department of History and Archives

Construction activities that take place at SRS require compliance with applicable federal historic preservation requirements administered through the state of South Carolina.

The SPD EIS (DOE 1999c) documented that there are no cultural resources located on the MFFF site. However, there is an archaeological resource area on the MFFF. Discussions have been initiated with the state historic preservation officer and mitigation measures have been identified. These mitigation measures will precede any construction activities and are part of the SRS Infrastructure Project.

7.2.3 South Carolina Department of Natural Resources (SCDNR)

SCDNR is responsible for the protection of threatened and endangered species listed by the State of South Carolina. Since there are no threatened or endangered species on the MFFF site, a negative declaration on endangered species has been requested of the SCDNR.

7.3 AIKEN COUNTY

Aiken County does not have any applicable environmental permitting requirements.

As part of the notification requirements associated with 40 CFR Part 355 (implementing regulation for the Emergency Planning and Community Right-to-Know Act), any necessary notifications will be established with the Local Emergency Planning Committee, at the appropriate time, to identify hazardous materials that will be used once the MFFF is operational.

7.4 PERMIT AND APPROVAL STATUS AND CONSULTATIONS

7.4.1 Permit and Approval Status

Several permits and plans associated with construction activities have been prepared and will be formally filed with the appropriate agency prior to the commencement of construction. Construction and operational permit applications will be prepared and filed, and regulator approval and/or permits will be received prior to applicable construction or facility operation. EPA Region IV and SCDHEC have granted approval of an Alternate Calculation Technique for MFFF NESHAPS determinations pursuant to 40 CFR Part 61. R1 R1

Table 7-1 provides the status of compliance with federal and state environmental laws.

7.4.2 Agency Consultations

Initial consultations have been made with the cognizant agencies. The MFFF Environmental Permitting Plan was presented to SCDHEC on June 28, 2001. More specific discussions will be held, as appropriate, as the project progresses. R1

Tables

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Table 7-1. Status of Compliance with Federal and State Environmental Laws

Requirement	Status	Comments
Federal Laws and Enabling Regulations		
Negative declaration on cultural resources from the State Historic Preservation Officer (SHPO) 43 CFR Part 7; 36 CFR Parts 60, 61, 63, 65, 67, 68	Completed	SHPO approved mitigation plan on 11 April 2001. See Appendix A. Mitigation complete August 2002.
Negative declaration on endangered species from the U.S. Fish and Wildlife Services (USFWS) 50 CFR Parts 13, 17, 222, 226, 227, 402, 424, 450-453	Completed	USFWS issued negative declaration on 20 June 2001. See Appendix A.
Negative declaration on prime or unique farmlands from U.S. Natural Resources Conservation Service (USNRCS) 7 CFR Part 658	Not required	USNRCS does not identify SRS as prime farmlands because the land is not available for agricultural production (DOE 1996b: 3-230).
Negative declaration on 404 Permit from U.S. Army Corps of Engineers (COE)	Not required	No jurisdictional wetlands exist on MFFF site.
Floodplain Assessment	Completed	Floodplain Assessment incorporated into the design basis.

R1

Table 7-1. Status of Compliance with Federal and State Environmental Laws (continued)

Requirement	Status	Comments
State of South Carolina Laws and Enabling Regulations		
Negative declaration on endangered species from South Carolina Department of Natural Resources (SCDNR) 50 CFR Parts 13, 17, 222, 226, 227, 402, 424, 450-453	Pending	Discussions with SCDNR have been initiated. See Appendix A.

Construction Environmental Plans and Permits		
Construction Emission Control Plan 40 CFR 60 South Carolina Regulation 61.62-6	Included in MFFF Environmental Permit Plan Completed	Consultation with SCDHEC initiated Tree Removal, Move Transmission Line, Remove Spoils Pile, Clearing and Grubbing, Rough Grading, Move Outfall, Detention Basin.
Bureau of Air Quality Construction Permit 40 CFR 60 South Carolina Regulation 61.62-5	Included in MFFF Environmental Permit Plan Initiated	Consultation with SCDHEC initiated. Individual permits for MFFF Stack Construction; Installation of Diesel Generators; Installation of Diesel Fuel Tanks; Operation of Concrete Batch Plant. R1
NESHAPS Construction Permit 40 CFR 61 Subpart H 10 CFR 20 South Carolina Regulation 61.62-5	Included in MFFF Environmental Permit Plan Completed	Alternative Calculation methodology accepted by EPA Region IV and SCDHEC (April 2002). Exemption from NESHAPS Construction Permit achieved. Long-Lead Time Procurement of Construction Materials and Equipment.
Construction NPDES General Permit 40 CFR 122 South Carolina Regulation 61-9 South Carolina Regulation 61-68 South Carolina Regulation 72-300 through 72-316 (GR)	Included in MFFF Environmental Permit Plan Initiated	Consultation with SCDHEC initiated. Tree Removal, Move Transmission Line, Remove Spoils Pile, Clearing And Grubbing, Rough Grading, Move Outfall, Detention Basin.
Sanitary Wastewater Construction Permit 40 CFR 122 South Carolina Regulation 61-9 South Carolina Regulation 61-67	Included in MFFF Environmental Permit Plan Initiated	Consultation with SCDHEC initiated. Connect to SRS F-Area Lift Station.

Table 7-1. Status of Compliance with Federal and State Environmental Laws (continued)

Requirement	Status	Comments
Construction Environmental Plans and Permits (continued)		
No Discharge NPDES Permit 40 CFR 122 South Carolina Regulation 61-9 South Carolina Regulation 61-68	Included in MFFF Environmental Permit Plan	Consultation with SCDHEC initiated. Operation of Concrete Batch Plant.
Construction Stormwater Pollution Prevention Plan (SWPPP) 40 CFR 122 South Carolina Regulation 61-9 South Carolina Regulation 61-68 South Carolina Regulation 72-300 through 72-316 (GR)	Included in MFFF Environmental Permit Plan Initiated	Consultation with SCDHEC initiated. Tree Removal, Move Transmission Line, Remove Spoils Pile, Clearing And Grubbing, Rough Grading, Move Outfall, Detention Basin.
Notice of Intent (supports SWPPP) 40 CFR 122 South Carolina Regulation 61-9 South Carolina Regulation 61-68 South Carolina Regulation 72-300 through 72-316 (GR)	Included in MFFF Environmental Permit Plan	Consultation with SCDHEC initiated. Tree Removal, Move Transmission Line, Remove Spoils Pile, Clearing And Grubbing, Rough Grading, Move Outfall, Detention Basin.
Domestic Water Distribution Construction Permit 40 CFR 141 South Carolina Regulation 61-58 South Carolina Regulation 61-71 South Carolina Regulation 61-101	Included in MFFF Environmental Permit Plan Initiated	Consultation with SCDHEC initiated. Tie-in to SRS domestic water distribution system for delivery of potable water.
Backflow Preventer Test Form (accompanies Domestic Water Distribution Construction Permit) 40 CFR 141 South Carolina Regulation 61-58 South Carolina Regulation 61-71 South Carolina Regulation 61-101	Included in MFFF Environmental Permit Plan Initiated	Consultation with SCDHEC initiated. Tie-in to SRS domestic water distribution system for delivery of potable water.
Spill Prevention Control and Countermeasures (SPCC) Plan 40 CFR 112 Section 110 South Carolina Regulation 61-9	Not required. Included in MFFF Environmental Permit Plan Not required.	Consultation with SCDHEC initiated. Although not required, MFFF will have an equivalent of a SPCC Plan as a Best Management Practice during construction.

R1

Table 7-1. Status of Compliance with Federal and State Environmental Laws (continued)

Requirement	Status	Comments
Construction Environmental Plans and Permits (continued)		
Underground Storage Tank (UST) Installation Permit 40 CFR 112 40 CFR 280 South Carolina Regulation 61-92	Included in MFFF Environmental Permit Plan Initiated	Consultation with SCDHEC initiated. Installation of Fuel Tanks, Fuel Oil Lines, and Fuel Unloading Station. Standby diesel tank is classified as a UST since it is not in a vault.
Pollution Prevention and Waste Minimization Plan 40 CFR 261 40 CFR 262 40 CFR 264 40 CFR 268 South Carolina Regulation 61-66 South Carolina Regulation 61-79 South Carolina Regulation 61-99 South Carolina Regulation 61-104	Included in MFFF Environmental Permit Plan Initiated	Consultation with SCDHEC initiated. Best Management Practices for Construction Waste Management.
Operational Environmental Plans and Permits		
Title V Operating Permit 40 CFR 71 South Carolina Regulation 61.62-70	Included in MFFF Environmental Permit Plan	Consultation with SCDHEC initiated. All MFFF Air emissions will be contained in permit.
Risk Management Plan 40 CFR 68.130 Tables 1 & 3 South Carolina Regulation 61.62-68	Included in MFFF Environmental Permit Plan Not required	Consultation with SCDHEC initiated. MFFF will impose administrative limits on 40 CFR 68.130 and South Carolina Regulation 61.62-68 extremely hazardous chemicals, which will preclude the need for a Risk Management Plan. R1
Industrial NPDES General Permit 40 CFR 122 South Carolina Regulation 61-9 South Carolina Regulation 61-67	Included in MFFF Environmental Permit Plan	Consultation with SCDHEC initiated. Condensate and stormwater discharges will become part of SRS General Permits for Stormwater and Industrial Water.
Sanitary Wastewater Operating Permit 40 CFR 122 South Carolina Regulation 61-9 South Carolina Regulation 61-67	Included in MFFF Environmental Permit Plan	Consultation with SCDHEC initiated. Tie-in to SRS Central Sanitary Wastewater Treatment Facility (CSWTF) for ultimate treatment and disposal of sanitary waste.

Table 7-1. Status of Compliance with Federal and State Environmental Laws (continued)

Requirement	Status	Comments
Operational Environmental Plans and Permits (continued)		
Underground Storage Tank (UST) Operating Permit 40 CFR 112 40 CFR 280 South Carolina Regulation 61-92	Included in MFFF Environmental Permit Plan	Consultation with SCDHEC initiated. Operation of Fuel Tanks, Fuel Oil Lines, and Fuel Unloading Station Standby diesel tank is classified as a UST since it is not in a vault..
Spill Prevention Control and Countermeasures (SPCC) Plan 40 CFR 112 Section 110 South Carolina Regulation 61-9	Included in MFFF Environmental Permit Plan	Consultation with SCDHEC initiated. SPCC Plan prior to MFFF Operations is required since underground diesel fuel quantities exceed 42,000 gallons.
Domestic Water Distribution Operating Permit 40 CFR 141 South Carolina Regulation 61-58 South Carolina Regulation 61-71 South Carolina Regulation 61-101	Included in MFFF Environmental Permit Plan	Consultation with SCDHEC initiated. Tie-in to SRS domestic water distribution system for delivery of potable water.
RCRA Generator Identification Number South Carolina Regulation 61-79	Included in MFFF Environmental Permit Plan	Consultation with SCDHEC initiated. Identification numbers to be filed with SCDHEC for any materials that are classified as RCRA wastes.
RCRA Part B Permit South Carolina Regulation 61-66 South Carolina Regulation 61-79 South Carolina Regulation 61-99 South Carolina Regulation 61-104	Included in MFFF Environmental Permit Plan Not required	Consultation with SCDHEC initiated. Generated hazardous waste will be stored and accumulated for less than 90 days prior to being sent to SRS, which will preclude the need to obtain a RCRA Part B Permit. R1
Pollution Prevention and Waste Minimization Plan 40 CFR 261 40 CFR 262 40 CFR 264 40 CFR 268 South Carolina Regulation 61-66, South Carolina Regulation 61-79, South Carolina Regulation 61-99, South Carolina Regulation 61-104	Included in MFFF Environmental Permit Plan	Consultation with SCDHEC initiated. Recycling and waste minimization practices throughout operations.
Emergency Planning and Community Right-to-Know notifications 40 CFR 355 40 CFR 372	Included in MFFF Environmental Permit Plan	Consultation with SCDHEC initiated. MFFF is expected to report as part of the SRS Site Item Reportability and Issue Management (SIRIM) program.

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APPENDIX A. AGENCY CONSULTATIONS AND CORRESPONDENCE

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Department of Energy
Washington, DC 20585

October 30, 1998

Dr. Rodger Stroup
State Historic Preservation Office
8301 Parklane Road
Columbia, South Carolina 29223

Subject: *Consultation for Surplus Plutonium Disposition Environmental Impact Analysis Process*

Dear Dr. Stroup:

The purpose of this letter is to notify you that the United States Department of Energy (DOE) is in the process of conducting an Environmental Impact Analysis concerning the disposition of surplus plutonium.

With this letter we are soliciting specific concerns the South Carolina State Historic Preservation Office may have about the proposal. This consultation is in accordance with National Environmental Policy Act and Section 106 of the National Historic Preservation Act.

The *Surplus Plutonium Disposition Environmental Impact Statement* (SPD EIS) is tiered from the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic EIS* (DOE/EIS-0229), issued in December 1996, and the associated Record of Decision (62 FR 3014), issued on January 14, 1997. DOE is producing the SPD EIS in compliance with the National Environmental Policy Act (NEPA) and Council on Environmental Quality regulations implementing NEPA, DOE's NEPA Implementing Regulations (10 CFR 1021), and other applicable federal and state environmental legislation.

The purpose and need for the proposed action is to reduce the threat of nuclear weapons proliferation worldwide by disposing of surplus plutonium in the United States in an environmentally safe and timely manner. The SPD Draft EIS, a copy of which is attached for your review, examines the potential environmental impacts for 24 alternatives for the proposed siting, construction, and operation of three types of facilities: pit disassembly and conversion; mixed oxide (MOX) fuel fabrication; and plutonium conversion and immobilization.

If an alternative is selected that includes siting of surplus plutonium disposition facilities at the Savannah River site (e.g., Alternatives 3A or 3B), a maximum of about 31 hectares (77 acres) of land adjacent to the Actinide Packaging and Storage Facility (APSF) in F-Area, would be impacted. Not all areas within the proposed construction

Mr. Rodger Stroup
State Historic Preservation Officer
10/30/98
Page 2

area have been completely surveyed for cultural resources, and this area has a high potential to yield subsurface deposits with cultural material. Based on previous archaeological investigations, four archaeological sites have been recorded in or near the proposed construction areas. One of these sites (38AK546) has been recommended as eligible for nomination to the National Register. All compliance activities, including survey, testing, and impact mitigation would be conducted in accordance with *Programmatic Memorandum of Agreement for the Savannah River Site* (1989).

If you have any specific concerns about the SPD EIS proposal, we would like to hear from you. Please contact me with your concerns or questions at:

Marcus Jones
SPD EIS Document Manager
U.S. Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, DC 20026-3786
(202) 586-0149.

You may also contact Mark Brooks, the Cultural Resources Manager at Savannah River Site, at (803) 725-3724.

Sincerely,

Marcus Jones
SPD EIS Document Manager

cc: Mark Brooks, Archaeological Program Manager, SRS
Lois Thompson, Federal Preservation Officer, DOE HQ

SPD EIS enclosure

South Carolina Archives History Center

November 12, 1998

Mr. Marcus Jones
SPD EIS Document Manager
Department of Energy
Washington, DC 20585

Re: Consultation for Surplus Plutonium Disposition Environmental Impact
Analysis Process
Savannah River Site, Aiken County

Dear Mr. Jones:

Thank you for providing the draft Environmental Impact Statement for the disposition of surplus plutonium.

We note that Alternatives 3A and 3B, if selected, will affect the Savannah River Site. If these alternatives are selected, we further note that cultural resources survey, testing, and impact mitigation will be conducted. These measures will be conducted in accordance with the stipulations of the existing Programmatic Memorandum of Agreement for the Savannah River Site.

We look forward to further consultation if Alternatives 3A and 3B are selected. If you have questions, please don't hesitate to call me (803-896-6169) or Staff Archaeologist Bill Green (803/896-6181).

Sincerely,

Nancy Brock

Nancy Brock, Coordinator
Review and Compliance Programs
State Historic Preservation Office

Cc: Mr. Mark Brooks, Archaeological Program Manager, SRS

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ERIC-1 EGMD

Mr. A. B. Gould, Director
Environmental Quality Management Division
Department of Energy, Savannah River Operations Office
P.O. Box A
Aiken, South Carolina 29802

RE: Draft report: *Archaeological Survey and Testing of the Surplus Plutonium Disposition Facilities* (Technical Report Series Number 24) prepared by Adam King and Keith Stephenson of the Savannah River Archaeological Research Program.

Dear Mr. Gould:

Thank you for providing us with one copy of the above-referenced draft report. We have reviewed the report and found that it is well written and informative and meets the standards and guidelines established by the Secretary of the Interior and this office.

We concur with the authors' recommendation that archaeological sites 38AK155, 38AK546/547, and 38AK757 are **eligible** for inclusion in the National Register of Historic Places (NRHP) and that these sites should be avoided by the SPDF. If these sites cannot be avoided, we should begin consultation on ways to mitigate the adverse effects to these important sites.

In regard to sites 38AK154, 38AK330, and 38AK548, we also concur with the authors' recommendation that these sites are **not eligible** for inclusion in the NRHP and that no additional work is required. I have attached some additional technical comments that should be addressed prior to submitting three copies of the final report to this office. These comments are provided to assist you with your responsibilities under Sections 106 and 110 of the National Historic Preservation Act, as amended, and the regulations codified at 36 CFR Part 800. I can be contacted at 803-216-9330 if you have any questions or comments about this matter.

Sincerely,

William Green
Staff Archaeologist
State Historic Preservation Office

Attachment

cc: Mark Brooks, Savannah River Archaeological Research Program
Don Klima, Advisory Council on Historic Preservation (w/o attachment)
Keith Derting, South Carolina Institute of Archaeology and Anthropology (w/o attachment)

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Department of Energy
Savannah River Operations Office
P.O. Box A
Aiken, South Carolina 29802

DEC 0 8 2000

Ms. Nancy Brock, Coordinator
Review and Compliance Program
South Carolina Department of Archives and History
8301 Parklane Road
Columbia, SC 29223-4905

Dear Ms. Brock:

Re: Department of Energy, Surplus Plutonium Disposition Facilities
Mixed Oxide Fuel Fabrication Facility

Report: *Archaeological Survey and testing of the Surplus Plutonium Disposition Facilities* (Technical Report Series Number 24)

In October, 1998 the Department of Energy notified the South Carolina State Historic Preservation Office concerning plans to locate the Surplus Plutonium Disposition Facilities at the Savannah River Site and solicited comments on the Surplus Plutonium Disposition Environmental Impact Statement (letter from Mr. Marcus Jones to Dr. Rodger Stroup, October 30, 1998). Subsequently, the Savannah River Archaeological Research Program provided the South Carolina State Historic Preservation Office with a copy of *Archaeological Survey and testing of the Surplus Plutonium Disposition Facilities* (Technical Report Series Number 24) for your review. In response, the South Carolina State Historic Preservation Office concurred that sites 38AK155, 38AK546/547, and 38AK757 were eligible for inclusion in the National Register of Historic Places. Your office also requested that if the sites could not be avoided, the Department of Energy should begin consultations with your office on ways to mitigate any adverse impacts.

The Department of Energy pursued site investigations including soil testing for the site of the Mixed Oxide Fuel Fabrication Facility (one of the three surplus plutonium disposition facilities). This testing included core borings west of 38AK546/547.

The Department of Energy has prepared a preliminary site layout for the Mixed Oxide Fuel Fabrication Facility (one of the three surplus plutonium disposition facilities) which is illustrated on the enclosed map as site "2M". We have located the facility as far to the west as possible without infringing on other surplus plutonium facilities. However we anticipate that construction activities will impact 38AK546/547. The Department of Energy is committed to mitigate any impact to 38AK546/547 by recovering artifacts in the affected area before any site preparation. A proposed mitigation plan for this area is currently being prepared and will be transmitted to you in January 2001 for your review and concurrence.

Sincerely,

A. B. Gould, Director
Environmental Quality and Management Division

kwd/aeo
Att.

The South Carolina Archives & History Center
Honor & Heritage For All Generations

April 11, 2001

Mr. A. B. Gould, Director
Environmental Quality Management Division
Department of Energy, Savannah River Operations Office
P.O. Box A
Aiken, South Carolina 29802 R2

RE: Mitigation Plans for Sites 38AK757 and 38AK546 at the proposed Surplus Plutonium Disposition Facility, Savannah River Site, Aiken County, SC

Dear Mr. Gould:

I have reviewed the above referenced proposals for archaeological site mitigation and find them to be acceptable plans that address important questions and comply with state and federal standards and guidelines. The information resulting from this work should add significantly to our understanding of prehistory in the state of South Carolina.

These comments are being provided to you to assist you with your responsibilities Section 106 of the National Historic Preservation Act, as amended, and the regulations codified at 36 CFR Part 800. I can be contacted at (803) 896-6173 if you have any questions.

Sincerely,

Valerie Marcil
Staff Archaeologist
State Historic Preservation Office

cc: Mark Brooks, Savannah River Archaeological Research Program
Keith Derting, South Carolina Institute of Archaeology and Anthropology

S. C. Department of Archives & History • 8301 Parklane Road • Columbia • South Carolina • 29223-4905 • (803) 896-6100 • www.state.sc.us/scdah

Department of Energy
Washington, DC 20585

October 30, 1998

Mr. Tom Berryhill, Council Member
National Council of the Muskogee Creek
P.O. Box 158
Okmulgee, OK 74447

Subject: *Consultation for Surplus Plutonium Disposition Environmental Impact Analysis Process, Under Executive Memorandum Concerning Government-to-Government Relations with Native American Tribal Governments*

Dear Mr. Berryhill:

The purpose of this letter is to notify you that the United States Department of Energy (DOE) is in the process of conducting an Environmental Impact Analysis concerning the disposition of surplus plutonium.

With this letter we are soliciting specific concerns the National Council of the Muskogee Creek may have about the proposal. This consultation is in accordance with the Executive Memorandum (29 April 1994) entitled, "Government-to-Government Relations with Native American Tribal Governments", and DOE Order 1230.2. It also follows prior consultation initiated for compliance with the American Indian Religious Freedom Act (AIRFA) (PL 95-341) and the Native American Graves Protection and Repatriation Act (NAGPRA) (PL 101-601).

The *Surplus Plutonium Disposition Environmental Impact Statement* (SPD EIS) is tiered from the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic EIS* (DOE/EIS-0229), issued in December 1996, and the associated Record of Decision (62 FR 3014), issued on January 14, 1997. DOE is producing the SPD EIS in compliance with the National Environmental Policy Act (NEPA) and Council on Environmental Quality regulations implementing NEPA, DOE's NEPA Implementing Regulations (10 CFR 1021), and other applicable federal and state environmental legislation.

The purpose and need for the proposed action is to reduce the threat of nuclear weapons proliferation worldwide by disposing of surplus plutonium in the United States in an environmentally safe and timely manner. The SPD Draft EIS, a copy of which is attached for your review, examines the potential environmental impacts for 24 alternatives for the proposed siting, construction, and operation of three types of facilities: pit disassembly and conversion; mixed oxide (MOX) fuel fabrication; and plutonium conversion and immobilization.

Mr. Tom Berryhill, Council Member
National Council of the Muskogee Creek
10/30/98
Page 2

If an alternative is selected that includes siting of surplus plutonium disposition facilities at the Savannah River Site (e.g., Alternatives 3A or 3B), a maximum of about 31 hectares (77 acres) of land adjacent to the Actinide Packaging and Storage Facility (APSF) in F-Area, would be impacted. No Native American cultural sites are known to exist within the proposed construction area.

If you have any specific concerns about the SPD EIS proposal, we would like to hear from you. Please contact me with your concerns or questions at:

Marcus Jones
SPD EIS Document Manager
U.S. Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, DC 20026-3786
(202) 586-0149

You may also contact A. Ben Gould, Savannah River Site Indian Liaison Officer, at: (803) 725-3969.

Sincerely,

Marcus Jones
SPD EIS Document Manager

cc: A. Ben Gould, SRS
Brandt Petrasek, EM-20, DOE HQ

SPD EIS enclosure

Department of Energy
Washington, DC 20585

October 30, 1998

Ms. Nancy Carnley, Secretary
Ma Chis Lower Alabama Creek Indian Tribe
Route 1
708 S. John Street
New Brockton, Alabama 36351

Subject: *Consultation for Surplus Plutonium Disposition Environmental Impact Analysis Process, Under Executive Memorandum Concerning Government-to-Government Relations with Native American Tribal Governments*

Dear Ms. Carnley:

The purpose of this letter is to notify you that the United States Department of Energy (DOE) is in the process of conducting an Environmental Impact Analysis concerning the disposition of surplus plutonium.

With this letter we are soliciting specific concerns the Ma Chis Lower Alabama Creek Indian Tribe may have about the proposal. This consultation is in accordance with the Executive Memorandum (29 April 1994) entitled, "Government-to-Government Relations with Native American Tribal Governments", and DOE Order 1230.2. It also follows prior consultation initiated for compliance with the American Indian Religious Freedom Act (AIRFA) (PL 95-341) and the Native American Graves Protection and Repatriation Act (NAGPRA) (PL 101-601).

The *Surplus Plutonium Disposition Environmental Impact Statement* (SPD EIS) is tiered from the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic EIS* (DOE/EIS-0229), issued in December 1996, and the associated Record of Decision (62 FR 3014), issued on January 14, 1997. DOE is producing the SPD EIS in compliance with the National Environmental Policy Act (NEPA) and Council on Environmental Quality regulations implementing NEPA, DOE's NEPA Implementing Regulations (10 CFR 1021), and other applicable federal and state environmental legislation.

The purpose and need for the proposed action is to reduce the threat of nuclear weapons proliferation worldwide by disposing of surplus plutonium in the United States in an environmentally safe and timely manner. The SPD Draft EIS, a copy of which is attached for your review, examines the potential environmental impacts for 24 alternatives for the proposed siting, construction, and operation of three types of facilities: pit disassembly and conversion; mixed oxide (MOX) fuel fabrication; and plutonium conversion and immobilization.

Ms. Nancy Carnley, Secretary
Ma Chis Lower Alabama Creek Indian Tribe
10/30/98
Page 2

If an alternative is selected that includes siting of surplus plutonium disposition facilities at the Savannah River Site (e.g., Alternatives 3A or 3B), a maximum of about 31 hectares (77 acres) of land adjacent to the Actinide Packaging and Storage Facility (APSF) in F-Area, would be impacted. No Native American cultural sites are known to exist within the proposed construction area.

If you have any specific concerns about the SPD EIS proposal, we would like to hear from you. Please contact me with your concerns or questions at:

Marcus Jones
SPD EIS Document Manager
U.S. Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, DC 20026-3786
(202) 586-0149

You may also contact A. Ben Gould, Savannah River Site Indian Liaison Officer, at: (803) 725-3969.

Sincerely,

Marcus Jones
SPD EIS Document Manager

cc: A. Ben Gould, SRS
Brandt Petrasek, EM-20, DOE HQ

SPD EIS enclosure

Department of Energy
Washington, DC 20585

October 30, 1998

Miko Tony Hill
Indian People's Muskogee Tribal Town Confederacy
P.O. Box 14
Okemah, OK 74859

Subject: *Consultation for Surplus Plutonium Disposition Environmental Impact Analysis Process, Under Executive Memorandum Concerning Government-to-Government Relations with Native American Tribal Governments*

Dear Miko Hill:

The purpose of this letter is to notify you that the United States Department of Energy (DOE) is in the process of conducting an Environmental Impact Analysis concerning the disposition of surplus plutonium.

With this letter we are soliciting specific concerns the Indian People's Muskogee Tribal Town Confederacy may have about the proposal. This consultation is in accordance with the Executive Memorandum (29 April 1994) entitled, "Government-to-Government Relations with Native American Tribal Governments", and DOE Order 1230.2. It also follows prior consultation initiated for compliance with the American Indian Religious Freedom Act (AIRFA) (PL 95-341) and the Native American Graves Protection and Repatriation Act (NAGPRA) (PL 101-601).

The *Surplus Plutonium Disposition Environmental Impact Statement* (SPD EIS) is tiered from the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic EIS* (DOE/EIS-0229), issued in December 1996, and the associated Record of Decision (62 FR 3014), issued on January 14, 1997. DOE is producing the SPD EIS in compliance with the National Environmental Policy Act (NEPA) and Council on Environmental Quality regulations implementing NEPA, DOE's NEPA Implementing Regulations (10 CFR 1021), and other applicable federal and state environmental legislation.

The purpose and need for the proposed action is to reduce the threat of nuclear weapons proliferation worldwide by disposing of surplus plutonium in the United States in an environmentally safe and timely manner. The SPD Draft EIS, a copy of which is attached for your review, examines the potential environmental impacts for 24 alternatives for the proposed siting, construction, and operation of three types of facilities: pit disassembly and conversion; mixed oxide (MOX) fuel fabrication; and plutonium conversion and immobilization.

Miko Tony Hill
Indian People's Muskogee Tribal Town Confederacy
10/30/98
Page 2

If an alternative is selected that includes siting of surplus plutonium disposition facilities at the Savannah River Site (e.g., Alternatives 3A or 3B), a maximum of about 31 hectares (77 acres) of land adjacent to the Actinide Packaging and Storage Facility (APSF) in F-Area, would be impacted. No Native American cultural sites are known to exist within the proposed construction area.

If you have any specific concerns about the SPD EIS proposal, we would like to hear from you. Please contact me with your concerns or questions at:

Marcus Jones
SPD EIS Document Manager
U.S. Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, DC 20026-3786
(202) 586-0149

You may also contact A. Ben Gould, Savannah River Site Indian Liaison Officer, at: (803) 725-3969.

Sincerely,

Marcus Jones
SPD EIS Document Manager

cc: A. Ben Gould, SRS
Brandt Petrasek, EM-20, DOE HQ

SPD EIS enclosure

Department of Energy
Washington, DC 20585

October 30, 1998

Ms. Virginia Montoya
Pee Dee Indian Association
101 E. Tatum Avenue
McColl, South Carolina 29570

Subject: *Consultation for Surplus Plutonium Disposition Environmental Impact Analysis Process, Under Executive Memorandum Concerning Government-to-Government Relations with Native American Tribal Governments*

Dear Ms. Montoya:

The purpose of this letter is to notify you that the United States Department of Energy (DOE) is in the process of conducting an Environmental Impact Analysis concerning the disposition of surplus plutonium.

With this letter we are soliciting specific concerns the Pee Dee Indian Association may have about the proposal. This consultation is in accordance with the Executive Memorandum (29 April 1994) entitled, "Government-to-Government Relations with Native American Tribal Governments", and DOE Order 1230.2. It also follows prior consultation initiated for compliance with the American Indian Religious Freedom Act (AIRFA) (PL 95-341) and the Native American Graves Protection and Repatriation Act (NAGPRA) (PL 101-601).

The *Surplus Plutonium Disposition Environmental Impact Statement* (SPD EIS) is tiered from the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic EIS* (DOE/EIS-0229), issued in December 1996, and the associated Record of Decision (62 FR 3014), issued on January 14, 1997. DOE is producing the SPD EIS in compliance with the National Environmental Policy Act (NEPA) and Council on Environmental Quality regulations implementing NEPA, DOE's NEPA Implementing Regulations (10 CFR 1021), and other applicable federal and state environmental legislation.

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Printed with soy ink on recycled paper

Ms. Virginia Montoya
Pee Dee Indian Association
10/30/98
Page 2

If an alternative is selected that includes siting of surplus plutonium disposition facilities at the Savannah River Site (e.g., Alternatives 3A or 3B), a maximum of about 31 hectares (77 acres) of land adjacent to the Actinide Packaging and Storage Facility (APSF) in F-Area, would be impacted. No Native American cultural sites are known to exist within the proposed construction area.

If you have any specific concerns about the SPD EIS proposal, we would like to hear from you. Please contact me with your concerns or questions at:

Marcus Jones
SPD EIS Document Manager
U.S. Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, DC 20026-3786
(202) 586-0149

You may also contact A. Ben Gould, Savannah River Site Indian Liaison Officer, at: (803) 725-3969.

Sincerely,

Marcus Jones
SPD EIS Document Manager

cc: A. Ben Gould, SRS
Brandt Petrasek, EM-20, DOE HQ

SPD EIS enclosure

Department of Energy
Washington, DC 20585

October 30, 1998

Mr. Al Rolland, Project Director
Yuchi Tribal Organization, Inc.
P.O. Box 1990
Sapulpa, OK 74067

Subject: *Consultation for Surplus Plutonium Disposition Environmental Impact Analysis Process, Under Executive Memorandum Concerning Government-to-Government Relations with Native American Tribal Governments*

Dear Mr. Rolland:

The purpose of this letter is to notify you that the United States Department of Energy (DOE) is in the process of conducting an Environmental Impact Analysis concerning the disposition of surplus plutonium.

With this letter we are soliciting specific concerns the Yuchi Tribal Organization may have about the proposal. This consultation is in accordance with the Executive Memorandum (29 April 1994) entitled, "Government-to-Government Relations with Native American Tribal Governments", and DOE Order 1230.2. It also follows prior consultation initiated for compliance with the American Indian Religious Freedom Act (AIRFA) (PL 95-341) and the Native American Graves Protection and Repatriation Act (NAGPRA) (PL 101-601).

The *Surplus Plutonium Disposition Environmental Impact Statement* (SPD EIS) is tiered from the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic EIS* (DOE/EIS-0229), issued in December 1996, and the associated Record of Decision (62 FR 3014), issued on January 14, 1997. DOE is producing the SPD EIS in compliance with the National Environmental Policy Act (NEPA) and Council on Environmental Quality regulations implementing NEPA, DOE's NEPA Implementing Regulations (10 CFR 1021), and other applicable federal and state environmental legislation.

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Mr. Al Rolland, Project Director
Yuchi Tribal Organization, Inc.
10/30/98
Page 2

If an alternative is selected that includes siting of surplus plutonium disposition facilities at the Savannah River Site (e.g., Alternatives 3A or 3B), a maximum of about 31 hectares (77 acres) of land adjacent to the Actinide Packaging and Storage Facility (APSF) in F-Area, would be impacted. No Native American cultural sites are known to exist within the proposed construction area.

If you have any specific concerns about the SPD EIS proposal, we would like to hear from you. Please contact me with your concerns or questions at:

Marcus Jones
SPD EIS Document Manager
U.S. Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, DC 20026-3786
(202) 586-0149.

You may also contact A. Ben Gould, Savanna River Site Indian Liaison Officer, at (803) 725-3969.

Sincerely,

Marcus Jones
SPD EIS Document Manager

cc: A. Ben Gould, SRS
Brandt Petrasek, EM-20, DOE HQ

SPD EIS enclosure

Department of Energy
Washington, DC 20585

October 30, 1998

Mr. John Ross, Chief Elect
United Keetoowah Band
2450 S. Muskogee
Tahlequah, Oklahoma 74464

Subject: *Consultation for Surplus Plutonium Disposition Environmental Impact Analysis Process, Under Executive Memorandum Concerning Government-to-Government Relations with Native American Tribal Governments*

Dear Mr. Ross:

The purpose of this letter is to notify you that the United States Department of Energy (DOE) is in the process of conducting an Environmental Impact Analysis concerning the disposition of surplus plutonium.

With this letter we are soliciting specific concerns the United Keetoowah Band may have about the proposal. This consultation is in accordance with the Executive Memorandum (29 April 1994) entitled, "Government-to-Government Relations with Native American Tribal Governments", and DOE Order 1230.2. It also follows prior consultation initiated for compliance with the American Indian Religious Freedom Act (AIRFA) (PL 95-341) and the Native American Graves Protection and Repatriation Act (NAGPRA) (PL 101-601).

The *Surplus Plutonium Disposition Environmental Impact Statement* (SPD EIS) is tiered from the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic EIS* (DOE/EIS-0229), issued in December 1996, and the associated Record of Decision (62 FR 3014), issued on January 14, 1997. DOE is producing the SPD EIS in compliance with the National Environmental Policy Act (NEPA) and Council on Environmental Quality regulations implementing NEPA, DOE's NEPA Implementing Regulations (10 CFR 1021), and other applicable federal and state environmental legislation.

The purpose and need for the proposed action is to reduce the threat of nuclear weapons proliferation worldwide by disposing of surplus plutonium in the United States in an environmentally safe and timely manner. The SPD Draft EIS, a copy of which is attached for your review, examines the potential environmental impacts for 24 alternatives for the proposed siting, construction, and operation of three types of facilities: pit disassembly and conversion; mixed oxide (MOX) fuel fabrication; and plutonium conversion and immobilization.

Mr. John Ross, Chief Elect
United Keetoowah Band
10/30/98
Page 2

If an alternative is selected that includes siting of surplus plutonium disposition facilities at the Savannah River Site (e.g., Alternatives 3A or 3B), a maximum of about 31 hectares (77 acres) of land adjacent to the Actinide Packaging and Storage Facility (APSF) in F-Area, would be impacted. No Native American cultural sites are known to exist within the proposed construction area.

If you have any specific concerns about the SPD EIS proposal, we would like to hear from you. Please contact me with your concerns or questions at:

Marcus Jones
SPD EIS Document Manager
U.S. Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, DC 20026-3786
(202) 586-0149

You may also contact A. Ben Gould, Savannah River Site Indian Liaison Officer, at: (803) 725-3969.

Sincerely,

Marcus Jones
SPD EIS Document Manager

cc: A. Ben Gould, SRS
Brandt Petrasek, EM-20, DOE HQ

SPD EIS enclosure

Department of Energy
Washington, DC 20585
July 28, 1998

Mr. Roger Banks
Field Supervisor
U.S. Department of the Interior
Fish and Wildlife Service
Post Office Box 12559
217 Fort Johnson Road
Charleston, SC 29422-2559

Dear Mr. Banks:

INFORMAL CONSULTATION UNDER SECTION 7 OF THE ENDANGERED SPECIES ACT FOR SURPLUS PLUTONIUM DISPOSITION

The Department of Energy (DOE) published its Notice of Intent to prepare the *Surplus Plutonium Disposition Environmental Impact Statement* (SPD EIS) in the Federal Register (Vol. 92, No. 99) on May 22, 1997. This SPD EIS is tiered from the *Storage and Disposition of Weapons-Usable Fissile Materials Programmatic EIS* (DOE/EIS-0229), issued in December 1996, and the associated Record of Decision (62 FR 3014), issued on January 14, 1997. To summarize, the purpose of the proposed action is to reduce the threat of nuclear weapons proliferation worldwide in an environmentally safe and timely manner by conducting disposition of surplus plutonium in the United States, thus setting a nonproliferation example for other nations.

The SPD Draft EIS, a copy of which is attached for your review, examines twenty-four alternatives and analyzes the potential environmental impacts for the proposed siting, construction, and operation of three types of facilities: pit disassembly and conversion, mixed oxide (MOX) fuel fabrication, and plutonium conversion and immobilization. The Savannah River Site (SRS) near Aiken, South Carolina is a candidate site for all three facilities. The candidate sites and alternatives are shown in Table 2-1 of the SPD Draft EIS. Please note that where practical, the modification of existing buildings is being considered.

Alternative 3A proposes locating the three surplus plutonium disposition facilities in new construction adjacent to the Actinide Packaging and Storage Facility in F-Area at SRS. In addition, the canister receipt area at the Defense Waste Processing Facility in S-Area would be modified to accommodate the receipt and processing of the canisters from the plutonium conversion and immobilization facility. Although several alternatives include locating facilities at SRS, Alternative 3A has the greatest potential for impacts on ecological resources.

Preliminary analyses suggest that overall impacts on ecological resources from constructing and operating the proposed surplus plutonium disposition facilities would be limited because the land area required (31 hectares [77 acres]) is relatively small in comparison to regionally available habitat; habitat disturbance would be minimized because construction would take place in previously disturbed or developed areas; and operational impacts would be minimized because facility releases of airborne and aqueous effluents would be controlled and permitted. Section 4.26.4.3 of the SPD Draft EIS presents the ecological resources analysis for SRS.

Although sources indicate that no critical habitat for any threatened and endangered species exists at SRS, there may be Federal or State-classified special status species in the environs surrounding F-Area. These species include American alligator, bald eagle, Oconee azalea, red-cockaded woodpecker, smooth purple coneflower, and wood stork. Noise disturbance is probably the most important impact affecting local wildlife populations.

Consistent with the Endangered Species Act, DOE requests that the Fish and Wildlife Service provide any additional information on the presence of threatened and endangered animal and plant species, both listed and proposed, in the vicinity of F- and S-Areas at SRS. Information on the habitats of these species would also be appreciated. DOE also requests information on any other species of concern that are known to occur or potentially occur in the vicinity of F- and S-Areas.

As part of DOE's National Environmental Policy Act process, DOE encourages the Fish and Wildlife Service to identify any concerns or issues it believes should be addressed in the SPD EIS. To facilitate incorporation of your input into the SPD Final EIS, please provide a written response by September 16, 1998.

Please mail your response to:

Marcus Jones
SPD EIS Document Manager
U.S. Department of Energy
Office of Fissile Materials Disposition
1000 Independence Avenue, SW
Washington, DC 20585

If you have any questions, please contact me at (202) 586-0149.

Sincerely,

Marcus Jones
SPD EIS Document Manager

cc: John B. Gladden, WSRC
David P. Roberts, DOE

United States Department of the Interior

FISH AND WILDLIFE SERVICE
P.O. Box 12559
217 Fort Johnson Road
Charleston, South Carolina 29422-2559

September 8, 1998

Mr. Marcus Jones
SPD EIS Document Manager
U.S. Department of Energy
Office of Fissile Materials Disposition
1000 Independence Avenue, SW
Washington, DC 20585

Re: FWS Log No. 4-6-98-364, Surplus Plutonium Disposition, Savannah River Site (SRS), Aiken County, South Carolina

Dear Mr. Jones:

We have reviewed the information received August 4, 1998 concerning the above-referenced project in Aiken County, South Carolina. The following comments are provided in accordance with the Fish and Wildlife Coordination Act, as amended (16 U.S.C. 661-667e), and Section 7 of the Endangered Species Act, as amended (16 U.S.C. 1531-1543), as well as, general comments from the review of the Draft Environmental Impact Statement (DEIS).

As indicated in your August 4 letter there is potential habitat for federally protected species within the action area of your proposed project. Therefore, we are providing you with the list of the federally endangered (E) and threatened (T) species which potentially occur in Aiken South Carolina (Table 1) and the habitat information you requested (Table 2). The list also includes species of concern under review by the Service. Species of concern (SC) are not legally protected under the Endangered Species Act, and are not subject to any of its provisions, including Section 7, until they are formally proposed or listed as endangered/threatened. We are including these species in our response for the purpose of giving you advance notification. These species may be listed in the future, at which time they will be protected under the Endangered Species Act. Therefore, it would be prudent for you to consider these species early in project planning to avoid any adverse effects.

TABLE 1. SOUTH CAROLINA COUNTY DISTRIBUTION RECORDS OF ENDANGERED, THREATENED, AND CANDIDATE SPECIES FOR AIKEN COUNTY
Updated [illegible]

These lists should be used only as a guideline. The lists include known occurrences and areas where the species has a high possibility of occurring. Records are updated continually and may be different from the following.

Aiken County		
Bald eagle (Haliaeetus leucocephalus)	T	Known
Wood stork (Mycteria americana)	E	Known
Red-cockaded woodpecker (Picoides borealis)	E	Known
Shortnose sturgeon (Acipenser brevirostrum)*	O	Known
Relict trillium (Trillium reliquum)	E	Known
Piedmont bishop-weed (Ptilimnium nodosum)	E	Known
Smooth coneflower (Echinacea laevigata)	E	Known
Rafinesque's big-eared bat (Corynorhinus rafinesquii)	SC	Possible
Southeastern myotis (Myotis austroriparius)	SC	Possible
Loggerhead shrike (Lanius ludovicianus)	SC	Possible
Painted bunting (Passerina ciris)	SC	Known
Gopher tortoise (Gopherus polyphemus)	SC	Known
Gopher frog (Rana areolata capito)	SC	Known
Aphodius tortoise commensal scarab (Aphodius troglodytes)	SC	Possible
Onthophagus tortoise commensal scarab (Onthophagus polyphemi)	SC	Possible
Georgia aster (Aster georgianus)	SC	Possible
Sandhills milk-vetch (Astragalus michauxii)	SC	Possible
Chapman's sedge (Carex chapmanii)	SC	Possible
Burhead (Echinodorus tenellus var. parvulus)	SC	Known
Stream-bank spider-lily (Hymenocallis coronaria)	SC	Known
Bog spicebush (Lindera subcoriacea)	SC	Known
Boykin's lobelia (Lobelia boykinii)	SC	Possible
Carolina birds-in-a nest (Macbridea caroliniana)	SC	Known
Loose watermilfoil (Myriophyllum laxum)	SC	Known
Pickering's morning-glory (Stylisma pickeringii)	SC	Known
Meadow rue (Thalictrum subrotundum)	SC	Known
American sandfiltering mayfly (Dolania americana)		SC
Arogos Skipper (Atrytone Arogus Arogos)	SC	Known

E=Endangered; T=Threatened; SC=Service has on file limited evidence to support proposals for listing these species; O=Contact National Marine Fisheries Service.

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TABLE 2. HABITAT, FRUITING/FLOWERING PERIOD & COUNTY OCCURRENCES

Scientific Name	Common Name	Federal Status
Haliaeetus leucocephalus	Bald eagle	E
Associated with coasts, rivers, lakes, usually nesting near bodies of water where it feeds. Aiken, Barnwell, Beaufort, Berkeley, Calhoun, Charleston, Chesterfield, Clarendon, Colleton, Dorchester, Fairfield, Georgetown, Jasper, Kershaw, Lexington, Marion, McCormick, Newberry, Oconee, Orangeburg, Pickens, Richland, Sumter, Williamsburg.		
Mycteria americana	Wood stork	E
Freshwater and brackish wetlands, primarily nesting in cypress or mangrove swamps. Feeding in freshwater marshes, flooded pastures, flooded ditches. Aiken, Allendale, Barnwell, Beaufort, Berkeley, Charleston, Colleton, Dorchester, Georgetown, Hampton, Horry, Jasper, Marion, Williamsburg.		
Picoides borealis	Red-cockaded woodpecker	E
Open stands of pines 60+ years old provide roosting/nesting habitat. Foraging habitat is pine and pine/hardwood stands 30+ year old. Aiken, Allendale, Bamberg, Barnwell, Beaufort, Berkeley, Calhoun, Charleston, Chesterfield, Clarendon, Colleton, Darlington, Dillon, Dorchester, Edgefield, Florence, Georgetown, Hampton, Horry, Jasper, Kershaw, Laurens, Lee, Lexington, Marion, Marlboro, McCormick, Orangeburg, Richland, Saluda, Sumter, Williamsburg.		
Alligator mississippiensis	American alligator	T(S/A)
Rivers systems, canals, lakes, swamps.		
Echinacea laevigata	Smooth coneflower	E
Piedmont- mountains. Basic or circumneutral soils (Hayesville, Cecil, Porter, Madison) of meadows and woodlands. Successful colonies are almost always at sites featuring open, bare soil, a fairly high soil pH, and exposures allowing optimal sunshines. Late May-July. Aiken, Allendale, Anderson, Barnwell, Lancaster, Lexington, Oconee, Pickens, Richland.		

From review of the DEIS for this project, it does not appear that the proposed siting or construction of the proposed facilities represent a substantial risk to federally listed or proposed endangered or threatened plant or animal species. In view of this, we believe that the requirements of Section 7 of the Endangered Species Act have been satisfied. However, obligations under Section 7 of the Act must be reconsidered if (1) new information reveals

3

impacts of this identified action that may affect listed species or critical habitat in a manner not previously considered, (2) this action is subsequently modified in a manner which was not considered in this assessment, or (3) a new species is listed or critical habitat determined that may be affected by the identified action.

In addition, the operation of these facilities and the subsequent disposition of large quantities of immobilized plutonium in geologic repositories at the SRS, may impact the future quality of the environment at the site. The DEIS does not fully address the issues associated with geological disposition and therefore they are not a part of this consultation. Once the issue of disposition in geologic repositories is addressed we would be glad to consult with DOE and provide any information necessary for the assessment of potential impacts to the environment.

Also, the DEIS does not present an adequate analysis of potential environmental impacts to the non-human environment. While human health is considered throughout the document, ecological health is rarely discussed. This presumably occurred due to the assumption that environmental receptors are not present within the action area. This assumption does suggest that substantial environmental impacts are improbable in the action area, but does not justify the exclusion of this analysis as a part of the environmental impact assessment. We suggest that the final Environmental Impact Statement (EIS) reflect that appropriate consideration was given not only to the human environment, but the ecological environment as well.

Your interest in ensuring the protection of endangered and threatened species and our nation's valuable wetland resources is appreciated. We hope this letter and the accompanying information on endangered and threatened species will be useful in project development. If you require further assistance please contact Mr. Rusty Jeffers of my staff at (803) 727-4707 ext. 20. In future correspondence concerning the project, please reference FWS Log No. 4-6-98-364.

Sincerely yours,

Edwin M. EuDaly
Acting Field Supervisor

EME/RDJ/km

Department of Energy
Savannah River Operations Office
P.O. Box A
Aiken, South Carolina 29802

DEC 0[illegible] [illegible]

Mr. Roger Banks
U. S. Department of the Interior
Fish and Wildlife Service
P. O. Box 12559
Charleston, SC 29422-2559

Dear Mr. Banks:

Re: Informal Consultation Under Section 7 of the Endangered Species Act for the Surplus Plutonium Disposition - Mixed Oxide Fuel Fabrication Facility

In July 1998, the Department of Energy notified the U.S. Fish and Wildlife Service of plans to locate the Surplus Plutonium Disposition Facilities at the Savannah River Site and solicited comment on the Surplus Plutonium Disposition Environmental Impact Statement. In your response (letter from Mr. R. Banks to Mr. M. Jones, September 8, 1998) you provided a listing of several species that are currently listed as endangered or threatened along with several species of concern that are known to exist in the Aiken, South Carolina area.

The Department of Energy has determined a preliminary site layout for the Mixed Oxide Fuel Fabrication Facility (one of the three surplus plutonium disposition facilities) which is illustrated on the enclosed map as site "2M". The Department of Energy also performed a survey of the Mixed Oxide Fuel Fabrication Facility site for wetlands, and endangered and threatened species or critical habitat. Enclosed is the survey report. We request your review and concurrence with the results of our survey.

Sincerely,

A. B. Gould, Director
Environmental Quality and Management Division

kwd/aeo
Att.

07/26/01 THU 16:08 FAX 843 727 4218 US FISH CHAS ES 001

Department of Energy
Savannah River Operations Office
P.O. Box A
Aiken, South Carolina 29802

DEC 0 4 2000

COPY

Mr. Roger Banks
U. S. Department of the Interior
Fish and Wildlife Service
P. O. Box 12559
Charleston, SC 29422-2559

Dear Mr. Banks:

Re: Informal Consultation Under Section 7 of the Endangered Species Act for the Surplus Plutonium Disposition - Mixed Oxide Fuel Fabrication Facility R2

In July 1998, the Department of Energy notified the U.S. Fish and Wildlife Service of plans to locate the Surplus Plutonium Disposition Facilities at the Savannah River Site and solicited comment on the Surplus Plutonium Disposition Environmental Impact Statement. In your response (letter from Mr. R. Banks to Mr. M. Jones, September 8, 1998) you provided a listing of several species that are currently listed as endangered or threatened along with several species of concern that are known to exist in the Aiken, South Carolina area.

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Sincerely,

A. B. Gould, Director
Environmental Quality and Management D

kwd/aeo
Att.

FAX TRANSMITTAL
To Keith Dyer | From Lori Duncan

The U.S. Fish and Wildlife Service (USFWS) has reviewed the plans for this proposed project. Based on our review and the information received, we concur with your determination that the proposed action:

X will have no effect on resources under the jurisdiction of the USFWS that are currently protected by the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et. seq.)(Act). Therefore, no further action is required under Section 7(a)(2) of the Act.

is not likely to adversely affect resources under the jurisdiction of the USFWS that are currently protected by the Act. Therefore, no further action is required under Section 7(a)(2) of the Act.

It is our opinion that the proposed action is not likely to have significant adverse wetland impacts. Please contact the Corps of Engineers for more information.

U.S. Fish and Wildlife Service, 176 Croghan Spur Road, Suite 200, Charleston, SC 29407, (843) 727-4707

FWS Log No. 4-6-01-I-305 Date 6-20-01

Department of Energy
Washington, DC 20585
July 28, 1998

Mr. Tom Murphy
South Carolina Department of Natural Resources
Lower Coastal Wildlife Diversity
585 Donnelley Drive
Green Pond, SC 29446

Dear Mr. Murphy:

The Department of Energy (DOE) published its Notice of Intent to prepare the *Surplus Plutonium Disposition Environmental Impact Statement* (SPD EIS) in the Federal Register (Vol. 92, No. 99) on May 22, 1997. This SPD EIS is tiered from the *Storage and Disposition of Weapons-Usable Fissile Materials Programmatic EIS* (DOE/EIS-0229), issued in December 1996, and the associated Record of Decision (62 FR 3014), issued on January 14, 1997. To summarize, the purpose of the proposed action is to reduce the threat of nuclear weapons proliferation worldwide in an environmentally safe and timely manner by conducting disposition of surplus plutonium in the United States, thus setting a nonproliferation example for other nations.

The SPD Draft EIS, a copy of which is attached for your review, examines twenty-four alternatives and analyzes the potential environmental impacts for the proposed siting, construction, and operation of three types of facilities: pit disassembly and conversion, mixed oxide (MOX) fuel fabrication, and plutonium conversion and immobilization. The Savannah River Site (SRS) near Aiken, South Carolina is a candidate site for all three facilities. The candidate sites and alternatives are shown in Table 2-1 of the SPD Draft EIS. Please note that where practical, the modification of existing buildings is being considered.

Alternative 3A proposes locating the three surplus plutonium disposition facilities in new construction adjacent to the Actinide Packaging and Storage Facility in F-Area at SRS. In addition, the canister receipt area at the Defense Waste Processing Facility in S-Area would be modified to accommodate the receipt and processing of the canisters from the plutonium conversion and immobilization facility. Although several alternatives include locating facilities at SRS, Alternative 3A has the greatest potential for impacts on ecological resources.

Preliminary analyses suggest that overall impacts on ecological resources from constructing and operating the proposed surplus plutonium disposition facilities would be limited because the land area required (31 hectares [77 acres]) is relatively small in comparison to regionally available habitat; habitat disturbance would be minimized because construction would take place in previously disturbed or developed areas; and operational impacts would be minimized because facility releases of airborne and aqueous effluents would be controlled and permitted. Section 4.26.4.3 of the SPD Draft EIS presents the ecological resources analysis for SRS.

Although sources indicate that no critical habitat for any threatened and endangered species exists at SRS, there may be Federal or State-classified special status species in the environs surrounding F-Area. These species include American alligator, bald eagle, Oconee azalea, red-cockaded woodpecker, smooth purple coneflower, and wood stork. Noise disturbance is probably the most important impact affecting local wildlife populations.

As part of DOE's National Environmental Policy Act process, DOE encourages the South Carolina Department of Natural Resources to identify any concerns or issues it believes should be addressed in the SPD EIS. To facilitate incorporation of your input into the SPD Final EIS, please provide a written response by September 16, 1998.

Please mail your response to:

Marcus Jones
SPD EIS Document Manager
U.S. Department of Energy
Office of Fissile Materials Disposition
1000 Independence Avenue, SW
Washington, DC 20585

If you have any questions, please contact me at (202) 586-0149.

Sincerely,

Marcus Jones
SPD EIS Document Manager

cc: John B. Gladden, WSRC
David P. Roberts, DOE

Department of Energy
Savannah River Operations Office
P.O. Box A
Aiken, South Carolina 29802

DEC 0 8 2000

Mr. D. L. Johnson
South Carolina Department of Natural Resources
1201 Main Street
Suite 1100
Columbia, SC 29201

Dear Mr. Johnson:

Re: U.S. Department of Energy, Savannah River Site
Surplus Plutonium Disposition - Mixed Oxide Fuel Fabrication Facility

In July 1998, the Department of Energy notified the South Carolina Department of Natural Resources, Lower Coastal Wildlife Diversity, of plans to locate the Surplus Plutonium Disposition Facilities at the Savannah River Site and solicited comment on the Surplus Plutonium Disposition Environmental Impact Statement (letter from Mr. M. Jones to Mr. T. Murphy July 28,1998).

The Department of Energy has determined a preliminary site layout for the Mixed Oxide Fuel Fabrication Facility (one of the three surplus plutonium disposition facilities) which is illustrated on the enclosed map as site "2M". The Department of Energy also performed a survey of the Mixed Oxide Fuel Fabrication Facility site for wetlands, and endangered and threatened species or critical habitat. Enclosed is the survey report. We request your review and concurrence with the results of our survey.

Sincerely,

A. B. Gould, Director
Environmental Quality and Management Division

kwd/aeo
Enc.

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APPENDIX C. ANALYSIS OF ENVIRONMENTAL JUSTICE

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C.1 INTRODUCTION

Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, directs federal agencies to identify and address, as appropriate, disproportionately high and adverse health or environmental effects of their programs, policies, and activities on minority and low-income populations.

The Council on Environmental Quality (CEQ) released guidance on environmental justice in December 1997. As an independent agency, the Council's guidance is not binding on the NRC; however, the NRC considered the CEQ's guidance when establishing its policies and procedures. The analysis of environmental justice in this ER is based on the guidance document *Environmental Justice in NEPA Documents*, developed as part of the NMSS Policy and Procedures Letter 1-50 (NRC 1999a) and provided by the NRC as guidance.

C.2 APPROACH

The NMSS document provides guidelines for identifying the geographical area for assessment of environmental justice as follows:

> If the facility is located within the city limits, a 0.56 mile radius (1 square mile) from the center of the site is probably sufficient for evaluation purposes; however, if the facility itself covers this much area, use a radius that would be equivalent to 0.5 miles from the site. If the facility is located outside the city limits or in a rural area, a 4-mile radius (50 square miles) should be used.

The MFFF site is located in a rural part of South Carolina, within the SRS property. The nearest SRS property boundary is over 4 mi (6.4 km) from the site, and there is no population except for a daily transient population associated with SRS activities within the 4-mi (6.4-km) distance suggested in the NMSS guidance.

Looking further beyond the suggested 4-mi (6.4-km) radius, the nearest residential population is located over 5 mi (8 km) northwest of the MFFF site. To be conservative, the distribution of the population below the federal poverty level and the minority population was reviewed within a 10-mi (16-km) radius using maps developed from 1990 census data at the block group level (Figures 4-15 and 4-16). Detailed population characteristics of the counties and towns that comprise the 10-mi (16-km) area were also reviewed.

C.3 POPULATION PROJECTIONS

Projections of population growth for the 50-mi (80-km) area surrounding the MFFF site were compiled by SRS as part of their regular GSAR update (Tables 4-12 through 4-16). The population is not projected to grow any closer to the MFFF.

C.4 GEOGRAPHICAL DISPERSION OF MINORITY AND LOW-INCOME POPULATIONS

Figures 4-16 and 4-17 show the geographical distribution of minority and low-income populations in the vicinity (within 10 mi [16 km]) of the MFFF site. Distributions shown on these figures are based on baseline U.S. Census 1990 block group data. Figure 4-16 shows the geographical distribution of minority populations in areas within a distance of 10 mi (16 km) of the MFFF site. Block groups are shaded to indicate the percentage of minorities within the total population (calculated by subtracting the white, not of Hispanic origin, count from the total persons count). The highest concentration of minorities is located in the town of New Ellenton, over 7 mi (11.3 km) north of the MFFF site.

The incorporated boundaries of the towns of New Ellenton and Jackson are situated entirely within a 10-mi (16-km) radius of the MFFF site. The combined populations of New Ellenton and Jackson represent about 66% of the population within a 10-mi (16-km) radius of the MFFF site. Growth rates obtained by race for South Carolina were applied to the populations of the towns to determine future potential shifts in the racial balance of the area (DOC 2000b). Within the town of New Ellenton, the population is expected to shift slightly from about 34% black and 66% non-Hispanic white in 1990 to about 41% black and 58% non-Hispanic white in 2025. The town of Jackson shows even less change. In 1990, Jackson's population was about 4% black and about 94% non-Hispanic white. The population is projected to change only slightly to about 5% black and 92% non-Hispanic white by 2025. Population projections by race for places entirely or partially within a 10-mi (16-km) radius of the MFFF site are listed in Table C-1.

Figure 4-17 shows the geographical distribution of low-income populations within the local, 10-mi (16-km) radial area. According to the decennial census of 1990, about 16.8% and 16.6% of the respective populations of Georgia and South Carolina were living below the federal poverty limit. Within the three-county local area, Aiken County was below the state average with only about 14% of its population living below the poverty threshold, while Barnwell County and Burke County were above their state averages with 21.9% and 29.2% below the poverty thresholds, respectively. As shown on Figure 4-17, the population within about a 7-mi (11.3-km) radius of the MFFF site is above the state average with only 0% to 12% living on less than the poverty limit. In total, a minimal portion, less than 25%, of the 10-mi (16-km) area contains high numbers of people living below the poverty threshold.

C.5 ENVIRONMENTAL EFFECTS ON MINORITY AND LOW-INCOME POPULATIONS

The analysis of environmental effects on populations residing within 10 mi (16 km) of proposed facilities is presented in Chapter 5. This analysis shows that no radiological fatalities are likely to result from implementation of the proposed action. Radiological risks to the public are small regardless of the racial and ethnic composition or the economic status of individuals comprising the population. Nonradiological risks to the general population are also small regardless of the racial and ethnic composition or economic status of the population. Thus, disproportionately high and adverse impacts on minority and low-income populations residing near the various facilities are not likely to result from implementation of the proposed action or alternatives.

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Tables

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Table C-1. Population Projections by Race and Ethnicity

	1990	1995	2000	2005	2015	2025
New Ellenton Division*	***4,603***	***4,095***	***4,515***	***4,866***	***5,421***	***5,922***
Black	1,849	2,031	2,293	2,529	2,946	3,341
Am. Indian, Eskimo, Aleut	31	34	36	38	40	44
Asian or Pacific Islander	18	20	25	29	35	42
Hispanic	50	55	69	82	101	125
Non-Hispanic White	2,655	1,955	2,092	2,188	2,299	2,370
New Ellenton Town	***2,630***	***2,890***	***3,151***	***3,360***	***3,673***	***3,936***
Black	898	987	1,114	1,229	1,432	1,624
Am. Indian, Eskimo, Aleut	0	0	0	0	0	0
Asian or Pacific Islander	0	0	0	0	0	0
Hispanic	5	5	6	7	9	11
Non-Hispanic White	1,727	1,898	2,031	2,124	2,232	2,301
Jackson Division*	***1,126***	***1,237***	***1,345***	***1,396***	***1,512***	***1,605***
Black	295	324	366	371	432	489
Am. Indian, Eskimo, Aleut	0	0	0	0	0	0
Asian or Pacific Islander	9	10	13	15	18	22
Hispanic	0	0	0	0	0	0
Non-Hispanic White	822	903	966	1,010	1,062	1,094
Jackson Town	***1,681***	***1,847***	***1,981***	***2,078***	***2,197***	***2,281***
Black	66	73	82	90	105	119
Am. Indian, Eskimo, Aleut	25	27	29	31	33	36
Asian or Pacific Islander	2	2	2	2	2	2
Hispanic	8	9	11	13	16	20
Non-Hispanic White	1,580	1,736	1,857	1,942	2,041	2,104
Barnwell Division	***8,371***	***9,200***	***10,015***	***10,354***	***11,246***	***11,983***
Black	2,460	2,704	3,053	3,061	3,566	4,044
Am. Indian, Eskimo, Aleut	0	0	0	0	0	0
Asian or Pacific Islander	41	45	57	67	82	99
Hispanic	14	15	19	23	28	35
Non-Hispanic White	5,856	6,436	6,886	7,203	7,570	7,805
Burke County	***20,534***	***21,649***	***22,693***	***23,664***	***25,585***	***27,217***
Black	10,741	11,325	11,867	12,365	13,391	14,368
Am. Indian, Eskimo, Aleut	26	27	27	27	34	34
Asian or Pacific Islander	5	5	6	7	9	11
Hispanic	58	61	71	82	107	133
Non-Hispanic White	9,702	10,229	10,720	11,181	12,042	12,668

* The populations of New Ellenton and Jackson towns are not included in their respective division's population to give a more reliable estimate of the divisions' racial mix in areas outside the incorporated boundaries of the towns.

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APPENDIX D. RISK FROM IONIZING RADIATION

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This appendix presents the assessment of potential radiation to offsite individuals, the offsite general population, site workers, and MFFF facility workers due to normal operations of the MFFF. Site workers are defined as those who work within the SRS boundaries but are not involved with process activities at the MFFF. Facility workers are defined as those individuals who are engaged in MFFF activities within the MFFF fence. The term "dose" is used here to reflect the committed effective dose equivalent (i.e., 50-year committed dose) due to internal exposure to radionuclides and the effective dose equivalent due to external exposure to radionuclides. The dose assessment considers chronic atmospheric releases from both an elevated release point and a release point at ground level. Exposure pathways for the offsite public are inhalation uptake, external exposure to the airborne plume, ingestion of terrestrial foods and animal products, and inadvertent soil ingestion. Exposure pathways for the site workers are inhalation uptake, external exposure to the airborne plume, and inadvertent soil ingestion. The MFFF does not have a liquid release to the environment as a result of normal operations and, therefore, the liquid/aquatic pathway was not considered in the dose calculations.

Potential offsite doses to the public were determined for the MEI and the general population residing within an assessment area defined by a 50-mi (80-km) radius around the facility. The entire population within the 50-mi (80-km) assessment area was assumed to consist of adults (DOE 1988). The MEI was assumed to reside 5 mi (8 km) from the facility (i.e., at the SRS boundary) in the southwest direction.

Potential doses to site workers (SRS workers not assigned to the MFFF) were determined for the MEI and the worker population within the SRS boundary but outside the boundary of the MFFF. All workers were assumed to be adults. The MEI was assumed to be located 328 ft (100 m) from the release point, which is the standard distance used at SRS. R2

Potential doses to facility workers (MFFF workers) were determined from preliminary dose analyses for the MFFF. The historical measurements from similar facilities were adjusted to reflect the expected source term in the MFFF.

Fifty-year committed doses were calculated for both the offsite public and site workers based on one year of release and one year of intake. All dose calculations assumed no previous contamination of the ground surface, no previous irrigation with contaminated water, and a finite plume model, which assumes that the center of the plume is located at ground level.

Determination of the potential annual doses utilized the GENII system (the Hanford Environmental Radiation Dosimetry Software System) (Pacific Northwest Laboratory 1988a). GENII is a system of codes and associated data libraries designed to calculate radiation doses to populations and individuals resulting from environmental contamination. The GENII system calculates the transport of radionuclides in the environment due to contamination of air, water, and soil. Calculated radionuclide concentrations are combined with external exposure rates and intake to determine external and internal radiation doses. A complete discussion of the theory and implementation of the GENII system is provided in *GENII – The Hanford Environmental Radiation Dosimetry Software System Volume 1: Conceptual Representation* (Pacific Northwest

Laboratory 1988a). The GENII user's manual is given in *GENII – The Hanford Environmental Radiation Dosimetry Software System Volume 2: Users' Manual* (Pacific Northwest Laboratory 1988b).

D.1 GENII INPUT

The following sections summarize the GENII input parameters and values used for the assessment of potential doses to the offsite public and to site workers due to normal operations of the MFFF.

D.1.1 Meteorological Data

GENII requires meteorological data in the form of a joint frequency distribution for the calculations of dose to the offsite public and to site workers due to airborne releases. This distribution contains wind data specifying the time (in percentage) that the wind blows in each of 16 sectors for user-specified wind speeds and atmospheric stability classes. The joint frequency distribution used in the dose calculations is presented in Table D-1. This distribution was developed using meteorological data collected from the 197-ft (60-m) tower level in H Area from 1992 to 1996. Data from the H-Area meteorological tower were used because the tower is located near F Area and the geographical center of SRS.

The GENII calculations of dose also use the absolute humidity when considering airborne releases. During the period from January 1995 to December 1996, the average monthly absolute humidity ranged from 6.0 to 18.4 g/m^3 (WSRC 1999a). The overall average absolute humidity for this same time period was 11.1 g/m^3, which is the value used in the GENII analyses.

D.1.2 Population Data for the Offsite Public

The population data used in the population dose calculations were taken from the GSAR (WSRC 1999a) and are presented in Table D-2. The 1990 Census of Population and Housing Data (DOC 1992a) were used to project the population distribution within a 50-mi (80-km) radius of the SRS F Area at 10-year intervals through 2030 (WSRC 1993). Population growth was determined using growth ratios relative to the 1990 population of 1.140 for the year 2000, 1.299 for the year 2010, 1.481 for the year 2020, and 1.688 for the year 2030. These ratios were determined assuming that the growth rate for the total population in the west-northwest sector can be applied to all other sectors (Huang 1993). The population growth projected by the GSAR was compared to actual population growth as determined by the 2000 census. The GSAR predicted a 14% increase in population within 50 mi (80 km) of the MFFF for the year 2000. Checking against actual increases from the 2000 census DCS determined that the county populations within 50 mi (80 km) actually increased by 16%. Therefore the GSAR underestimated population increase by 2%. The population was distributed into 16 radial sectors and six radial distances of 0 to 5, 5 to 10, 10 to 20, 20 to 30, 30 to 40, and 40 to 50 mi (0 to 8, 8 to 16, 16 to 32, 32 to 64, and 64 to 80 km). All property within 5 mi (8 km) of F Area is owned by DOE and has zero permanent population. R1

Calculation of the population dose for the offsite public used the projected population for 2030. Operation of the MFFF is expected to end in 2027 based on a 20-year license and startup in R2
2007. Use of a population distribution projected for a time later than the end of operational life ensures conservative dose calculations and provides a buffer for underestimates of population R1
growth or if the start of the project is delayed.

Dose calculations for the MEI assumed that the individual resides 5 mi (8 km) from the MFFF in the southwest direction. The nearest SRS boundary is actually located 5.1 mi (8.2 km) from the facility in the northwest direction. This distance was reduced to 5 mi (8 km) for the analysis. Examination of the joint frequency distribution data indicates that the wind blows in the southwest direction the majority of the time (see Table D-1). Therefore, an individual located southwest of the facility should receive the highest dose due to airborne releases. This assumption was confirmed by conducting GENII simulations with the MEI located in each of the 16 wind directions. Results from those simulations yielded the highest dose due to airborne releases when the MEI was assumed to be located in the southwest direction.

D.1.3 Population Data for Site Workers

Approximately 13,616 site workers were employed at SRS in 2000. The current spatial distribution of those workers is not readily available. Therefore, a population dose for the site workers could not be directly determined. The methodology used to estimate the population dose for the site workers is discussed in Section D.2.

The MEI dose calculations for the maximally exposed site worker assumed that the worker was located at the edge of the MFFF boundary, which is 328 ft (100 m) from the release point. The maximally exposed site worker was assumed to be located in the direction from the release point that gives the maximum dose based on dose calculations for the 16 wind directions considered by GENII. These directions are east-northeast for the elevated release and southwest for the groundlevel release.

D.1.4 Food Production Data

The dose due to ingestion of terrestrial food and animal products, calculated for the offsite population only, requires information regarding food production. Production data for the 50-mi (80-km) assessment area surrounding SRS were taken from the 1987 Census of Agriculture (Halliburton NUS Corp. 1996). The food production data were organized into a food grid, or wheel, consistent with the grid developed for the population distribution. The fraction of each county located within the grid sectors was combined with the food production in each sector to generate the food grid. Food production in each county was assumed to occur uniformly across the entire county. The grid consists of data for the eight food categories included in the analysis (i.e., leafy vegetables, root vegetables, fruits, grains, beef, poultry, milk, and eggs) at 10 radial distances from the facility for 16 wind directions. The food grid used in the GENII analysis was taken from the data for an F-Area release location given in Table 3.6-5 of *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact*

Statement Volume 2: Health Risk Data Reading Room Material (Halliburton NUS Corp. 1996). These data are reproduced in Table D-3.

The radiation dose from ingestion of food products was not included in the calculation of dose to the site workers because no food is produced within the SRS boundary and, therefore, consumption of food grown within the SRS boundary is impossible.

D.1.5 Food Ingestion Data (applicable for calculations of dose to the offsite public only)

This section summarizes the input parameters required for the calculation of dose to the offsite public due to food ingestion. The two types of food considered in the analysis were terrestrial food and animal products.

D.1.5.1 Terrestrial Food

Determination of dose due to the ingestion of terrestrial food requires input of (1) consumption rate, (2) the length of the growing season (used only for analyses with acute releases), (3) data related to irrigation with contaminated water, (4) crop yield, (5) the food production rate, and (6) holdup time between harvest and storage. Although the growing season lengths are input, they are not used by GENII for this analysis, which considers a chronic release rather than an acute release. Irrigation of the terrestrial food with contaminated water was not incorporated into the dose calculations. The dose calculations assumed that the MEI and the general population consume only food grown within the assessment area. The input parameters related to the ingestion of terrestrial foods are summarized in Table D-4. The source for the consumption rates is *Savannah River Site Environmental Data for 1999* (Arnett and Mamatey 2000b). For the remaining parameters, the GENII default values were used.

D.1.5.2 Animal Products

Calculation of dose due to the ingestion of animal products requires input of (1) consumption rates, (2) holdup times, (3) production rates, (4) the fraction of drinking water consumed by the animals that comes from a contaminated source, and (5) parameters related to the diet and food sources for the animals. GENII considers two food sources for beef (stored feed and fresh forage), and a single food source for poultry (stored feed). The dose calculations assume that (1) all water consumed by the animals comes from an uncontaminated source, (2) animal food sources are not irrigated, and (3) all animal products consumed by the MEI and general population are produced within the assessment area. The input parameters related to the ingestion of animal products are summarized in Table D-5 along with their sources.

D.1.6 External Exposure Data

The calculation of dose to the offsite public and to site workers due to external and inhalation exposure to contaminated air requires input of (1) external exposure time to chronic atmospheric plumes, (2) external exposure time to soil contamination, (3) inhalation exposure time to contaminated air from either chronic plumes or from resuspension, (4) the resuspension model to be used, and (5) stack height for elevated releases. Values for these parameters are needed for calculation of the dose for the MEI in the offsite public, the general public population, and the maximally exposed site worker. The parameter values used are given in Table D-6.

NRC Regulatory Guide 1.109 (NRC 1977a) states the following:

- The annual external exposure time to the plume and to soil contamination should be 0.7 year for the MEI.
- The annual external exposure time to the plume and to soil contamination should be 0.5 year for the population.
- The annual inhalation exposure time to the plume should be 1 year for the MEI and the population.

These guidelines were used for the GENII analyses.

All dose calculations assumed no resuspension of soil particles into the air. Based on the design heights for the MFFF building and the vent stack, airborne emissions will exit the facility at a height of 120 ft (37 m) above grade (see Section 3.1.1). Calculations of dose to the offsite public and to site workers considered a groundlevel release in order to bound the dose calculations and to provide a buffer in the event that the designed building and/or vent stack heights are modified in the future. For both releases, plume rise was conservatively ignored since calculated dose decreases as release height increases. R2

D.1.7 Release Data

Airborne releases due to normal operations of the MFFF were taken from the SPD EIS (DOE 1999c) and are given in Table D-7. These releases are about an order of magnitude higher than the releases expected during normal MFFF operations. Therefore, these source terms are conservative and bounding based on the latest design information.

D.2 CALCULATED DOSES

Recall that the spatial distribution of site workers within the SRS boundary is not readily available and, therefore, a population dose for site workers could not be directly determined. In order to estimate a site worker population dose, the MEI dose was multiplied by the estimated number of site workers for the year 2000 (13,616 workers). Calculation of the dose in this manner overestimated the site worker population dose because it used the dose for the maximally exposed site worker rather than the dose for an average exposed worker. As previously stated, the MEI dose for the maximally exposed site worker assumed that the worker is located at the MFFF boundary 328 ft (100 m) from the release point. Not all site workers will work this close to the MFFF. In order to take into account the fact that site workers are distributed between the MFFF boundary and the SRS boundary located 5 mi (8 km) from the release point, a range in the population dose for the site workers was determined. The maximum value for the range was estimated using an MEI dose calculated for a worker located at the MFFF boundary, and the minimum value for the range was estimated using an MEI dose calculated for a worker located at the SRS boundary. For both locations GENII simulations were performed to determine the direction from the release point to the maximally exposed worker that yielded the highest dose. Those maximum doses were then used to calculate the worker population dose. The direction giving the highest dose was southwest for both groundlevel releases. R2 R2

Table D-8 gives the doses calculated for the offsite public and for site workers due to airborne releases resulting from normal operations of the MFFF. This table also shows a comparison of the calculated potential doses due to normal operations to the all-pathway standard given in 10 CFR Part 20, Subpart D for the offsite public and in 10 CFR Part 20, Subpart C for site workers, and the doses from natural background radiation. Annual LCFs were calculated based on a cancer risk factor of 0.0005 per rem (500 cancers per 10^6 person-rem) for the offsite public and 0.0004 per rem (400 cancers per 10^6 person-rem) for site workers (see Table D-8). The annual dose to an average member of the offsite population within the 50-mi (80-km) assessment area is also presented in Table D-8. This dose was calculated as the annual offsite population dose divided by the total population projected to live in the assessment area in the year 2030.

As can be seen from Table D-8, the MEI doses for both the offsite public and site workers fall below the 10 CFR Part 20 standards and the natural background radiation. In addition, the population doses for both the offsite public and site workers, as well as the dose for an average individual in the offsite public, also fall below natural background radiation levels. These results indicate that normal operation of the MFFF should have no adverse health effect on the offsite public or site workers.

Tables

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Table D-1. Joint Frequency Distribution Used for Calculation of Dose to the Offsite Public and to Site Workers Due to Airborne Releases Resulting from Normal Operations of the MFFF

Wind Speed (m/s)	Stability Class	Wind Direction															
		S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
2.0	A	0.25	0.20	0.24	0.24	0.21	0.18	0.15	0.18	0.17	0.17	0.21	0.22	0.18	0.18	0.16	0.21
	B	0.02	0.03	0.03	0.03	0.01	0	0	0.01	0.01	0.01	0.03	0.03	0	0.03	0.03	0.02
	C	0.02	0.01	0.01	0.02	0.01	0.01	0.02	0.03	0.03	0.01	0.01	0.01	0.01	0.02	0.01	0.01
	D	0.01	0.02	0	0.02	0.02	0.01	0.01	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.03
	E	0	0	0	0	0	0	0	0	0.01	0.01	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.5	A	0.88	0.73	0.92	1.04	1.06	0.79	0.70	0.55	0.74	0.78	1.12	1.37	1.19	0.82	0.56	0.57
	B	0.24	0.36	0.43	0.44	0.35	0.25	0.19	0.21	0.26	0.24	0.34	0.38	0.29	0.25	0.16	0.16
	C	0.15	0.39	0.73	0.50	0.39	0.24	0.24	0.29	0.33	0.36	0.43	0.49	0.34	0.28	0.23	0.18
	D	0.09	0.25	0.59	0.34	0.31	0.27	0.34	0.37	0.42	0.39	0.38	0.33	0.30	0.22	0.26	0.21
	E	0.01	0.09	0.28	0.11	0.08	0.16	0.17	0.18	0.26	0.22	0.19	0.20	0.13	0.13	0.11	0.13
	F	0.01	0.02	0.02	0.01	0	0.03	0.02	0.03	0.03	0.03	0.02	0.05	0	0.01	0.02	0.04
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10.0	A	1.03	0.66	0.53	0.50	0.44	0.30	0.26	0.20	0.37	0.43	0.60	0.70	0.71	0.48	0.24	0.36
	B	0.21	0.57	0.65	0.67	0.32	0.23	0.16	0.19	0.31	0.33	0.55	0.75	0.55	0.36	0.16	0.18
	C	0.16	0.69	1.49	0.86	0.67	0.44	0.42	0.42	0.52	0.58	0.74	0.78	0.78	0.57	0.27	0.14
	D	0.12	0.52	1.64	0.95	0.81	0.70	0.84	1.12	1.48	1.05	1.26	1.27	1.01	0.88	0.50	0.20
	E	0.06	0.64	1.08	0.81	0.62	0.62	0.82	0.98	1.20	1.10	1.06	1.12	0.63	0.47	0.42	0.24
	F	0.02	0.22	0.19	0.07	0.10	0.16	0.18	0.17	0.22	0.16	0.21	0.27	0.07	0.06	0.05	0.06
	G	0	0.02	0.01	0	0	0.01	0.01	0.01	0.02	0.01	0.01	0.02	0	0	0	0
15.5	A	0.21	0.18	0.03	0.03	0.01	0.02	0.02	0.01	0.02	0.04	0.05	0.10	0.09	0.11	0.03	0.09
	B	0.02	0.17	0.12	0.04	0.04	0.03	0.05	0.04	0.04	0.09	0.18	0.31	0.46	0.34	0.09	0.03
	C	0	0.18	0.46	0.21	0.08	0.09	0.16	0.22	0.20	0.29	0.41	0.46	0.73	0.62	0.13	0.01
	D	0	0.09	0.19	0.08	0.05	0.06	0.13	0.46	0.43	0.24	0.24	0.12	0.13	0.11	0.07	0
	E	0	0.09	0.06	0.09	0.07	0.05	0.05	0.09	0.13	0.10	0.19	0.07	0.02	0.02	0.01	0
	F	0	0.04	0.02	0.03	0.01	0.03	0.02	0.01	0.01	0.01	0.03	0.02	0.01	0	0	0
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table D-1. Joint Frequency Distribution Used for Calculation of Dose to the Offsite Public and to Site Workers Due to Airborne Releases Resulting from Normal Operations of the MFFF (continued)

Wind Speed (m/s)	Stability Class	Wind Direction															
		S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
21.5	A	0.01	0	0	0	0	0	0	0	0	0	0	0.01	0.02	0.02	0	0.01
	B	0	0.01	0	0	0	0	0	0	0	0	0.02	0.03	0.08	0.06	0.01	0
	C	0	0.01	0	0	0.01	0	0.01	0.04	0.04	0.05	0.05	0.08	0.18	0.10	0.02	0
	D	0	0	0	0	0	0	0	0.03	0.02	0.02	0.01	0	0.02	0	0	0
	E	0	0	0	0	0	0	0	0	0	0	0	0	0.01	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25.0	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table D-2. Projected Population Distribution for the Offsite Public Within 50 miles (80 km) of SRS F Area for the Year 2030[a]

	Distance (miles)						
Direction	**0 to 5**	**5 to 10**	**10 to 20**	**20 to 30**	**30 to 40**	**40 to 50**	**Total**
S	0	0	920	2,696	11,367	6,013	**20,996**
SSW	0	15	1,317	3,692	8,115	4,376	**17,515**
SW	0	186	1,978	7,732	3,535	4,579	**18,010**
WSW	0	171	2,572	7,553	4,368	10,385	**25,049**
W	0	407	10,186	17,766	15,109	11,753	**55,221**
WNW	0	2,331	8,556	219,212	54,849	24,980	**309,928**
NW	0	1,861	25,692	137,243	15,851	5,567	**186,214**
NNW	0	1,978	33,320	18,925	11,627	5,648	**71,498**
N	0	3,500	36,210	15,530	11,294	17,670	**84,204**
NNE	0	397	3,010	3,515	6,925	28,857	**42,704**
NE	0	14	2,609	4,611	8,850	19,325	**35,409**
ENE	0	0	5,535	7,865	8,764	53,785	**75,949**
E	0	2	8,061	8,590	18,423	9,310	**44,386**
ESE	0	14	3,658	4,352	5,466	488	**13,978**
SE	0	0	951	7,673	7,409	17,619	**33,652**
SSE	0	0	615	1,154	1,767	4,234	**7,770**
Total	**0**	**10,876**	**145,190**	**468,109**	**193,719**	**224,589**	**1,042,483**

[a] Source: Figure 1.3-39 of the GSAR (WSRC 1999a).

Table D-3. Agricultural Food Production Within 50 miles (80 km) Surrounding SRS Used for Determination of Population Dose to the Offsite Public

Leafy Vegetables (kg/yr)

Direction	Distance (miles)					
	0 to 5	**5 to 10**	**10 to 20**	**20 to 30**	**30 to 40**	**40 to 50**
S	0	0	0	0	0	1.0E+05
SSW	0	0	0	0	0	1.0E+05
SW	0	3.4E+05	0	0	0	1.1E+03
WSW	0	3.7E+02	33	0	1.6E+03	8.8E+03
W	0	1.3E+03	1.3E+02	0	2.8E+03	4.1E+03
WNW	0	1.4E+03	3.4E+03	0	0	0
NW	0	1.4E+03	6.3E+03	4.7E+03	0	0
NNW	0	1.3E+03	6.9E+03	8.7E+03	8.6	2.4E+03
N	0	1.1E+03	6.9E+03	1.2E+04	1.1E+04	4.8E+04
NNE	0	3.9E+02	3.9E+03	1.2E+04	5.1E+03	5.3E+03
NE	0	46	6.0E+03	3.1E+04	2.5E+05	7.7E+05
ENE	0	0	7.6	3.2E+04	1.6E+05	2.1E+05
E	0	0	0	0	2.3E+04	1.3E+05
ESE	0	0	0	0	0	1.0E+05
SE	0	0	0	0	0	1.0E+05
SSE	0	0	0	0	0	1.0E+05

Table D-3. Agricultural Food Production Within 50 miles (80 km) Surrounding SRS Used for Determination of Population Dose to the Offsite Public (continued)

Root Vegetables (kg/yr)

Direction	Distance (miles)					
	0 to 5	5 to 10	10 to 20	20 to 30	30 to 40	40 to 50
S	0	0	1.8E+06	3.1E+06	4.1E+06	6.3E+06
SSW	0	3.1E+03	2.1E+06	3.4E+06	4.3E+06	6.7E+06
SW	0	9.7E+07	2.2E+06	3.6E+06	4.8E+06	5.8E+06
WSW	0	1.1E+05	2.1E+06	3.6E+06	5.3E+06	8.0E+06
W	0	1.8E+05	2.3E+05	1.3E+06	3.4E+06	4.4E+06
WNW	0	1.9E+05	5.0E+05	1.1E+05	5.4E+04	3.2E+05
NW	0	2.0E+05	8.8E+05	8.2E+05	4.0E+05	1.4E+05
NNW	0	1.9E+05	9.6E+05	1.3E+06	7.3E+05	1.2E+06
N	0	1.5E+05	9.6E+05	1.6E+06	1.7E+06	2.4E+06
NNE	0	8.1E+04	9.6E+05	1.6E+06	2.5E+06	3.8E+06
NE	0	6.3E+03	1.2E+06	2.6E+06	4.2E+06	5.1E+06
ENE	0	0	3.4E+06	6.3E+06	7.8E+06	9.9E+06
E	0	0	3.6E+06	6.3E+06	7.9E+06	1.0E+07
ESE	0	0	3.3E+06	6.6E+06	8.4E+06	5.3E+06
SE	0	0	6.4E+07	6.8E+06	8.8E+06	9.2E+06
SSE	0	0	3.8E+07	3.0E+07	6.7E+06	7.8E+06

Table D-3. Agricultural Food Production Within 50 miles (80 km) Surrounding SRS Used for Determination of Population Dose to the Offsite Public (continued)

Fruit (kg/yr)

Direction	Distance (miles)					
	0 to 5	**5 to 10**	**10 to 20**	**20 to 30**	**30 to 40**	**40 to 50**
S	0	0	3.9E+05	1.1E+06	1.7E+06	2.5E+06
SSW	0	6.9E+02	4.5E+05	8.7E+05	1.4E+06	2.3E+06
SW	0	3.3E+07	4.8E+05	7.9E+05	1.2E+06	1.2E+06
WSW	0	4.4E+04	4.7E+05	7.9E+05	1.0E+06	8.8E+05
W	0	1.1E+05	4.5E+04	2.7E+05	4.4E+05	3.9E+05
WNW	0	1.2E+05	2.8E+05	1.1E+03	2.3E+02	1.3E+03
NW	0	1.2E+05	5.3E+05	2.8E+06	6.6E+06	2.2E+06
NNW	0	1.1E+05	5.8E+05	2.8E+06	1.2E+07	1.4E+07
N	0	9.0E+04	5.8E+05	9.7E+05	5.1E+06	4.8E+06
NNE	0	4.9E+04	5.8E+05	9.7E+05	1.0E+06	7.4E+05
NE	0	3.9E+03	5.3E+05	8.9E+05	1.0E+06	7.5E+05
ENE	0	0	2.5E+05	4.9E+05	8.5E+05	1.1E+06
E	0	0	2.6E+05	3.4E+05	1.6E+05	7.0E+05
ESE	0	0	2.4E+05	4.0E+05	1.8E+05	5.6E+04
SE	0	0	4.3E+06	3.1E+05	3.7E+05	3.1E+05
SSE	0	0	2.6E+06	2.0E+06	1.1E+06	1.0E+06

Table D-3. Agricultural Food Production Within 50 miles (80 km) Surrounding SRS Used for Determination of Population Dose to the Offsite Public (continued)

Grains (kg/yr)

Direction	Distance (miles)					
	0 to 5	5 to 10	10 to 20	20 to 30	30 to 40	40 to 50
S	0	0	2.6E+06	7.4E+06	1.1E+07	1.5E+07
SSW	0	4.5E+03	2.9E+06	6.0E+06	1.1E+07	1.4E+07
SW	0	1.1E+08	3.1E+06	5.1E+06	8.2E+06	1.0E+07
WSW	0	1.4E+05	3.0E+06	5.1E+06	8.1E+06	1.5E+07
W	0	2.1E+05	6.4E+05	2.2E+06	6.1E+06	7.9E+06
WNW	0	2.2E+05	7.6E+05	7.2E+05	2.6E+05	6.5E+05
NW	0	2.2E+05	1.0E+06	1.2E+06	7.5E+05	3.3E+05
NNW	0	2.1E+05	1.1E+06	1.6E+06	1.3E+06	2.0E+06
N	0	1.7E+05	1.1E+06	1.8E+06	2.3E+06	4.1E+06
NNE	0	9.3E+04	1.1E+06	1.8E+06	2.7E+06	3.6E+06
NE	0	7.3E+03	1.3E+06	3.6E+06	6.1E+06	6.9E+06
ENE	0	0	4.0E+06	8.7E+06	1.4E+07	1.8E+07
E	0	0	4.2E+06	9.0E+06	1.6E+07	1.9E+07
ESE	0	0	3.9E+06	8.9E+06	1.6E+07	1.2E+07
SE	0	0	8.2E+07	1.1E+07	1.5E+07	1.7E+07
SSE	0	0	5.2E+07	5.2E+07	1.3E+07	1.6E+07

Table D-3. Agricultural Food Production Within 50 miles (80 km) Surrounding SRS Used for Determination of Population Dose to the Offsite Public (continued)

Beef (kg/yr)

Direction	Distance (miles)					
	0 to 5	5 to 10	10 to 20	20 to 30	30 to 40	40 to 50
S	0	0	1.2E+05	4.6E+05	7.3E+05	9.9E+05
SSW	0	2.2E+02	1.5E+05	3.4E+05	6.9E+05	9.3E+05
SW	0	6.0E+04	1.5E+05	2.5E+05	4.6E+05	6.1E+05
WSW	0	1.0E+04	1.5E+05	2.5E+05	4.1E+05	7.9E+05
W	0	2.1E+04	4.0E+04	1.2E+05	3.4E+05	5.1E+05
WNW	0	2.2E+04	7.0E+04	5.0E+04	9.5E+04	1.8E+05
NW	0	2.3E+04	1.1E+05	1.4E+05	1.6E+05	2.1E+05
NNW	0	2.2E+04	1.1E+05	1.8E+05	2.3E+05	3.5E+05
N	0	1.7E+04	1.1E+05	1.9E+05	3.1E+05	6.5E+05
NNE	0	9.6E+03	1.1E+05	1.9E+05	2.5E+05	2.9E+05
NE	0	7.5E+02	1.0E+05	2.6E+05	4.3E+05	5.0E+05
ENE	0	0	2.4E+04	2.2E+05	8.2E+05	1.1E+06
E	0	0	2.6E+04	1.4E+05	5.2E+05	8.8E+05
ESE	0	0	2.4E+04	8.2E+04	3.4E+05	4.5E+05
SE	0	0	4.8E+05	6.4E+04	2.0E+05	5.2E+05
SSE	0	0	3.6E+05	5.8E+05	4.3E+05	6.7E+05

Table D-3. Agricultural Food Production Within 50 miles (80 km) Surrounding SRS Used for Determination of Population Dose to the Offsite Public (continued)

Poultry (kg/yr)

Direction	Distance (miles)					
	0 to 5	5 to 10	10 to 20	20 to 30	30 to 40	40 to 50
S	0	0	0	0	0	5.4E+04
SSW	0	0	0	0	0	6.7E+04
SW	0	4.7E+07	0	0	0	45
WSW	0	5.1E+04	4.5E+03	0	61	3.5E+02
W	0	1.7E+05	1.8E+04	0	1.1E+02	1.6E+02
WNW	0	1.9E+05	4.6E+05	0	0	5.1E+03
NW	0	1.9E+05	8.6E+05	6.4E+05	0	3.0E+05
NNW	0	1.8E+05	9.4E+05	1.2E+06	1.2E+03	5.4E+05
N	0	1.5E+05	9.4E+05	1.6E+06	1.7E+06	3.6E+06
NNE	0	8.0E+04	9.4E+05	1.6E+06	1.3E+06	5.4E+03
NE	0	6.3E+03	8.2E+05	1.2E+06	9.7E+05	0
ENE	0	0	1.1E+03	0	0	0
E	0	0	0	0	0	1.0E+05
ESE	0	0	0	0	0	1.0E+05
SE	0	0	0	0	0	1.0E+05
SSE	0	0	0	0	0	1.0E+05

Table D-3. Agricultural Food Production Within 50 miles (80 km) Surrounding SRS Used for Determination of Population Dose to the Offsite Public (continued)

Milk (kg/yr)

Direction	Distance (miles)					
	0 to 5	5 to 10	10 to 20	20 to 30	30 to 40	40 to 50
S	0	0	5.5E+05	6.2E+05	6.5E+05	7.6E+05
SSW	0	9.7E+02	6.4E+05	2.9E+06	7.9E+06	8.1E+06
SW	0	3.2E+06	6.7E+05	1.1E+06	3.8E+06	2.9E+06
WSW	0	2.2E+04	6.6E+05	1.1E+06	2.0E+06	4.4E+06
W	0	1.2E+04	4.9E+04	3.8E+05	1.8E+06	3.5E+06
WNW	0	1.3E+04	3.1E+04	0	4.7E+04	1.2E+06
NW	0	1.3E+04	5.8E+04	4.4E+05	1.1E+06	7.9E+05
NNW	0	1.2E+04	6.4E+04	4.3E+05	2.0E+06	3.3E+06
N	0	9.9E+03	6.4E+04	1.1E+05	1.9E+06	7.4E+06
NNE	0	5.4E+03	6.4E+04	1.1E+05	3.9E+05	9.7E+06
NE	0	4.2E+02	5.5E+04	6.9E+05	1.7E+06	1.8E+06
ENE	0	0	70	1.1E+06	4.6E+06	5.6E+06
E	0	0	0	9.6E+05	4.2E+06	5.7E+06
ESE	0	0	0	3.2E+05	2.6E+06	1.6E+06
SE	0	0	2.4E+04	1.2E+04	4.2E+04	1.2E+05
SSE	0	0	2.0E+05	3.2E+05	3.5E+05	3.9E+05

Table D-3. Agricultural Food Production Within 50 miles (80 km) Surrounding SRS Used for Determination of Population Dose to the Offsite Public (continued)

Eggs (kg/yr)

Direction	Distance (miles)					
	0 to 5	5 to 10	10 to 20	20 to 30	30 to 40	40 to 50
S	0	0	6.3E+02	0	0	8.3E+04
SSW	0	0	0	0	0	1.0E+05
SW	0	6.2E+05	0	0	0	91
WSW	0	0	0	0	1.2E+02	7.0E+02
W	0	0	0	0	2.2E+02	3.3E+02
WNW	0	0	0	0	0	1.0E+05
NW	0	0	0	1.2E+05	3.2E+05	1.1E+05
NNW	0	0	0	1.0E+05	5.9E+05	6.4E+05
N	0	0	0	0	1.7E+05	29
NNE	0	0	0	0	0	1.0E+05
NE	0	0	4.1E+03	4.0E+03	1.6E+02	1.2E+02
ENE	0	0	4.3E+04	5.5E+04	5.0E+02	6.3E+02
E	0	0	4.5E+04	5.6E+04	71	4.0E+02
ESE	0	0	4.2E+04	5.8E+04	1.2E+02	0
SE	0	0	6.3E+05	1.2E+03	0	0
SSE	0	0	3.1E+05	0	0	0

Source: *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement Volume 2: Health Risk Data Reading Room Material* (Halliburton NUS Corp. 1996)

Table D-4. Input Parameters and Values for Calculation of Dose to the Offsite Public Due to Ingestion of Terrestrial Food

Parameter	Value	
	Maximally Exposed Individual	Population
Consumption rate (kg/yr)[a]		
leafy vegetables	43	21
root vegetables	276	163
fruit	276	163
grain	276	163
Length of growing season[b]	N/A	N/A
Crop yield (kg/m^2)[c]		
leafy vegetables	1.5	1.5
root vegetables	4.0	4.0
fruit	2.0	2.0
grain	0.8	0.8
Production rates (kg/yr)	N/A	[d]
Hold time between harvest and storage (days)[c]		
leafy vegetables	1	14
root vegetables	5	14
fruit	5	14
grain	180	180

[a] Source: *Savannah River Site Environmental Data for 1999* (Arnett and Mamatey 2000b).

[b] Growing season length, which is used only for acute releases, is not applicable for this analysis, which considers chronic releases.

[c] GENII default values.

[d] See Section D.1.4 and Table D-3.

N/A = Not applicable

Table D-5. Input Parameters and Values for Calculation of Dose to the Offsite Public Due to Ingestion of Animal Products

Parameter	Value	
	Maximally Exposed Individual	Population
Consumption rate (kg/yr)		
beef[a]	81	43
milk[a]	230	120
poultry[b]	18	8.5
eggs[b]	30	20
Holdup time (days)[b]		
beef	15	34
milk	1	3
poultry	1	34
eggs	1	18
Production rate (kg/yr)	N/A	[c]
Diet fraction for animal food sources[b]		
stored feed		
beef	0.25	0.25
milk	0.25	0.25
poultry	1.00	1.00
eggs	1.00	1.00
fresh forage		
beef	0.75	0.75
milk	0.75	0.75
Growing time for animal food sources (days)[b]		
stored feed		
beef	90	90
milk	45	45
poultry	90	90
eggs	90	90
fresh forage		
beef	45	45
milk	30	30
Yield of animal food sources (kg/m^3)[b]		
stored feed		
beef	0.8	0.8
milk	2.0	2.0
poultry	0.8	0.8
eggs	0.8	0.8
fresh forage		
beef	2.0	2.0
milk	1.5	1.5

Table D-5. Input Parameters and Values for Calculation of Dose to the Offsite Public Due to Ingestion of Animal Products (continued)

Parameter	Value	
	Maximally Exposed Individual	Population
Storage time for animal food sources (days)[b]		
stored feed		
beef	180	180
milk	100	100
poultry	180	180
eggs	180	180
fresh forage		
beef	100	100
milk	0	0

[a] Source: *Savannah River Site Environmental Data for 1999* (Arnett and Mamatey 2000b).

[b] GENII default values.

[c] See Section D.1.4 and Table D-3.

N/A = Not applicable

Table D-6. Input Parameters and Values for Calculation of Dose to the Offsite Public and Site Workers Due to External Exposure and Inhalation

Parameter	Value	
	Maximally Exposed Individual[a]	Population[b]
External exposure time to chronic atmospheric plume (hr/yr)[c]	6,136.2	4,383
External exposure time to soil contamination (hr/yr)[c]	6,136.2	4,383
Inhalation exposure time to chronic plume (hr/yr)[c]	8,766	8,766
Stack height (m)	28 and 0.3[d]	28 and 0.3[d]

[a] Applicable for calculation of radiological impact on both the offsite public and site workers.

[b] Applicable for calculation of radiological impact to the offsite public only.

[c] Source: *Calculation of Annual Doses to Man From Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR 50, Appendix I* (NRC 1977a).

[d] Doses were calculated for both an elevated release (93 ft [28 m] above grade; see Section 3.1.1) and an essentially groundlevel release (1 ft [0.3 m] above grade) to bound the dose calculations.

Table D-7. Estimated Radiological Releases from the MFFF during Normal Operations[a] and Radionuclide Half-lives[b]

Isotope	Airborne Radiological Releases (μCi/yr)	Half-Life (days)
Plutonium-236	1.3E-08	1,041.33
Plutonium-238	8.5	32,050.7
Plutonium-239	91	8.814E+06
Plutonium-240	23	2.388E+06
Plutonium-241	101	5,259.6
Plutonium-242	6.1E-03	1.373E+08
Americium-241	48	157,861
Uranium-234	5.1E-03	8.93E+07
Uranium-235	2.1E-04	257.1E+09
Uranium-238	0.012	1.63E+12

[a] Source terms taken from the SPD EIS (DOE 1999c); these source terms are about an order of magnitude higher than the source terms expected for normal MFFF operations.

[b] Values for radionuclide half-lives used by GENII.

Table D-8. Potential Radiological Impacts on the General Public and Site Workers Due to Normal Operations of the MFFF

RADIATION DOSE TO THE GENERAL PUBLIC	Groundlevel Release[b]
Maximally Exposed Individual	
Annual Dose (mrem/yr)[c]	1.5E-03
Percentage of 10 CFR Part 20, Subpart D Standard[d]	1.5E-03
Percentage of Natural Background Radiation[e]	5.1E-04
Annual LCF Risk[f]	7.5E-10
General Population Within 50 mi (80 km)	
Annual Dose (person-rem/yr)[c]	0.12
Percentage of Natural Background Radiation[g]	3.9E-05
Annual LCF Risk[f]	6.0E-05
Average Exposed Individual Within 50 mi (80 km)	
Annual Dose (mrem/yr)[h]	1.2E-04
Percentage of 10 CFR Part 20, Subpart D Standard[d]	1.2E-04
Percentage of Natural Background Radiation[e]	4.1E-05
Annual LCF Risk[f]	6.0E-11

R2

RADIATION DOSE TO SITE WORKERS	Groundlevel Release[b]	
Maximally Exposed Site Worker		
Annual Dose (mrem/yr)[i]	3.0	
Percentage of 10 CFR Part 20, Subpart C Standard[j]	6.0E-02	
Percentage of Natural Background Radiation[e]	1.0	
Annual LCF Risk[k]	1.2E-06	
General Site Worker Population	**Minimum[l]**	**Maximum[m]**
Maximum Annual Dose (person-rem/yr)[g]	0.019	40.8
Percentage of Natural Background Radiation[e]	4.7E-04	1.0
Annual LCF Risk[k]	7.6E-06	1.6E-02

Table D-8. Potential Radiological Impacts on the General Public and Site Workers Due to Normal Operations of the MFFF R2

[a] [Text Deleted]

[b] Height of groundlevel release is 1 ft (0.3 m) above grade.

[c] Source is GENII model results for the offsite public.

[d] 10 CFR Part 20, Subpart D standard is an annual dose of 100 mrem.

[e] Natural background radiation is 295 mrem/yr (see Table 4-23).

[f] Calculated using a cancer risk factor of 0.0005 per rem (500 cancers/10^6 person-rem).

[g] Natural background radiation for the offsite public was calculated as the individual background radiation (295 mrem/yr) times the number of people projected to live in the 50-mi (80-km) assessment area in the year 2030 (1,042,483 people). The calculated value is 307,532 person-rem/yr.

[h] Calculated as the population dose divided by the number of people projected to live in the 50-mi (80-km) assessment area in the year 2030 (1,042,483 people).

[i] Source is GENII model results for site workers.

[j] 10 CFR Part 20, Subpart C standard is an annual dose of 5,000 mrem.

[k] Calculated using a cancer risk factor of 0.0004 per rem (400 cancers/10^6 person-rem).

[l] Minimum values based on a distance of 5 mi (8 km) from the release point (i.e., at the SRS boundary).

[m] Maximum values based on a distance of 328 ft (100 m) from the release point (i.e., at the MFFF boundary).

[n] Dose for the site worker population was determined by multiplying the MEI dose at the respective distance from the release point by the total number of site workers (13,616 workers). The MEI doses are as follows:

MEI dose at the MFFF boundary for an elevated release =	2.2E-02 mrem/yr
MEI dose at the SRS boundary for an elevated release =	3.9E-04 mrem/yr
MEI dose at the MFFF boundary for a groundlevel release =	3.0 mrem/yr
MEI dose at the SRS boundary for a groundlevel release =	1.4E-03 mrem/yr

[o] Natural background radiation for the site workers was calculated as the individual background radiation (295 mrem/yr) times the estimated number of site workers in 2000 (13,616 workers). The calculated value is 4,017 person-rem/yr.

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APPENDIX F. FACILITY ACCIDENTS

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This appendix summarizes the assessment methods and important analysis assumptions used to support the accident analysis presented in Section 5.5. This information is based on the MFFF safety assessment in the Construction Authorization Request. R1

F.1 GENERAL CONSEQUENCE ANALYSIS METHODS AND ASSUMPTIONS

F.1.1 Total Effective Dose Equivalent

The Total Effective Dose Equivalent (TEDE) to the receptors of interest is equal to the Inhalation Dose. Air submersion, ingestion, water immersion, and contaminated soil dose pathways are assumed negligible contributors to the TEDE. The Inhalation Dose is calculated as follows:

$$[\text{Inhalation Dose}]_{\text{effective}} = [\text{ST}] \cdot [\chi/\text{Q}] \cdot [\text{BR}] \cdot [\text{C}] \cdot \sum_{X=1}^{N} ST_X \cdot f_X \cdot [\text{DCF}]_{effective,X} \quad \text{(F-1)}$$

where:

ST_x	=	source term expressed as mass of radionuclide, x, released
χ/Q	=	atmospheric dispersion factor
BR	=	breathing rate
C	=	unit's conversion constant
f	=	specific activity of nuclide x
DCF	=	dose conversion factor of nuclide x
N	=	total number of dose-contributing radionuclides

R1

F.1.2 Source Term

The source term (ST) is the amount of respirable radioactive material released to the air. The initial source term is the amount of radioactive material driven airborne at the accident source. The initial respirable source term, a subset of the initial source term, is the amount of radioactive material driven airborne at the accident source that is effectively inhalable. Lesser source terms are determined by applying filtration or deposition factors to the initial source term. The MFFF Safety Assessment uses the following equation to determine the quantity of respirable material released by an event to the environs:

$$[ST_X] = [\text{MAR}] \times [\text{DR}] \times [\text{ARF}] \times [\text{RF}] \times [\text{LPF}] \quad \text{(NRC 1998d)} \qquad \text{(F-2)}$$

R1

The material at risk (MAR) is the amount of radioactive material (in grams) available to be acted on by a given physical stress associated with the accident. For facilities, processes, and activities, the MAR is a value representing some maximum quantity of radionuclide present or reasonably anticipated for the process or structure being analyzed. Different MARs may be assigned for different accidents since it is only necessary to define the material in those discrete physical locations that are exposed to a given stress. R1

The damage ratio (DR) is the fraction of the MAR actually impacted by the accident-generated conditions. The DR is estimated based upon engineering analysis of the response of structural materials for containment to the type and level of stress or force generated by the event. Conservative engineering approximations are typically used. These approximations often include a degree of conservatism due to simplification of phenomena to obtain a usable model, but the purpose of the approximation is to obtain, to the degree possible, a realistic understanding of potential effects.

The airborne release fraction (ARF) is the coefficient used to estimate the amount of a radioactive material suspended in air as an aerosol and thus available for transport due to physical stresses from a specific accident. For discrete events, the ARF is a fraction of the material affected. An entrainment event is treated in the same manner, with the exception that its release mechanism is a function of time. Thus, to use the five-factor formula, the airborne release rate (ARR) of an entrainment event must be multiplied by the duration of the entrainment and then equated to the ARF (i.e., ARF = ARR x duration). Entrainment is not considered for materials in the form of a pellet or for materials contained in rods or filters.

The respirable fraction (RF) is the fraction of airborne radionuclides as particles that can be transported through air and inhaled into the human respiratory system.

Values for the RF and ARF are based on bounding values from the NRC (NRC 1998d).

The leak path factor (LPF) is the fraction of the radionuclides in the aerosol transported through some confinement deposition or filtration mechanism. There can be many LPFs for some hazard events, and their cumulative effect is often expressed as one value that is the product of all leak-path multiples. Inclusion of these multiples in a single LPF is done to clearly differentiate between calculations of doses without controls (where the LPF is assumed equal to 1) and calculations of doses with controls (where the LPF reflects the dose credit provided to the controls). In this manner, the LPF represents the credit taken for the control features at the MFFF.

Specific values for these parameters used in the bounding analysis are provided in Section F.6.

F.1.3 Potential Receptors

For each potential accident, information is provided on accident consequences and frequencies to three types of receptors: (1) a site worker, (2) the maximally exposed member of the public, and (3) the offsite population. The first receptor, a site worker or SRS worker, is a hypothetical individual working on the site but not involved in the proposed activity. The worker is conservatively evaluated downwind at a point 328 ft (100 m) from the accident. The second receptor, a maximally exposed member of the public, is a hypothetical individual assumed to be downwind at the site boundary. The MFFF site boundary is conservatively evaluated at a distance of 5 mi (8 km). Exposures received by this individual are intended to represent the highest doses to a member of the public. The third receptor, the offsite population, is all members of the public within 50 mi (80 km) of the accident location.

F.1.4 Dispersion Modeling

The MACCS2 (MELCOR Accident Consequence Code System for the Calculation of the Health and Economic Consequences of Accidental Atmospheric Radiological Releases) computer code was used to compute the downwind relative air concentrations (χ/Q) for a groundlevel release from the MFFF (NRC 1998a). The relative concentration (atmospheric dispersion factors) (χ/Q) is the dilution provided relative to site meteorology and distance to the receptor(s). MACCS2 simulates the impact of accidental atmospheric releases of radiological materials on the surrounding environment. MACCS2 was developed as a general-purpose application to diverse reactor and nonreactor facilities licensed by the NRC or operated by DOE or the Department of Defense.

The receptor of interest includes the maximally exposed individual (MEI) member of the public at the SRS boundary [5 mi (8 km)]. This input is conservative with respect to the nearest site boundary and the nearest public road barricade (5.4 and 5.2 miles, respectively). R1 The input into the MACCS2 code included a meteorological data file, which contains one year of hourly meteorological conditions for SRS. No credit is taken for building wake effects. The SRS meteorological data files are composed of hourly data for each calendar year from 1987 through 1996. Test runs demonstrated that 1987 and 1988 yield the most conservative site boundary χ/Q R1 values; therefore, calculations were performed using the 1987 and 1988 meteorological data files. The dose incurred by the MEI is reported at the 95th percentile level, without regard to sector, from a ground release. The associated atmospheric dispersion factor (χ/Q) is 3.69E-06 sec/m^3. New meteorological data was used in the calculation of χ/Q with no effect on the resultant value. R1

The ARCON96 computer code was used to compute the downwind relative air concentrations (χ/Q) for the onsite receptor located within 328 ft (100 m) of a groundlevel release from the MFFF to account for low wind meander and building wake effects (NRC 1997). ARCON96 implements a straight-line Gaussian dispersion model with dispersion coefficients that are modified to account for low wind meander and building wake effects. A constant release rate is assumed for the entire period of release. Building wake effects are considered in the evaluation of relative concentration from groundlevel releases. ARCON96 calculates relative concentration using hourly meteorological data. The SRS meteorological data files are composed of hourly data taken at a height of 61m for each calendar year from 1987 through 1996. R1 It then combines the hourly averages to estimate concentrations for periods ranging in duration from 2 hours to 30 days. Wind direction is considered as the averages are formed. As a result, the averages account for persistence in both diffusion conditions and wind direction. Cumulative frequency distributions are prepared from the average relative concentrations. Relative concentrations that are exceeded no more than 5% of the time (95th percentile relative concentrations) are determined from the cumulative frequency distributions for each averaging period. The associated χ/Q for the site worker is 6.09E-04sec/m^3. R1

The breathing rate is conservatively assumed to be 3.47E-04 m^3/sec. This value is from Regulatory Guide 1.25 (NRC 1972) and is equivalent to the uptake volume (353 ft^3 [10 m^3]) of a worker in an eight-hour workday.

The inhalation dose conversion factors are taken from Federal Guidance Report 11 (EPA 1988). While some events involve radionuclides such as americium, the bounding releases from potential events at the MFFF involve plutonium particulate in the form of an oxide. The dose conversion factors corresponding to the yearly lung clearance class are applied to the released radionuclides accounting for this chemical form.

F.1.5 Source Term Composition

Source term composition for the plutonium involved in the bounding events is provided in Table F-1. Plutonium is designated as unpolished prior to being processed through the aqueous polishing process. Plutonium is designated as polished after it has been processed through the aqueous polishing process.

F.1.6 Likelihood Of Fatal Cancer

The probability coefficients for determining the likelihood of fatal cancer, given a dose, is taken from the *1990 Recommendations of the International Commission on Radiological Protection* (ICRP 1991). For low doses or low dose rates, respective probability coefficients of 4.0E-04 and 5.0E-04 fatal cancers per rem are applied for workers and the general public. For high doses received at a high rate, respective probability coefficients of 8.0E-04 and 1.0E-03 fatal cancers per rem are applied for noninvolved workers and the public. These higher probability coefficients apply where doses are above 20 rem and dose rates are above 10 rem/hr.

F.2 FREQUENCY CATEGORIES

Frequency categories in the MFFF Safety Assessment are based on qualitative estimates. The frequency categories are defined as follows:

- Not Unlikely – Event may occur during the facility's lifetime.
- Unlikely – Event is not expected to occur during the facility's lifetime.
- Highly Unlikely – The use of sufficient principal SSCs (or IROFS) applied to unmitigated events classified as Not Unlikely or Unlikely to further reduce their frequency to an acceptable level.

- Credible – Events that are not "Not Credible."
- Not Credible – Natural phenomena or external man-made events with an extremely low initiating frequency, or process events that are not possible.

Note that the Highly Unlikely category is not used in the unmitigated analysis. Only through the application of MFFF engineered features are events placed into this category. Also note that events deemed Not Credible are not considered in the MFFF design.

F.3 CONSEQUENCE CATEGORIES

Consequences are categorized according to three severity levels: High, Intermediate, and Low. The consequence severity levels are based on 10 CFR §70.61 and are shown in Table F-2.

F.4 RISK CATEGORIES

Risk is represented by the frequency and the consequence. Based on 10 CFR §70.61, the risk categories are shown in Table F-3. This matrix is applicable to all receptors.

In accordance with 10 CFR §70.61, the risk posed by those events falling in risk categories 6 and 9 must be addressed with engineered controls, administrative controls, or both to reduce the risk to an acceptable level.

Note that 10 CFR §70.61 places no consequence criteria for events considered Highly Unlikely. Thus, the environmental assessment does not report consequences for events deemed Highly Unlikely.

F.5 UNCERTAINTIES AND CONSERVATISM

The determination of risk is based on calculations associated with hypothetical sequences of events and models of their effects. The models provide estimates of the frequencies, source terms, pathways for dispersion, exposures, and the effects on human health and the environment that are as realistic as possible within the scope of the analysis. The uncertainty in the calculation of consequences and event frequency requires the use of models or input values that yield conservative consequence and frequency estimates. All events have been evaluated using uniform methods and data, allowing a fair comparison of all events.

The bounding consequence calculations are based on extremely conservative assumptions. The actual source term involved in the event would be far lower than the source term considered in the calculation due to the actual MFFF design. Specific conservative assumptions include 95% meteorology; an LPF of 1E-04 for more than two sets of HEPA filters; and bounding source terms, release fractions, and respirable fractions as described in Section F.6. When relied upon to mitigate the effects of an accident, the filters are assumed to have a 99% removal efficiency (i.e. 1% leak path factor) per stage. Each HEPA system relied upon for safety includes two banks or stages of HEPA filters in series. The effective leak path factor for a system of staged HEPA R1 filters is the product of the individual leak path factors for successive filter stages. Thus, a leak path factor of 1E-04 was applied for the HEPA system. The combination of efficiencies is more conservative than the value of 2E-06 presented in NRC 1998d (Section F.2.1.3) for filters protected by pre-filters, sprinklers and demisters. R1

The estimation of event frequency is especially subject to considerable uncertainty. The uncertainty in estimates of the frequency of Highly Unlikely events can be several orders of magnitude. For this reason, event frequency is reported qualitatively, in terms of broad frequency bins, as opposed to numerically.

The analysis uses an extremely conservative approach with respect to frequency. All natural phenomena hazards and external man-made hazards are considered unless their probability of impacting the MFFF is extremely low, and all internal hazards generated by the MFFF design and operations are considered. For these hazards, unmitigated events are evaluated without regard to the frequency of the initiating event. In most cases, the failure of many features is required for the bounding event to occur.

F.6 ADDITIONAL INTERNAL EVENT DESCRIPTIONS

This section provides supporting details for the bounding events described in Section 5.5. Two types of events are presented; bounding events and bounding low consequence events. Bounding events are defined as events that have a frequency greater than or equal to unlikely and that have the potential to produce the largest unmitigated consequences. Bounding low consequence events are defined as events that have the potential to produce the largest unmitigated consequences that are below the intermediate consequence criteria of 10CFR70.61. These events do not require mitigation or prevention, however mitigation may be available from features required for other events. All events identified in the PHA (Preliminary Hazards Analysis) are evaluated to determine the bounding and bounding low consequence events.

F.6.1 Loss of Confinement

R1

The bounding loss of confinement event is an event caused by a load handling accident of the Jar Storage and Handling Unit. (See Section F.6.3 for a description of this event.) The bounding radiological consequences associated with this event are provided in Table 5-13a. The frequency associated with this event is estimated to be unlikely or lower since multiple failures are required for this event to occur.

The bounding low consequence event is a spill of the silver recovery tank. This unit contains americium and other metals that have been removed during the plutonium purification process. The evaluation conservatively assumes the tank is full to its service capacity resulting in a total MAR for this event of 2.2 lb (1.0 kg) of americium in solution. The ARF is 2E-5, the RF is 1.0, and the DR is conservatively assumed to be 1.0. Consequences are presented in Table 5-13b. R1
Although not required in order to satisfy the requirements of 10CFR70.61, an LPF of 1E-4 is applied to this event because the event takes place in a process cell and the release of the radiological material would pass though multiple banks of credited HEPA filters.

The MFFF utilizes many features to reduce the likelihood and consequences of these events as well as other loss-of-confinement events. Key features include reliable and redundant confinement systems; process temperature, pressure, and flow controls; radiation monitoring systems; redundant control systems; emergency procedures; and worker training.

F.6.2 Internal Fire

The bounding internal fire event is a fire in the fire area containing the Final Dosing Unit. This unit contains polished plutonium powder for the purpose of down blending the mixed oxide R2
powder to the desired blend for fuel rod fabrication. This fire area is postulated to contain the largest source term for this event, thus producing the largest consequences. Fire areas with a larger material at risk have a lower damage ratio for this event resulting in a lower overall source term.

The evaluation conservatively assumes that a fire occurs in this fire area and impacts the powder R2
stored in this area, resulting in a release of radioactive material. The maximum amount of plutonium in this fire area does not exceed 90 lb (41 kg) of polished powder. Due to the low combustible loading in this fire area, just a small fraction of this material would be expected to be involved in the fire. However, the evaluation conservatively uses the entire fire area inventory in the consequence analysis. The damage ratio is assumed to be 1.0, the bounding respirable release fraction is 6E-04, and the bounding leak path factor is 1E-04. The bounding radiological consequences associated with this event are provided in Table 5-13a. R2

The MFFF utilizes many features to reduce the likelihood and consequences of this event as well as other fire-related events. Key features include fire barriers, minimization of combustibles and ignition sources, ventilation systems with fire dampers and HEPA filters, qualified canisters and containers, fire suppression and detection systems, emergency procedures, worker training, and local fire brigades.

The frequency associated with this event is estimated to be Unlikely or lower because multiple failures are required for this event to occur.

The bounding low consequence fire event is due to a fire in a waste drum located in the truck bay. Although most waste drums contain only small amounts of plutonium, the evaluation R1
conservatively assumes that 50 grams of unpolished plutonium is involved in the fire. The ARF is 6E-3, the RF is 0.1, the LPF is 1.0, and the DR is 1.0. The results are presented in Table 5-13b.

F.6.3 Load Handling

The bounding load-handling event is a drop event involving the glovebox in the Jar Storage and Handling Unit. This glovebox contains jars of plutonium powder. This glovebox is postulated to contain the largest source term for this event, thus producing the largest consequences. Gloveboxes that contain a larger material at risk have a lower damage ratio for this event resulting in a lower overall source term.

The glovebox is postulated to be impacted during maintenance operations by either a lifting device or a lifted load outside of the glovebox, damaging a portion of the glovebox causing some of its contents to drop to the floor, resulting in a release of radioactive material. The maximum amount of plutonium in this glovebox is approximately 743 lb (337 kg) of polished powder. Due to the large glovebox size, it is expected that just a small fraction of this amount would be involved in the event. However, the evaluation conservatively uses the entire glovebox inventory in the consequence calculations. The damage ratio is assumed to be one, the bounding respirable release fraction is 6E-04, and the bounding leak path factor is 1E-04. The bounding radiological consequences associated with this event are provided in Table 5-13a.

The MFFF utilizes many features to reduce the likelihood and consequences of this event as well as other load-handling events. Key features include loadpath restrictions, crane-operating procedures, maintenance procedures, operator training, qualified canisters, reliable load-handling equipment, and ventilation systems with multiple banks of HEPA filters.

The frequency associated with this event is estimated to be Unlikely or lower because multiple failures are required for this event to occur.

The bounding low consequence load handling event is a spill of the silver recovery tank. This event differs from the previous loss of confinement bounding low consequence event in the respect that this event is postulated to occur during maintenance operations in the process cell. During maintenance operations, the tank contains a minimal amount of MAR to minimize the potential exposure to operators. However, for conservative evaluation of the event, the tank is assumed to be full resulting in a total MAR of 2.2 lb (1.0 kg) of americium in solution form. The ARF is 2E-5, the RF is 1.0, and the DR is conservatively assumed to be 1.0. Although not required in order to satisfy the requirements of 10CFR70.61, an LPF 1E-4 is applied to this event because the event takes place in a process cell and the release of the radiological material would pass though multiple banks of credited HEPA filters. Consequences are presented in Table 5-13b.

F.6.4 Hypothetical Criticality Event

The MFFF processes are designed to preclude a criticality event through the use of reliable engineered features and administrative controls. Adherence to the double contingency principle, as specified in ANSI/ANS-8.1 (ANSI/ANS 1983b), is employed. Simultaneous failure of the criticality controls is Highly Unlikely.

Although criticality events at the MFFF are prevented, a generic hypothetical criticality event is evaluated. A bounding source term of 10^{19} fissions in solution is evaluated consistent with guidance provided in Regulatory Guide 3.71 (NRC 1998c). Airborne releases and direct radiation result from the criticality. The direct radiation contribution is negligible due to the shielding provided by the building and the distance to the site worker and the offsite public. Airborne releases are calculated consistent with the guidance of Regulatory Guide 3.35 (NRC 1979). The leak path factor for gases and particulates is 1.0 and 1E-04, respectively. The evaluation is based on 88 lb (40 kg) of unpolished plutonium, the maximum tank inventory of plutonium in solution. The radiological consequences associated with this event are shown in Table 5-13a. R2

F.6.5 Hypothetical Explosion Event

The MFFF processes are designed to preclude explosions through the use of reliable engineered features and administrative controls, the simultaneous failure of which is Highly Unlikely.

Although explosion events at the MFFF are Highly Unlikely, a generic hypothetical explosion event is evaluated. The evaluation conservatively assumes that an explosion occurs and involves the entire material at risk within a process cell. The maximum amount of plutonium in any process cell is approximately 132 lb (60 kg) of unpolished plutonium. Because the material at risk is in three separate tanks within this cell, only a fraction of this amount would be involved in the event. However, the evaluation conservatively uses the entire process cell inventory in the consequence calculation. The damage ratio is assumed to be one, the bounding respirable release fraction is 0.01, and the bounding leak path factor is 1E-04. The radiological consequences of this hypothetical event are presented in Table 5-13a. R1

F.6.6 Chemical Releases

Consequences of chemical releases were determined for a potential release of each chemical. For evaporative releases, the chemical consequence analysis modeling for public consequences used the ALOHA code (EPA 1999), the ARCON96 code (NRC 1997), and the MACCS2 code (NRC 1998a) to calculate the maximum airborne chemical concentration at the SRS boundary (5.0 miles from the MFFF). R1

An evaporation model extracted from the ALOHA code was used to calculate a release from a spilled or leaked chemical, which is assumed to form a puddle one-centimeter deep. A spill or leak from the largest tank or container holding the chemical was modeled. Consideration for spill size, location, container integrity, and chemical concentration was included in the evaluation. R2

Calculated concentrations were compared to Emergency Response Planning Guidelines (ERPGs) or to Temporary Emergency Exposure Limits (TEELs). TEELs describe temporary or equivalent exposure limits for chemicals for which official Emergency Response Planning Guidelines have not yet been developed. This method was adopted by DOE's Subcommittee on Consequence Assessment and Protective Action (SCAPA). The SCAPA-approved methodology published in the American Industrial Hygiene Association Journal was used to obtain hierarchy-derived TEELs (WSRC 1998). TEELs are provided for nearly 1,200 additional chemicals. TEELs are equal to the Acute Exposure Guideline Level and Emergency Response Planning Guidelines, where these values are available.

The definitions of TEEL levels consistent with 10 CFR §70.61 are as follows:

- TEEL-1 – The maximum concentration in air below which it is believed nearly all individuals could be exposed without experiencing other than mild transient adverse health effects or perceiving a clearly defined objectionable odor.
- TEEL-2 – The maximum concentration in air below which it is believed nearly all individuals could be exposed without experiencing or developing irreversible or other serious health effects or symptoms that could impair their abilities to take protective action.
- TEEL-3 – The maximum concentration in air below which it is believed nearly all individuals could be exposed without experiencing or developing life-threatening health effects.

Three severity consequence levels identified are Low, Intermediate, and High. The consequence severity level defined in Table F-4 is based on 10 CFR §70.61.

Based on the results of the chemical evaluation, DCS concludes that the chemical consequences at the site boundary and to the site worker are low. R1

Tables

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Table F-1. Isotopic Composition for Bounding Accidents

Isotope	Unpolished Pu Isotopic Fraction	Polished Pu Isotopic Fraction
Pu-236	0.00%	0.00%
Pu-238	0.04%	0.04%
Pu-239	92.02%	92.67%
Pu-240	6.14%	6.18%
Pu-241	1.00%	1.01%
Pu-242	0.10%	0.10%
Am-241	0.70%	0.00%

Table F-2. Consequence Severity Categories Based on 10 CFR §70.61

Consequence Category	Worker TEDE	Offsite Public TEDE/Uranium Intake	Environmental Release
3: High	> 1 Sv (> 100 rem)	> 0.25 Sv (> 25 rem) >30 mg soluble uranium intake	Not applicable
2: Intermediate	0.25 Sv to ≤ 1 Sv (25 rem to ≤ 100 rem)	0.05 Sv to ≤ 0.25 Sv (5 rem to ≤ 25 rem)	> 5,000 times the concentrations in Table 2, Attachment B of 10 CFR Part 20
1: Low	Events of lesser radiological exposures to workers than those above in this column	Events of lesser radiological exposures to the public than those above in this column	Radioactive releases producing effects less than those specified above in this column

TEDE – Total Effective Dose Equivalent

Table F-3. Event Risk Matrix

CONSEQUENCE	Highly Unlikely	Unlikely	Not Unlikely
High	3 acceptable risk	6 unacceptable risk	9 unacceptable risk
Intermediate	2 acceptable risk	4 acceptable risk	6 unacceptable risk
Low	1 acceptable risk	2 acceptable risk	3 acceptable risk
	LIKELIHOOD		

Table F-4. Consequence Severity Categories Based on TEEL

Consequence Category	Workers	Offsite Public
High	> TEEL-3	> TEEL-2
Intermediate	TEEL-2 < x < TEEL-3	TEEL-1< x < TEEL-2
Low	< TEEL-2	< TEEL-1

APPENDIX G.

ENVIRONMENTAL IMPACTS OF CONSTRUCTION AND OPERATION OF THE WASTE SOLIDIFICATION BUILDING

[NEW APPENDIX]

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The DOE has decided to construct the Waste Solidification Building (WSB) as part of the PDCF. This building will remove radioisotopes from the MFFF and PDCF liquid wastes and convert them into solid waste that will be disposed as transuranic waste or low-level radioactive waste. Because the environmental impacts of constructing and operating the WSB were not explicitly evaluated as part of the SPD EIS, and the WSB is a connected action, the impacts are included in those evaluated for the MFFF in this ER. The environmental impacts of constructing and operating the WSB are less than the projected impacts from the construction and operation of the Plutonium Immobilization Plant evaluated in the SPD EIS but subsequently cancelled.

The WSB design is at the conceptual design stage. Information and impact projections presented in this appendix are bounding projections.

G.1 DESCRIPTION OF THE WASTE SOLIDIFICATION BUILDING

G.1.1 Building Description

The 75,000 ft^2 WSB, which is not part of the NRC licensed MFFF, will be constructed by the DOE on the PDCF site south of the PDCF to process the following liquid waste streams from the PDCF and the MFFF:

MFFF High Alpha Stream

MFFF Stripped Uranium Stream

PDCF Laboratory Liquid Stream

PDCF Laboratory Concentrated Liquid Stream

The building will be a combination of concrete and soft structure. Concrete will be utilized to provide confinement of the high alpha exposure field caused by the MFFF high alpha stream. A concrete-cell configuration will be utilized as this stream is processed through the building. Process enclosures adjacent to the cells will provide worker protection to accommodate operations and maintenance activities. The shielding and confinement will also serve as fire isolation barriers. The soft-shell construction composed of a steel siding on structural steel members will house the low activity process, cold chemical feeds, storage, shipping areas and balance of plant services. Secondary confinement features such as dikes, sumps and leak detection will be provided for those areas with liquid waste spill potential. The major pieces of process equipment are tanks, evaporators, and cementation equipment.

The building will contain no more than 11,000 gallons of high alpha waste stream (including transfer pipeline flush water) and 21,000 gallons (including transfer pipeline flush water) of low activity waste. Materials in drum storage will be in cement form and are not considered to be at risk because the cement matrix immobilizes the radionuclides. Cold chemical processing rooms, drum storage, and truck loading/unloading will be performed in non-hardened structures. The drum storage area will be at grade.

The waste receipt area has tanks to separately receive high alpha waste, stripped uranium waste, and the PDCF laboratory liquid stream waste. The tank volumes are sufficient to receive and store waste from six weeks of processing by the MFFF and eight weeks by PDCF.

The PDCF and MFFF will each transfer a transuranic (TRU) waste and a low-level radioactive waste (LLW) stream to the WSB. Within the WSB, these TRU and LLW streams will be treated separately. The WSB will produce a TRU and a LLW solid waste form acceptable for shipment and disposal at their respective locations. The TRU waste form will be sent to WIPP. The LLW form will be sent to E-Area (SRS) or to another permitted disposal site.

Within the WSB, the waste streams are collected into receipt tanks, chemically adjusted, evaporated, neutralized, combined with cement into drums, stored and shipped. The MFFF high alpha stream receipt tanks and process rooms will be located inside a hardened (reinforced concrete) structure. The other streams will be included in a standard metal constructed building. The process areas will be exhausted through a HEPA filtration confinement system prior to release through a stack. The building will be divided into individual fire zones to reduce potential doses to the on-site receptor.

G.1.2 Waste Processing

The WSB will receive waste from the MFFF and PDCF. Table G-1 provides a characterization of these waste streams. As noted in Chapter 3, Table 3-3, three of the MFFF liquid waste streams (liquid americium, excess acid, and solvent regeneration alkaline wash) are combined into the high alpha waste. The stripped uranium waste stream is transferred as a separate waste to the WSB. The two wastes are batch transferred through separate double-walled stainless steel pipes to the WSB. PDCF Laboratory Liquid Stream (Table G-1) is also transferred through double-walled stainless steel pipes to the WSB. Following each transfer, provisions exist to rinse the pipeline, if necessary. The pipes are maintained in a drained state between waste transfers. PDCF Laboratory Concentrated Liquid Stream is transported in containers to the WSB.

Evaporation with cementation will be used to process PDCF Laboratory Liquid Stream, MFFF High Alpha Stream, and MFFF Stripped Uranium Stream. Evaporation will be used to reduce the "water" content of the streams to that needed for efficient cement mixing. Excess water will be recycled where practical or transferred to the existing SRS Effluent Treatment Facility (ETF) and processed to allow release to the environment.

The PDCF Lab Concentrated Waste is processed separately through neutralization and absorption in a solidification additive for eventual disposal to WIPP.

Chemicals used in the treatment process are listed in Table G-2.

G.1.2.1 PDCF Laboratory Liquid Stream Receipts

The PDCF Laboratory Liquids Stream is 0.5 Molar (average) acidic with large quantities of nitrates salts but very little radionuclides. This stream will be pumped approximately 800 ft (243.8 m) to the WSB from PDCF in a welded-jacketed stainless steel pipe, which will be direct buried. The volume of this waste stream is anticipated to be a nominal 11,000 gallons per year, and will be received in approximately 12 transfers (900 gallons each) at a frequency of about one transfer every month. Each transfer may be accompanied by a two line volume flush which is estimated to be 300 gallons total of water provided by PDCF.

The line flush technique for PDCF waste will be to pump one line volume of flush water (estimated to be 150 gallons) to the WSB tanks. The residual line volume will then be drained back to a PDCF flush water collection tank for use in the next flush.

The WSB receipt tanks will be sized to hold two transfers (eight weeks of PDCF Laboratory Liquid Stream capacity) in two 1,500 gallons tanks. The PDCF tanks are similarly sized, providing a total system storage of eight to 16 weeks of PDCF processing capacity in the event of a shutdown of WSB operations for maintenance or processing anomalies. The WSB tanks will be agitated to mix the waste and flush water.

G.1.2.2 MFFF Stripped Uranium Stream Receipts

The MFFF Stripped Uranium Stream will be nominally 0.1 Molar acidic with large quantities of Uranium (<1% ^{235}U). This stream will be pumped approximately 2,000 ft (609.6 m) from the MFFF to the WSB in a double-walled stainless steel pipe. The nominal waste volume of this stream will be 42,530 gallons per year, received in approximately 42 transfers at a frequency of about one every week. Each transfer will be accompanied by a two line volume flush, which is estimated to be 700 gallons total of distillate wash liquid provided by MFFF. The first flush volume will go into the WSB stripped uranium stream receipt tanks. The second flush volume will drain back into the MFFF stripped uranium stream collection tank.

The WSB receipt tanks will be sized to hold six transfers (six weeks of MFFF capacity). The MFFF tanks are sized to hold three months of MFFF waste. The WSB tanks will be agitated to mix the waste and flush.

G.1.2.3 Processing Of PDCF Lab Liquids and MFFF Stripped Uranium

Both streams are anticipated to be LLW and to be RCRA corrosive wastes (pH will be less than 2). Due to extremely low fissile material content, criticality is not a credible event. In addition, these streams are compatible for mixing. The WSB will be able to process these streams in any combination necessary. Sampling will be done to support downstream processing.

G.1.2.3.1 Evaporator

The low activity waste (LAW) evaporator will be designed to operate at approximately 100°C and may be electrically or steam heated. External coils may be used to provide isolation from the waste and to lengthen the evaporator life. The bottoms size of the evaporator will be approximately 500 gallons with a continuous feed from the head tank during steady state operation. Bottoms will be pumped to the LAW bottoms collection tank, cooled and sampled before being pumped to the neutralization tank. If the sample results are unacceptable, the bottoms may be pumped back to the LAW head tank for reprocessing. Overheads will be condensed and collected in the effluent head tank and pumped to the effluent polishing evaporator for a second evaporator cleanup if needed or, in the case of a batch of high activity overheads, a third evaporator pass.

G.1.2.3.2 Neutralization

The acidic bottoms from evaporation must be pH adjusted in order to be compatible with the cementation process. Sodium hydroxide (50%) was selected to mix in the neutralization tank to achieve a free hydroxide normality of approximately 1.2, with pH 12-14. Chemical reaction heat will require dissipation via cooling coils and a cooling tower. Any overflows will be contained. Rinse water will be provided.

G.1.2.3.3 Cement Process

Neutralized waste will be pumped to a cement mixer. A metering pump will inject controlled amounts of the waste stream from the neutralization tank to a twin-screw cement mixer to be continuously mixed with supplied dry cement powder. Forty gallons of the mix is caught in a 55-gallon steel drum. A splash collar will be utilized to minimize the spread of contamination. This sequence will be repeated until the LAW neutralization tank is emptied. The conveyor supplying drums will be loaded and will accommodate approximately one week's production of drums.

In-drum automated mixing is considered a viable alternative to the twin screw mixer. A metering pump would be used to provide a precise amount of neutralized waste deposited directly into the 55-gallon (40-gallon final volume cement waste form) container. A lid with paddle blade agitator would be lowered into place, dry cement powder would be added and the cement would be thoroughly mixed in the lined drum. The motor head would be de-coupled from the paddle blade shaft and withdrawn. The paddle blade assembly would remain in the drum. The drum would be conveyed down the line, the next drum moved to the fill position, and the process repeated until the LAW Neutralization Tank is emptied.

Dust control measures and collection will be provided for the dry cement powder. The output air stream will be pre-filtered before being introduced to the main exhaust ventilation system, preventing cement blinding of the building HEPA system. In addition, this air is pulled from around the mixer and at the dry cement addition zone, and is anticipated to contain radionuclides.

G.1.2.3.4 Overheads Processing to ETF

Overheads from the high activity waste (HAW) Condensate Hold Tank will be batch fed into the LAW head tank (separately from MFFF / PDCF LAW waste streams) for feed to the LAW Evaporator. Overheads from the LAW evaporator will be processed through the Effluent Polishing Evaporator to meet the SRS ETF Waste Acceptance Criteria (WAC) limits. This stream will be condensed, collected, sampled, and neutralized in the Effluent Holding Tank before being pumped to an existing F-Area process sewer connected to the ETF facility. This condensate can also be pumped to either the HAW Head Tank or LAW Head Tank and used for dilution purposes. Bottoms from this evaporation step will be transferred to the LAW Bottoms Collection Tank where it will mix with the bottoms evolved from LAW evaporator operations.

The Effluent Polishing Evaporator is similar to the other evaporators used in the WSB. Overheads are condensed to the Effluent Holding Tank. They are sampled and are either acceptable and pumped to ETF, rejected and adjusted to be sent to ETF, or used as dilution water in the HAW Head Tank. Adjustment would consist of the addition and mixing of small amounts of caustic to meet the pH requirements of ETF.

G.1.2.4 PDCF Lab Concentrates Processing

PDCF is anticipated to transport less than 200 one-liter containers of Laboratory Concentrated Waste to the WSB for processing each year. Each container will hold between 10 and 37 gram equivalent Pu. The average expected receipt rate is approximately 96 containers per year at 13 grams Pu equivalent in a 1.9-molar nitric acid solution. Processing only one liter-container of waste at a time, which reflects similar processes currently in use at SRS for materials of this type, precludes criticality events.

The WSB will accept/store up to 10 containers maximum in a rack storage. This rack and the solidification process will be housed in a glovebox. One container at a time will be processed by pouring its contents into a 5-liter bottle containing approximately two liters of dry soda ash for neutralization, and set aside to offgas. Up to three liters of a solidification additive will be added to absorb the neutralized material, ensuring no free liquids. The 5-liter container will be closed, bagged out of the glovebox, packaged into a "paint" can (with a second 5-liter bagged bottle), the "paint" can inserted into a WIPP "Pipe-N-Go" and over-packed into a 55-gallon drum for shipment in a TRUPACT II. As an alternative, solidification could also be accomplished by directly placing neutralized material in a 55-gallon drum with concrete.

G.1.2.5 MFFF High Alpha Stream

G.1.2.5.1 Receipts

The MFFF high alpha stream will be pumped approximately 2,000 ft (609.6 m) from MFFF to the WSB in a double-walled stainless steel pipe. The waste stream can vary within given ranges. The nominal volume received is anticipated to be approximately 22,000 gallons per year of this combined stream, which will be received in approximately 25 transfers, at a frequency of about once every two weeks. Each transfer will be accompanied by a two line volume flush, estimated to be approximately 700 gallons of distillate wash liquid provided by MFFF.

The line flush technique for MFFF high alpha waste will pump a line volume of flush (estimated to be 350 gallons in the 2,000-ft (609.6-m) run to WSB) to the WSB tanks. The second line volume will then be drained back to MFFF waste tanks.

The WSB receipt tanks will be sized to hold three transfers (six weeks capacity in two 3,000-gallon tanks). The MFFF high alpha stream collection tanks are sized for three months capacity. This arrangement will provide continued MFFF processing capacity in the event of a shutdown of WSB operations due to maintenance or other disruptions. The tanks are agitated to mix the waste and flush.

These receipt tanks will generate a radiation field and will be contained in concrete walled cells. Sampling capability, pumps, and valves will be located in gloveboxes in order to minimize the potential for contamination, to provide shielding during operations and maintenance, and to facilitate disposal. The waste stream is anticipated to include a silver constituent and to exceed the RCRA threshold for corrosivity (pH < 2), necessitating leak detection and confinement. Sump liquids will be directed to overflow tanks.

Hydrogen gas generated by the radiolysis of water in this waste stream will be vented and purged by a vessel vent system in order to prevent hydrogen from reaching the lower flammability limit.

G.1.2.5.2 Evaporator

The HAW evaporator will be designed to operate at approximately 100°C and may be electrically or steam heated. External coils may be used to provide isolation from the waste and to lengthen the evaporator life. Bottoms will be pumped to the bottoms collection tank (approximately 50 gallon bottoms), where it will be cooled and sampled before being pumped to the HAW neutralization tank. If the sample results are unacceptable, the bottoms will be pumped back to the HAW head tank for reprocessing. Overheads will be condensed and collected in the HAW condensate hold tank, sampled, and if the results are acceptable, pumped to the LAW head tank for a second evaporator cleanup. If the sample results are not acceptable, the overheads will be pumped back to the HAW head tank for reprocessing.

The HAW evaporator will be able to be bypassed, and the HAW head tank directed to the HAW bottoms collection tank. While not as efficient, this arrangement will allow continued processing if necessary during an evaporator outage, with alternate processing directly to the cement process. In this case, the amount of dilution water used in the process would be adjusted, in order to reduce the total amount of cement produced while keeping the americium loading at an acceptable level for shipment to WIPP. In using the bypass mode approximately 120 additional drums of TRU waste may be added to the annual waste values discussed in Section G.3.6.

G.1.2.5.3 Neutralization

The acidic bottoms from evaporation must be pH adjusted in order to be compatible with the cementation process. Sodium hydroxide (50%) was selected to mix in the neutralization tank to achieve a free hydroxide Normality of approximately 1.2, with pH 12-14. Chemical reaction heat will require dissipation via cooling coils and a cooling tower. Caustic solution will be batch fed into a Cold Chemical addition tank before being gravity fed to the HAW Neutralization Tank. This approach will prevent over-addition of caustic and will aid in controlling the rate of reaction. Any overflows will be directed to an overflow tank in order to contain the americium. Rinse water is connected to the HAW Neutralization Tank in order to provide the capability to remove buildup in the tank bottom. This tank is sampled to ensure that the input to the cement process is within anticipated parameters.

G.1.2.5.4 Cement Process

Neutralized high alpha waste will be pumped to two 30-gallon cement head tanks. One tank will receive material while the other tank is being pumped to the cement mixer. A metering pump will inject controlled amounts of the waste stream from the 30-gallon head tank to a twin-screw cement mixer to be continuously mixed with supplied dry cement powder. The mix is caught in a twenty-gallon cement waste container, which will then be deposited into a 55-gallon steel drum. A splash collar will be utilized to minimize the spread of contamination. This sequence will be repeated until the high activity waste Neutralization Tank is emptied. The conveyor supplying drums will be loaded and will accommodate approximately one week's production of drums.

In-drum automated mixing is considered a viable alternative to the twin screw mixer. A metering pump would be used to provide a precise amount of neutralized waste from the 30-gallon tanks. In this case, the waste would be deposited directly into the 20-gallon cement waste-form container. A lid with paddle blade agitator would be lowered automatically in place, dry cement powder would be added, and the cement would be thoroughly mixed in the drum. The motor head would be de-coupled from the paddle blade shaft and withdrawn. The paddle blade assembly would remain in the drum. The drum would be conveyed down the line, the next drum moved to the fill position, and the process repeated until the high activity Neutralization Tank is emptied.

The high activity waste cementation process area is anticipated to have a high background radiation level. Equipment requiring regular operator access will be shielded. Remotely operated drum handling (conveyor), instrumentation, pumps, and valves will also be required to limit exposure. Some components will be located in gloveboxes to prevent the spread of contamination, to provide shielding for operations and maintenance, and to facilitate maintenance and disposal. Dikes or other methods of leak detection and confinement prevent this silver containing waste from entering building drains and the NPDES permitted treatment system.

G.2 EFFECTS OF FACILITY CONSTRUCTION

The WSB will be located on the south end of the PDCF site (Figure G-1). The ecological description of this land is provided in the SPD EIS and is similar to the terrestrial ecology of the MFFF site described in Chapter 4.

G.2.1 Impacts to Air Quality

Potential impacts to local air quality during construction of the WSB are anticipated to be bounded by the impacts presented in Section G.4.2.3.1 of the SPD EIS (DOE 1999c) for the immobilization plant. These impacts are summarized in Table G-3 of this ER.

G.2.2 Impacts to Water Quality

G.2.2.1 Water Use

All water (25 million gallons per year) for construction activities will be provided from existing SRS utilities. Local surface water would not be used in the construction of proposed facilities at SRS. Thus, there would be no impact on the local surface water availability to downstream users.

G.2.2.2 Surface Water Quality

Sanitary waste will be collected using portable toilets or processed through the SRS Central Sanitary Wastewater Treatment Facility. Because this sanitary wastewater is a small fraction of the SRS Central Sanitary Wastewater Treatment Facility capacity, no impacts on surface water quality would be expected from the discharge of these flows to the treatment system and, subsequently, to the receiving stream.

Proven construction techniques will be used to mitigate the impact of soil erosion on receiving streams. The WSB construction stormwater pollution prevention plan will be consistent with the existing SRS stormwater and erosion management practices. Because of the effectiveness of these techniques, no long-term impacts from soil erosion due to construction activities would be expected.

To comply with *South Carolina State Standards for Stormwater Management and Sediment Reduction* (SCDHEC 2000b), detention ponds designed to control the release of the stormwater runoff at a rate equal to or less than that of the pre-development stage will be built at strategic locations as part of SRS infrastructure development.

G.2.2.3 Groundwater Quality

The estimated water usage for constructing the WSB site is estimated to be 25 million gal/yr (95 million L/yr). Current water usage in F Area is 98.8 million gal/yr (374 million L/yr) (DOE 1999c). The total construction requirement represents approximately 1.6% of the A-Area loop groundwater capacity, which includes F Area, of about 1.58 billion gal/yr (6.0 billion L/yr) (Tansky 2002). WSB groundwater withdrawals are not anticipated to have any impact on SRS or local groundwater supplies.

G.2.3 Impacts to Terrestrial Ecology

G.2.3.1 Land Use

The WSB will be constructed on the PDCF site. Construction of the WSB will require approximately 5 acres (2 ha) of land. Construction on the site is consistent with other SRS uses and with the industrial land use activity in the surrounding area. It is also consistent with the

SRS Land Use Technical Committee's *Draft SRS Long Range Comprehensive Plan* (DOE 2000a) for land use in the area.

Part of the land within F Area has been previously disturbed and is partially developed. The area where the WSB will be located is mostly grass and pine plantation. This area was already designated to be cleared for the PDCF construction. Some changes in topography have already taken place.

G.2.3.2 Non-Sensitive Habitat

There should be no direct impacts on non-sensitive aquatic habitats because best-management practices for soil erosion and sediment control will be used to prevent construction runoff to these habitats, and direct construction disturbance would be avoided. Any scrub vegetation located on the site will be removed. The associated animal populations would be affected. Some of the less-mobile or established animals within the construction zone could perish during land-clearing activities and from increased vehicular traffic. Furthermore, activities and noise associated with construction could cause larger mammals and birds to relocate to similar habitat in the area. Also, 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. The recent survey of the site (DOA 2000) did not reveal any migratory bird nests. There would be no impacts on aquatic habitat from surface water consumption because water required for construction will be drawn from groundwater by the SRS utilities.

G.2.3.3 Sensitive Habitat

Wetlands associated with floodplains, streams, and impoundments will not be directly impacted by construction activities. No runoff or sediments are expected to be deposited in these areas because appropriate erosion and sedimentation controls will be used during construction.

No critical habitat for any threatened or endangered species exists on SRS. However, as discussed in Section 4.6.2.1, the bald eagle, red-cockaded woodpecker, wood stork, American alligator, smooth purple coneflower, and Oconee azalea might occur near F Area. Surveys conducted in 1998 and 2000 for the proposed WSB did not find any federally listed threatened, endangered, proposed, or sensitive plant or animal species (DOA 2000). Consultations were initiated by DOE with the U.S. Fish and Wildlife Service (USFWS) and the South Carolina Department of Natural Resources (SCDNR) to request comments on potential impacts on animal and plant species and to request any additional sensitive species information. The USFWS field office in Charleston, South Carolina, provided a written response indicating that the proposed facilities at SRS do not appear to present a substantial risk to federally listed species or other species of concern.

G.2.3.4 Noise

Construction impacts on local noise levels were evaluated in Section 4.4.1.1 of the SPD EIS (DOE 1999c).

The location of the WSB relative to the site boundary and sensitive receptors was examined to evaluate the potential for onsite and offsite noise impacts. Noise sources during construction would include heavy construction equipment, employee vehicles, and truck traffic. Traffic noise associated with the construction of the WSB would occur on the site and along offsite local and regional transportation routes used to bring construction materials and workers to the site.

Given the distance to the SRS site boundary (about 5 mi [8 km]), noise emissions from construction equipment would not be expected to annoy the public. These noise sources would be far enough away from offsite areas that the contribution to offsite noise levels would be small. Some noise sources could have onsite impacts, such as the disturbance of wildlife. However, noise would be unlikely to affect federally-listed threatened or endangered species or their critical habitats because none are known to occur in F Area (see ER Section 4.6.2.2). Noise from traffic associated with the construction of the WSB would likely produce less than a 1-dB increase in traffic noise levels along roads used to access the site, and thus would not result in any increased annoyance of the public.

Construction workers could be exposed to noise levels higher than the acceptable limits specified by the Occupational Safety and Health Administration (OSHA) in its noise regulations (29 CFR §1926.52). However, DOE has implemented appropriate hearing protection programs to minimize noise impacts on workers. These programs include the use of standard silencing packages on construction equipment, administrative controls, engineering controls, and personal hearing protection equipment.

G.2.4 Impacts to SRS Infrastructure

The WSB will use the same roads and utility headers as the MFFF and PDCF. Less than one acre of land will be used for new roads within the WSB boundary, beyond those described for the MFFF in ER Section 5.1.11. Construction would require only a fraction of the available resources and thus would not jeopardize the resources required to operate the site. Total construction requirements for diesel fuel might be higher than currently available storage, but the majority of fuel usage would be connected to construction vehicle usage. Therefore, storage would not be limiting. Table G-4 reflects estimates of the additional infrastructure requirements for construction of the proposed facilities. Site resource availability is also presented.

G.2.5 Impacts from Construction Waste

Construction wastes for the WSB are expected to be bounded by the values projected in the SPD EIS for the immobilization plant. Table G-5 compares these waste values to the existing treatment, storage, and disposal capacity for the various waste types. It is anticipated that no

TRU waste, LLW, or mixed LLW would be generated during the construction period. In addition, no soil contaminated with hazardous or radioactive constituents should be generated during construction. However, if any were generated, the waste would be managed in accordance with site practice and applicable federal and state regulations.

Hazardous wastes generated during construction would be typical of those generated during the construction of an industrial facility. Any hazardous wastes generated during construction would be packaged in DOT-approved containers and shipped offsite to permitted commercial recycling, treatment, and disposal facilities.

G.2.6 Impacts to Historic, Scenic, and Cultural Resources

The area that will be used for the WSB is part of the area designated for the PDCF. Historic, scenic and cultural resource investigations were performed in this area for the SPD EIS. WSB construction will not affect pre-historic or historic resources, including those associated with the Cold War Era, nor will construction affect resources of value to Native Americans. Preliminary consultations with appropriate American Indian Tribal Governments and the State Historic Preservation Office have been performed by DOE. Consultations with Native American groups indicate that it is unlikely that significant Native American resources will be impacted.

Inadvertent 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.

The WSB will have a minimal effect on the scenic character of the surrounding area and is consistent with the VRM Class IV designation for the area. The buildings are low-rise structures of varying heights less than 100 ft (30 m). This height is consistent with, and does not exceed, the other building heights in the area, which range from 10 to 100 ft (3 to 30 m). The distance from sensitive receptors and screening by trees will minimize its impact as a visual intrusion to the scenic character of the area.

G.2.7 Socioeconomic Impacts

Construction of the WSB at SRS would have some beneficial socioeconomic impacts on the region. Construction will employ 1,000 workers. The impacts on the local economy are anticipated to be similar to those for the MFFF discussed in Section 5.1.8.

G.2.8 Environmental Justice Impacts

The WSB is located within SRS and is over 5 mi (8 km) from the nearest minority or low-income community. Impacts from construction activities that could affect public health, such as the generation of noise and dust, will be limited to the construction site area. As presented in Section 4.4.1.6 of the SPD EIS (DOE 1999c), there are no anticipated environmental justice issues associated with construction of the WSB at SRS. Construction would pose no significant health risks to the public regardless of racial or ethnic composition, or economic status.

G.3 EFFECTS OF FACILITY OPERATION

G.3.1 Impacts to Air Quality

There are four sources of non-radioactive air emissions from the WSB operations:

- NO_X emissions from the WSB stack derived from acidic waste evaporation
- Criteria pollutant emissions from routine testing of the diesel generator
- Fugitive emissions from chemical and fuel storage tanks
- Emissions from employee and site vehicles.

Maximum air pollutant concentrations resulting from operation of the WSB are anticipated to be bounded by the concentrations projected for the immobilization plant in the SPD EIS, with the exception of NO_X. Depending upon the final design, the new WSB could generate a maximum of 14,000 lbs[1] of NO_X annually. While this is more NO_X than considered for the PIP, the WSB offgas system design will include NO_X emission control equipment as needed to cost effectively control the WSB emissions so that SRS site boundary NO_X concentrations due to the WSB are less than 10% of the most stringent standard or guideline for total SRS site emissions. Projected impacts to ambient air quality concentrations are summarized in Table G-6.

The potential airborne chemical emissions from waste processing are comprised of aluminum nitrate, nitric acid, and sodium hydroxide. A chemical consequences analysis was performed and determined that the airborne releases from the WSB at both 328 ft (100 m) from the WSB and at the SRS site boundary are well below the Temporary Emergency Exposure Limits (TEELs) for each chemical. Therefore, the impact on air quality from process chemicals is low.

G.3.2 Impacts to Water Quality

G.3.2.1 Water Use

The annual domestic and process water uses for the WSB are bounded by the water use of 29 million gallons (110 million liters) projected for the immobilization facility in the SPD EIS.

[1] Assumes complete evaporation of all waste streams and no offgas treatment to reduce NOx.

G.3.2.2 Surface Water Quality

The WSB does not discharge any process liquid directly to the environment. The WSB design will include discharges of water (HVAC condensate, storm water, etc.) to an NPDES outfall. All liquid discharges to NPDES outfalls will meet state and federal regulations. All liquid wastes are transferred to SRS waste management facilities for treatment and ultimate disposal. Liquid LLW generated by the treatment of MFFF and PDCF wastes in the WSB will be transferred to the SRS ETF for treatment and disposal. The WSB will generate a maximum of 235,000 gallons (890 m^3) of liquid LLW annually from the processing of the MFFF and PDCF waste streams. The ETF discharges treated wastewater to Upper Three Run. The LLW volume represents less than 0.001% of the 7-day, 10-year low flow of Upper Three Run.

G.3.2.3 Groundwater Quality

The WSB does not employ settling or holding basins as part of the waste treatment system. There will be no direct discharge of wastewater to the groundwater. Therefore, no impacts on groundwater quality are expected.

G.3.3 Impacts to Terrestrial Ecology

G.3.3.1 Land Use

Operation of the WSB is not projected to have any impact on land use other than the continued removal of the 5-acre (2-ha) site from other uses. The operation of the WSB should not impact site geology.

G.3.3.2 Non-Sensitive Habitat

Noise disturbance will probably be the most significant impact of routine operation of the WSB on local wildlife populations. Disturbed individual members of local populations could migrate to adjacent areas of similar habitat. However, impacts associated with airborne releases of criteria pollutants, hazardous and toxic air pollutants, and radionuclides would be unlikely because scrubbers and filters will be used. Impacts on aquatic habitats should be limited because all liquid will be transferred to SRS for disposal in accordance with approved permits and procedures.

G.3.3.3 Sensitive Habitat

Operational impacts on wetlands or other sensitive habitats would be unlikely because airborne and aqueous effluents would be controlled through state permits.

It is also unlikely that any federally listed threatened or endangered species would be affected, although South Carolina state-classified special-status species (American alligator) could be affected by noise or human activity during operations.

G.3.3.4 Noise

The location of the WSB relative to the SRS site boundary and sensitive receptors was examined to evaluate the potential for onsite and offsite noise impacts. Noise sources during operations would include new or existing sources (e.g., cooling systems, vents, motors, material-handling equipment, emergency and standby diesel generators), employee vehicles, and truck traffic. Given the distance to the site boundary (about 5.4 mi [8.7 km]), noise emissions from equipment would not be expected to annoy the public.

G.3.4 Impacts from Ionizing Radiation

All potential sources of radioactivity associated with the WSB were evaluated for potential releases during normal operations. This includes both the vapors from the waste receipt tanks exhausted through the stack (after HEPA filtration) and the liquid effluent pumped to the SRS ETF for further site processing.

G.3.4.1 Radiation Doses to the Public

The total radioactivity in the waste streams processed by the WSB on an annual basis is estimated to be approximately 85,000 Curies, of which 99.7% is a result of the Am-241 in the High Alpha Waste Stream from the MFFF. Radioactive releases from the WSB are dominated by Am-241 entrained in vapors which may escape from the High Alpha Waste Receipt Tanks. The plutonium isotopes do not significantly contribute to the dose. The emission is projected to result in a dose to the general public at the SRS site boundary of less than 5E-08 Rem/yr which is below the 10 CFR 835 regulated limit.

A series of evaporation steps will be used to reduce the waste volume for the LLW and TRU waste that will be mixed with cement to form an acceptable solid waste form. Each evaporator reduces the radionuclide concentration in the output liquid waste stream by a conservative factor of at least 1000 (NUREG-0017, *Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Pressurized Water Reactors*, US NRC, April 1976). Consequently, the maximum amount of activity in the effluent waste stream to be sent to the SRS ETF for further processing prior to release to the environment is 8.42 E-05 Curies. This source of radioactivity would have negligible impact on receptor doses. In addition, the waste streams are further treated by the onsite ETF prior to release to the environment.

The dose to the public from operations of the WSB (5E-05 mrem/yr) is bounded by the conservative estimate of public dose for the MFFF (1.5E-03 mrem/yr).

G.3.4.2 Radiation Doses to Site Workers

The dose to the site workers from operations of the WSB are bounded by the conservative estimates and ranges calculated for the MFFF (see Section 5.2.10.2).

G.3.4.3 Radiation Doses to Facility Workers

The annual dose to facility workers in the WSB is estimated to be below 200 person-rem/yr. The maximum dose to the worker from normal operations will below the DOE Administrative Control Level of 2,000 mrem/year. The average annual dose will be below the current SRS guideline of 500 mrem/year.

G.3.5 Impacts to SRS Infrastructure

The WSB is anticipated to use less than 30,000 MWh /yr.

As noted in Section G.3.2.1, the annual domestic and process water uses for the WSB are bounded by the water use of 29 million gallons (110 million liters) projected for the immobilization facility in the SPD EIS. This represents a groundwater withdrawal rate of 55 gal/min (208 L/min). The domestic water capacity from deep wells supplying the A area loop, which includes F Area, is 3,000 gpm and that the average domestic water consumption from the A area domestic water loop in 2000 was 754 gpm (about 1,200 gpm peak). F area process water system capacity is 2,100 gpm with an average demand of 350 gpm (800 gpm peak). WSB groundwater withdrawals are not anticipated to have any impact on SRS or local groundwater supplies.

G.3.6 Impacts to SRS Waste Management

As discussed in Section G.1.2.5.4, after evaporation, the high alpha waste bottoms will contain essentially all of the salts, silver, etc. in the MFFF high alpha waste stream. This will be metered into the cement process. The 20-gallon final package sent to WIPP will have approximately 20 grams Am-241 per drum, and the remaining waste constituents as received from the MFFF. The WSB will produce 405 yd^3 (310 m^3)[2] of TRU waste annually. The forecast in DOE (1995b) for SRS TRU waste generation over the next 30 years ranges from a minimum estimate of 7,578 yd^3 (5,794 m^3) to 710,648 yd^3 (543,361 m^3), with an expected forecast of 16,433 yd^3 (12,564 m^3) (DOE 1995b, Table A-1). The estimated lifetime WSB contribution (4,050 yd^3 or 3,100 m^3) to SRS TRU solid waste quantity is a 25% increase over the expected volume but only a small fraction (< 1%) of the maximum SRS estimate. The environmental impacts of adding this waste to the SRS inventory are bounded by the environmental impacts projected in the *Savannah River Site Waste Management Final Environmental Impact Statement* (DOE 1995b).

The environmental impacts resulting from the disposal of TRU waste at the Waste Isolation Pilot Plant (WIPP) are discussed in *Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement* (DOE 1997e). The impacts projected in DOE 1997e (Table 2-2 in DOE 1997e) were based on disposal of 170,000 m^3 TRU waste. The additional 3,100 m^3 TRU waste from the WSB represents an increase of < 2% in the projected waste disposed. Any

[2] These volumes are based on no reduction from evaporation. Use of evaporation would reduce these volumes to 125 yd^3 (100 m^3)

increase in impacts resulting from disposing WSB solid TRU waste at WIPP should be within the error associated with any projected impacts of WIPP operation. Furthermore, the *Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement* projected that, "No LCFs would be expected in the population around WIPP from radiation exposure (3 E-4 LCFs). … no cancer incidence (2 x 10^{-5} cancers) would be expected in the population from hazardous chemical exposure." (DOE 1997e, pg 5-29) The addition of 3,100 m^3 TRU waste from the WSB would not be expected to change this conclusion.

The WSB will generate a maximum of 235,000 gallons (890 m^3) of liquid LLW annually from the processing of the MFFF and PDCF high radioactivity waste streams. This waste will be transferred to the ETF. This volume will be less than 0.1% of the 1,930,000 m^3/yr capacity of the ETF.

Assuming that solidification of stripped uranium waste does not result in any volume reduction, the WSB will produce a maximum of 228 yd^3 (175 m^3) of solid LLW per year. The forecast for SRS LLW generation over the next 30 years ranges from a minimum estimate of 480,310 yd^3 (367,000 m^3) to 1,837,068 yd^3 (1,400,000 m^3), with an expected forecast of 620,533 yd^3 (475,000 m^3) (DOE 1995b, Table A-1).). The estimated lifetime WSB contribution to SRS solid LLW waste quantity is only a small fraction (<1%) of the expected SRS estimate. The environmental impacts of adding this waste to the SRS inventory are bounded by the environmental impacts projected in the *Savannah River Site Waste Management Final Environmental Impact Statement* (DOE 1995b).

The building job control waste will be in compliance with WSRC Manual 1S, *SRS Waste Acceptance Criteria Manual* (2002). All streams will be managed in accordance with applicable laws and regulations (e.g., RCRA).

G.3.7 Impacts to Historic, Scenic, and Cultural Resources

Operation of the WSB will not impact any historic, scenic or cultural resources.

G.3.8 Socioeconomic Impacts

Less than 100 new permanent jobs will be created in 2006 for WSB operation. To fill these jobs, some employees may be hired from other regions of the state or country. Over 400,000 people resided within the five-county region of influence (ROI) in 1990. Assuming that any WSB employees and their families that may move into the area as a direct result of WSB employment choose to live in one of the five ROI counties, their numbers would represent less than 1% of the total 1990 ROI population. Given the size of the population of the region, and the rate of growth it is already experiencing, no significant socioeconomic impacts are anticipated.

G.3.9 Environmental Justice Impacts

Nuclear Materials Safety and Safeguards policy and procedures[3] specify that a 4-mi (6.4-km) radius should be used as the area of consideration in rural areas or areas that are outside of city limits. The WSB is located on SRS. There is no resident population within a 5-mi (8-km) radius of the WSB site, and the nearest minority or low-income community is over 5 mi (8 km) away. As noted in Section 4.9 and shown on Figures 4-15 and 4-16, a disproportionate minority or low-income population does not exist even within a 10-mi (16-km) radius of the WSB site. As a result, WSB operation will pose no significant health risks to the public regardless of the racial or ethnic composition or economic status.

G.3.10 DECOMMISSIONING

G.3.10.1 Introduction

After all of the MFFF and PDCF waste is processed, NNSA will determine the future use of the WSB, including any decision to decommission or reutilize the facility. If NNSA should decide to decommission the WSB, the ultimate goal of decommissioning is unrestricted release or restricted use of the site.[4] In decommissioning, the facility is taken to its ultimate end state through decontamination and/or dismantlement to demolition or entombment. Four guidance documents have been developed to support the disposition of contaminated, excess facilities:

- DOE G 430.1-2, Implementation Guide For Surveillance and Maintenance During Facility Transition And Disposition
- DOE G 430.1-3, Deactivation Implementation Guide
- DOE G 430.1-4, Decommissioning Implementation Guide
- DOE G 430.1-5, Transition Implementation Guide.

Upon completion of WSB activities, a preliminary characterization will be performed to establish a baseline of information concerning the physical, chemical, and radiological condition of the facility. These results will serve as the technical basis for decommissioning.

G.3.10.2 Design Features to Facilitate Decommissioning

Design features are incorporated into the WSB design that will facilitate both deactivation and the eventual decommissioning or reutilization of the facility; these features minimize the spread

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[3] *Environmental Justice in NEPA Documents* (NRC 1999) specifies the guidelines for determining the area for assessment, "If the facility is located outside the city limits or in a rural area, a 4 mile radius (50 square miles) should be used."

[4] DOE O 430.1A, Life Cycle Asset Management.

of radioactive contamination and maintain occupational and public doses at as low as reasonably achievable (ALARA) levels during WSB operations. Design features that will minimize the spread of radioactive contamination and maintain occupational and public doses ALARA:

1. **Plant layout**: All areas of the WSB will be sectioned off into clean areas and potentially contaminated areas with appropriate radiation zone designations to meet 10 CFR Part 835 criteria. Process equipment and supporting systems will be situated according to radiation zone designations and have adequate space to facilitate access for required maintenance to permit easy installation of shielding. The plant layout provides for ready removal of equipment and appropriate space for equipment decontamination.

2. **Access control**: In accordance with ALARA design considerations in 10 CFR Part 835, an appropriate entry control program for WSB radiological areas will be established with associated ingress and egress monitoring to minimize the spread of contamination.

3. **Radiation shielding**: The radiation shielding design will be based on conservative estimates of quantity and isotopic materials anticipated during operations. The analyses address both gamma and neutron radiation and include exposures due to scatter and streaming radiation. Therefore, the shielding design will minimize the occupational doses during deactivation.

4. **Ventilation**: The WSB ventilation system will be designed with the capability of capturing and filtering airborne particulate activity and is continuously maintained under a slight negative pressure.

5. **Structural, mechanical, instrumentation, and electrical components**: Numerous design features of the WSB (e.g., use of washable epoxy coatings, segregation of waste streams, remote readout for instrumentation, and location of breaker boxes and electrical cabinets in low-dose-rate areas) facilitate decontamination, minimize the spread of contamination, and maintain doses to facility personnel ALARA.

6. **Radiation monitoring**: The WSB is designed with radiation monitoring systems to monitor working spaces and potential releases to the environment for the purpose of protecting the health and safety of the workforce, the public, and the environment.

G.3.10.3 Administrative Programs to Facilitate Decommissioning

The WSB design utilizes lessons learned from the operation of similar waste processing facilities to minimize contamination during operations, thereby reducing the effects of contamination on deactivation/decommissioning. Good housekeeping practices are essential to minimize the buildup of contamination and the generation of contaminated waste.

G.3.10.4 Projected Environmental Impacts of Potential Decommissioning

If NNSA should decide to decommission the WSB, a conservative approach to decommissioning is to assume that the facility will be decontaminated, dismantled, and the environment restored as presently being implemented at the Rocky Flats Environmental Technology Site (RFETS) near Denver, Colorado. The values for decommissioning waste volumes for the WSB were estimated using waste volumes from the decommissioned RFETS facilities. The following assumptions apply to this analysis:

1. The WSB waste estimate was based on the decommissioning waste estimating method used for RFETS plutonium handling facilities. This method used the physical characteristics and waste generated from the decommissioning of the first DOE site plutonium facility that was completed in 2000. Relevant metrics (e.g., process area square feet, cubic meters of process equipment) were compared against the TRU, low-level, low-level mixed, and construction demolition waste generated during the decontamination, strip-out, and decommissioning of the building.

2. The summary estimate methodology identified the RFETS buildings that were most representative of the MFFF since the majority of the waste is from the MFFF. The methodology assumed that the secondary systems (i.e., ventilation, instrumentation and control, power, etc.) were similar. It also assumed that the decommissioning methods used for these facilities would be similar to those that were used for RFETS facilities.

The results of the comparison projected 78 yd^3 (60 m^3) of TRU waste, 13,830 yd^3 (10,570 m^3) of LLW and 22,400 tons of nonradioactive demolition waste.

G.3.10.5 Accessibility of Land After Decommissioning

Accessibility to the land surrounding the WSB will be controlled by NNSA or DOE and subject to its applicable security requirements. A final radiological survey will verify that accessibility will not be limited as a result of radioactive contamination.

G.4 FACILITY ACCIDENTS

This section summarizes the evaluation of potential facility accidents applicable to the WSB. The volumes of the various tanks, vessels, evaporators, etc.. upon which this accident analysis is based are specified in Table G-7. The assumed concentrations of the waste streams processed are provided in Tables G-8 through G-11. The assumed concentrations of the high activity evaporation process feed, bottoms and overhead are provided in Table G-12. The accident evaluation includes internal process-related events, external man-made events, and events associated with natural phenomena. The evaluations of these events show that the risk from a facility accident is low.

G.4.1 Environmental Risk Assessment Method

Accidents that could occur as a result of WSB operations are identified and evaluated in a systematic, comprehensive manner. The general approach includes the following evaluations:

- Internal Hazard Identification – A systematic and comprehensive identification of radioactive, hazardous material, and energy sources in the WSB
- External Hazard Identification – A systematic and comprehensive identification of applicable natural phenomena and events originating from nearby facilities
- Hazard Evaluation – A systematic and comprehensive evaluation to postulate event scenarios involving the information developed in the Hazard Identification
- Accident Analysis – A Preliminary Hazards Analysis is performed for the WSB to identify possible accident events and to estimate consequences and frequencies and to identify preliminary prevention and mitigation features. The accident analysis evaluates all credible events. Thus, all internally initiated accidents are evaluated without regard to their initiating frequency, and all natural phenomena hazard and external man-made hazard generated events are evaluated unless their probability of impacting the WSB is extremely low. The results of the evaluation include events with no or low consequences, design basis events, and severe accidents.

G.4.2 Environmental Risk Assessment Summary

From the Hazard Evaluation, those WSB accidents that represent the highest risk to the worker or public were identified. These potential accidents were then grouped into one of the following event types based on similar initiators:

- Natural phenomena
- Loss of confinement (Spill)
- Fire
- Explosion
- Direct Radiation Exposure
- Nuclear Criticality
- Chemical Releases.

The environmental risk assessment addresses the consequences associated with accidents in each event type up to and including design basis accidents. The environmental impacts of beyond design basis events are remote and speculative and do not warrant consideration under NEPA. While beyond design basis events are theoretically possible, their likelihood of occurrence is so low as to not result in any significant, additional risk from WSB operations.

For each potential accident, accident consequences and frequencies are evaluated for two types of receptors: (1) a site worker, and (2) the maximally exposed member of the public. The first receptor, a site worker or SRS worker, is a hypothetical individual working on the SRS site but not involved in the proposed activity. The worker is conservatively evaluated downwind at a point 328 ft (100 m) from the accident. The second receptor, a maximally exposed member of the public, is a hypothetical individual assumed to be downwind at the SRS boundary. The SRS boundary is conservatively evaluated at a distance of 5.8 mi (9.4 km). Exposures received by this individual are intended to represent the highest doses to a member of the public.

The unmitigated consequences of the events identified in the hazard evaluation have been estimated based on the quantities and types of hazardous material, the release mechanisms associated with the accident, and the release pathway of the hazardous material to the environment.

The Total Effective Dose Equivalent (TEDE) to the receptors of interest is equal to the Inhalation Dose. Air submersion, ingestion, water immersion, and contaminated soil dose pathways are assumed negligible contributors to the TEDE. The Inhalation Dose is calculated as follows:

$$[\text{Inhalation Dose}]_{\text{effective}} = [ST]\cdot[\chi/Q]\cdot[BR]\cdot[C]\cdot\sum_{X=1}^{N} f_X \cdot[DCF]_{effective,X}$$

where:

ST	=	source term
χ/Q	=	atmospheric dispersion factor
BR	=	breathing rate
C	=	unit's conversion constant
f	=	specific activity of nuclide x
DCF	=	dose conversion factor of nuclide x
N	=	total number of dose-contributing radionuclides

Based on local SRS meteorological data, the atmospheric dispersion factor (χ/Q) for the MEI member of the public at the SRS boundary (5.8 mi [9.4 km]) from a ground release is 2.8E-06 sec/m^3. The associated χ/Q for the site worker located within 328 ft (100 m) of a groundlevel release of 3-minutes duration from the WSB based on the local SRS meteorological conditions is 7.5E-04 sec/m^3.

The radiological doses are based on the amount of respirable radioactive material released to the air, the source term (ST). The initial source term is the amount of radioactive material driven airborne at the accident source. The initial respirable source term, a subset of the initial source term, is the amount of radioactive material driven airborne at the accident source that is effectively inhalable. The following equation is used to determine the respirable airborne source term (ST) for each event:

$$[ST] = [MAR]\times[DR]\times[ARF]\times[RF]\times[LPF] \quad \text{(NRC 1998d)}$$

The material at risk (MAR) is the amount of radioactive material (in grams or curies of activity) available to be acted on by a given physical stress. For facilities, processes, and activities, the MAR is a value representing some maximum quantity of radionuclide present or reasonably anticipated for the process or structure being analyzed. Different MARs may be assigned for different accidents since it is only necessary to define the material in those discrete physical locations that are exposed to a given stress.

The damage ratio (DR) is the fraction of the MAR actually impacted by the accident-generated conditions. The DR is estimated based upon engineering analysis of the response of structural materials for containment to the type and level of stress or force generated by the event. For conservatism, the DR is conservatively assumed to be 1.0 for all accident analyses for the WSB.

The airborne release fraction (ARF) is the coefficient used to estimate the amount of a radioactive material suspended in air as an aerosol and thus available for transport due to physical stresses from a specific accident. For discrete events, the ARF is a fraction of the material affected.

The respirable fraction (RF) is the fraction of airborne radionuclides as particles that can be transported through air and inhaled into the human respiratory system.

Values for RF and ARF were selected for these dose consequence analyses based on bounding values obtained from *Airborne Release Fractions/Rates and Respirable Fractions for Nonreactor Nuclear Facilities* (DOE 1994c) based on the release mechanism for solutions.

The leak path factor (LPF) is the fraction of the radionuclides in the aerosol transported through some confinement deposition or filtration mechanism. There can be many LPFs for some hazard events, and their cumulative effect is often expressed as one value that is the product of all leak-path multiples. Inclusion of these multiples in a single LPF is done to clearly differentiate between calculations of unmitigated doses (where the LPF is assumed equal to 1.0) and calculations of mitigated doses (where the LPF reflects the dose credit provided to the controls). For all unmitigated dose consequence calculations for the WSB, a value of 1.0 is used. For most of the identified hazard events, a value of 1.0 for the LPF is also used for the mitigated dose consequences. Any deviations from a LPF of 1.0 are identified in the summary of the accident events that follow.

Design basis events for each event type are discussed in the following sections.

G.4.2.1 Natural Phenomena

A screening process is performed on a comprehensive list of natural phenomena to identify those credible natural phenomena that have the potential to affect the WSB during the period of facility operation. Credible natural phenomena that could have an impact on WSB operations include the following:

- Extreme winds
- External flooding
- Earthquakes
- Tornadoes
- Rain, snow, and ice.

Natural phenomena could result in the dispersion of radioactive material and hazardous chemicals. Performance goals for annual probability of exceedance were determined to be 5E-04 for all process areas and equipment except for the high activity waste processing and receipt cells. For those cells in which the high activity waste is stored or processed, the hardened reinforced concrete structure will be designed for a performance goal for annual probability of exceedance of 1E-04. Natural phenomena events are discussed in the following sections.

G.4.2.1.1 Extreme Winds

Extreme winds are straight-line winds associated with thunderstorms or hurricanes. Extreme wind loads include loads from wind pressure and wind-driven missiles.

For all portions of the WSB except those hardened reinforced concrete cells housing the MFFF High Alpha Waste, the equipment will be housed inside a standard metal-constructed building designed to withstand a 3-second wind speed of 107 mph. Because of the lower quantity of radioactive material in the areas processing the low activity waste streams, there is no design criteria for the wind-driven missiles. However, no significant radioactive or hazardous material release at the WSB is postulated to occur as a result of damage from wind-driven missiles caused by extreme wind events.

The process cells housing the High Alpha Waste stream will be designed to withstand the effects of the design basis extreme wind of 133 mph and the associated missiles. The missile criteria include the ability to withstand the force of a 2x4 timber plank weighing 15 pounds being driven at the structure at a horizontal velocity of 50 mph at a maximum height of 30 ft (9.1 m).

G.4.2.1.2 External Flooding

External flooding includes floods associated with rising rivers or lakes. For all process areas and equipment except for the high activity waste processing and receipt cells, the structures are designed for the flooding consequences associated with flooding events with an annual exceedance probability of 5E-04 (return period of 2,000 years). For the high activity cells, the hardened reinforced concrete structure will be designed to withstand the flooding consequences associated with a flooding event with an annual hazard exceedance probability of 1E-04.

G.4.2.1.3 Earthquakes

Earthquakes may result from movement of the earth's tectonic plates or volcanic activity. For all process areas and equipment except for the high activity waste processing and receipt cells, the structures are designed for the seismic consequences associated with an earthquake with a minimum annual exceedance probability of 1E-03 (return period of 1,000 years). For the high activity cells, the hardened reinforced concrete structure will be designed to withstand the consequences associated with an earthquake event with a minimum annual hazard exceedance probability of 5E-04 (return period of 2,000 years). Earthquake load design for the WSB is performed in accordance with the SRS-specific structural design criteria given in Section 5.2.9 of *SRS Engineering Standards Manual: Structural Design Criteria* (WSRC 2001b).

Although the MFFF High Alpha waste stream receipt tanks may fail as a result of the design basis earthquake, the concrete cells surrounding the tanks are designed to enhanced seismic criteria. The other waste streams will be included in a standard metal-constructed building and may be subject to full release as a result of structural damage caused by this natural phenomenon event. The loss of confinement caused by earthquakes is evaluated in the loss of confinement (spill) event.

G.4.2.1.4 Tornadoes

Tornadoes may occur in extreme weather such as thunderstorms or hurricanes. All process areas and equipment are designed in accordance with the SRS-specific tornado wind load criteria given in Section 5.2.8 of *SRS Engineering Standards Manual: Structural Design Criteria* (WSRC 2001b). For the high activity cells, the hardened reinforced concrete structure will be designed to withstand the consequences associated with a design basis tornado having an annual exceedance probability of 2E-05. Tornado loads include loads due to tornado wind pressure, loads created by the tornado-created differential pressure, and loads resulting from tornado-generated missiles.

The associated wind load criteria and differential pressure load criteria for the WSB's hardened concrete structures are based on the following criteria used for the MFFF site:

- Maximum tornado wind speed: 180 mph
- Pressure drop across tornado: 70 psf
- Rate of pressure drop: 31 psf/sec.

The associated tornado-generated missile load criteria are based on the following:

Missile Description	Mass (lb)	Size (in)	Horizontal Impact Speed (mph)	Maximum Height (ft)	Vertical Impact Speed (mph)
Penetrating missile – 3-in (7.6-cm) diameter steel pipe	75	3 ½ (outside diameter)	50	75	35
Small missile – 2- by 4-in (5.1- by 10.2-cm) timber plank	15	1 ½ by 3 ½	100	150	70

Missile Description	Mass (lb)	Size (in)	Horizontal Impact Speed (mph)	Maximum Height (ft)	Vertical Impact Speed (mph)
Automobile	3,000	not applicable	19	rolls and tumbles	not applicable

The MFFF High Alpha waste stream receipt tanks and process rooms are enclosed with hardened reinforced concrete and will be designed to withstand the effects of the design basis tornado. The other waste streams will be included in a standard metal-constructed building and may be subject to damage and release following this natural phenomenon event. No significant radioactive or hazardous material release at the WSB is postulated to occur for tornadoes (see bounding loss of confinement (spill) event).

G.4.2.1.5 Rain, Snow, and Ice

Rain, snow, and ice are postulated to occur at the WSB several times during operation of the facility. These loads are defined according to the methodology in Sections 5.2.5, 5.2.6, and 5.2.7 of *SRS Engineering Standards Manual: Structural Design Criteria* (WSRC 2001b). The minimum drainage system design corresponds to a 25-year, 6-hour rainfall event (4.5 inches total accumulation). Snow loads are based on an annual exceedance probability of 4E-04, or a return period of about 2,500 years.

The WSB will be designed to withstand the effects of rain, snow, and ice. Thus, no radioactive or hazardous material release at the WSB is postulated to occur during or following these conditions.

G.4.2.2 Loss of Confinement

Within the WSB, radioactive material is confined within one or more confinement barriers. Primary confinement barriers include welded vessels, tanks, and piping; and their associated ventilated systems. Secondary confinement barriers include the WSB building structure itself and the associated ventilation system which maintains a negative differential pressure relative to the outside atmospheric pressure. Confinement capabilities will ensure that a controlled, continuous airflow pattern from the environment to the WSB, and from the non-contaminated areas of the building to potentially contaminated areas, to the normally contaminated areas, and through HEPA filters and the stack prior to release to the environment.

The loss or damage of the primary confinement barrier may result in the dispersion of radioactive materials and hazardous chemicals. The effects of hazardous chemicals are discussed in Section G.4.2.7. The loss at each level of confinement is necessary for a non-negligible release from the WSB to occur.

Damage to or failure of the confinement barriers can be caused by human error or equipment failure resulting in the following:

- Breaches of container boundaries due to crushing, shearing, grinding, cutting, and handling errors
- Corrosion-induced confinement failures
- Pipe or vessel breaks or leaks
- Clogging or failure of HEPA filters.

Loss-of-confinement events caused by fires, explosions, load-handling events, natural phenomena, and external events are covered in their respective event discussions.

The bounding credible loss-of-confinement event involves a facility-wide spill of all material in the building due to a natural phenomena or external event. Only the high activity waste and overheads were analyzed as the low activity waste would add only a slight increase to the dose. The total quantity of high activity waste includes 6,500 gallons in the storage tanks and evaporator, 500 gallons of high activity bottoms each in the High Level Evaporator, High Activity Bottoms Collection Tank, and High Activity Neutralization Tank, and 4,000 gallons of high activity overhead. The release factors applied for the release of waste from failed components was that based on a free fall spill, with an ARF of 2E-05 and a RF of 1.0. The radiological consequences associated with this event are mitigated by the robust cell structure design for the high activity waste processing area and implementation of an Emergency Response Plan. The release from the MFFF High Alpha Waste Stream tanks is estimated to be reduced by a factor of 10 (LPF = 0.1) by the structural confinement capability of the cell. In addition, as part of the Emergency Response Plan, personnel would be directed to proceed to assembly points away from the facility in order to limit potential radiological exposures. With these controls in place, the radiological consequences associated with a spill are less than the limits, as shown in Table G-13.

As shown in Table G-13, the radiological consequences at the SRS boundary are negligible. Such impacts would not be sufficient to warrant evacuation of the public or interdiction or decontamination of land or food supplies. Table G-13 also shows that the radiological consequences to the nearest site worker are low.

The WSB utilizes many features to reduce the likelihood and consequences of this event as well as other loss-of-confinement events. Key features include: piping design to take into consideration thermal and pressure stresses, erosion, corrosion, etc.; material selection for chemical compatibility; a concrete bunker to protect waste transfer pipelines; and facility emergency response procedures; and worker training. The waste transfer lines from the PDCF and the MFFF to the WSB are composed of welded, jacketed two-inch stainless steel piping, enclosed in an underground seismically-qualified pipe trench.

Given the low consequences and/or small likelihood of this type of accident, the radiological risk from the loss-of-confinement events is low.

G.4.2.3 Fire

A fire hazard arises from the simultaneous presence of combustible materials, an oxygen source, and a sufficient ignition source. A fire can spread from one point to another by conduction, convection, or radiation. The immediate consequence of a fire is the destruction, by combustion or by thermal damage, of elements in contact with the fire. A fire can lead to the dispersion of radioactive materials and hazardous chemicals.

Fires can be caused by human error, electrical equipment failures, equipment that operates at high temperatures, uncontrolled chemical reactions, or static electricity.

A number of fire events were postulated in the individual process cells. For each event, the value of ARF used is 2E-03 with an RF value of 1.0. It is assumed that the fire is severe enough to cause boiling of the material. Though limited combustibles are expected to be present in the process cells, the fire events assumed the fire spreads and impacts the entire cell inventory. In addition, both area fires and a full facility fire were postulated having potentially high consequences to facility and site workers. Postulated fire events include the following:

- Cell fires involving the low activity and effluent processing sections of the WSB (process feed tanks, evaporators, and/or piping containing waste solutions)
- Cell fires involving the high alpha storage and processing tanks (receipt tank, head tank, evaporator, bottoms collection tank, neutralization tank, cementation cell)
- Full facility fire that affects the entire facility inventory
- An area fire affecting just the low activity and effluent processing sections of the facility
- An area fire affecting the area used to store and process the PDCF Lab Concentrate waste.

The control strategies used to reduce the risk of the postulated fire events include a combination of administrative controls and design features. A Fire Protection Program provides controls to reduce the probability of a fire and the means to ensure protection of personnel and equipment if a fire should occur. Key elements of the administrative control program include: a fire pre-plan, a transient combustible control program, a control on the use of flammable liquids and gases, fire department response, and worker training. These administrative controls are supplemented with the following design features: fire barriers between the High Alpha receipt tanks and within the high activity waste stream processing area, fires sprinkler systems, fire resistant construction materials, and the building confinement system. Robust construction of the cells used for storing and processing high activity waste prevents fires in these areas and the potential release of its large source term.

The bounding credible fire event postulated to produce the largest radiological consequences is a fire in the low activity and effluent processing sections of the WSB, causing structural damage to the facility and causing the release of radionuclides in these areas. An area fire involving the low activity and effluent processing sections of the WSB could potentially release up to 18,600 gallons of the unprocessed low activity waste, 1,500 gallons of low activity bottoms, 6,000 gallons of low activity overheads, 1,000 gallons of effluent bottoms, and 6,000 gallons of effluent overheads. The radiological consequences associated with this event are provided in Table G-13.

The MFFF utilizes many features to reduce the likelihood and consequences of this event as well as other fire-related events. Key features include minimization of combustibles and ignition sources through mitigative programs, fire suppression and detection systems (designed to NFPA standards), and emergency procedures. As part of the emergency response program, facility and onsite workers would be directed to proceed to assembly locations away from the WSB to limit potential exposures.

Given the low consequences and/or small likelihood of this type of accident, the radiological risk from fire events is low.

G.4.2.4 Explosion

Internal explosion events within the WSB could result from the presence of potentially explosive mixtures and potential overpressurization events. These events may result in the dispersion of radioactive materials and hazardous chemicals. Explosions may be caused by human error or equipment failure and include the following:

- Hydrogen accumulation in the any of the tanks or evaporators used to process radiological material (caused by radiolysis)
- Inadvertent caustic addition to the acidic waste streams causing an energetic acid/base chemical reaction
- Red Oil Explosion in the High Activity Evaporator
- Overpressurization of the High Activity Evaporator.

The control strategy for explosion events associated with the WSB tanks and vessels other than the high activity evaporator is to prevent the explosions through the use of a passive vent on the tanks. Hydrogen gas generated by the radiolysis of water in the MFFF High Alpha Waste stream will be vented and connected to a vessel vent system in order to prevent hydrogen from reaching the lower flammability limit. In addition, inert atmospheres will be present in the storage tanks and vessels to preclude the formation of an explosive atmosphere in those areas containing the high activity waste streams. Radiolysis is not a concern for the other waste streams due to their low activities.

A configuration control program and a chemical control program will be implemented to ensure no caustic is introduced to the tank and to prevent possible energetic chemical reactions. Organics in the waste streams will be eliminated or at least minimized through waste acceptance criteria and sampling and/or the use of inert oils or lubricants. Design features of temperature and pressure interlocks will also be utilized to shut down the High Activity Evaporator upon detection of high temperature or pressure conditions. For overpressurization events in the High Activity Evaporator, controls selected to mitigate the event include the robust cell structure to confine potential releases, and an access control program to minimize the potential for a worker to be near the evaporator during its operation.

The bounding credible explosion event at the WSB is a hydrogen deflagration in the High Activity Evaporator due to hydrogen accumulation if waste material remains in the evaporator vessel during shutdown. The volume of the high activity evaporator is 528 gallons with the normal operating volume of high activity waste expected to be approximately 250 gallons. To determine the source term for this explosion, the tank volume is conservatively assumed to contain hydrogen at a stoichiometric concentration of 30%. The volume of hydrogen in the vapor space of the evaporator is converted to moles of hydrogen based on one mole of hydrogen occupying 22.4 liters. The bounding respirable release for an explosion is the mass of inert material equal to the TNT equivalent for the exploding vapor (DOE 1994c). One mole of hydrogen is equivalent to 68,317 calories and one gram of TNT is equal to 1,100 calories per gram, Assuming the density of the waste material is approximately 1.2 g/ml, the respirable source term for the explosion is calculated using the following equation:

$$\text{SourceTerm (gal)} = \left\{\frac{1\,\text{mole}\,H_2}{22.4\,L}\right\} \times \left\{\frac{68{,}317\,\text{cal}}{\text{mole}\,H_2}\right\} \times \left\{\frac{\text{gram TNT}}{1{,}100\,\text{cal}}\right\} \times \left\{\frac{L\ \text{of material}}{1.2\,g/ml}\right\} \times \left\{\frac{1\,\text{gal}}{3{,}785\,ml}\right\}$$

The likelihood and consequences of such an event will be limited through the use of reliable engineering features and administrative controls. Key features include a vent device on the evaporator with a vent position indicator, dedicated instrument air purge with air bottle (or other source) backup purge capability, alarm on loss of purge flow to the evaporator, robust design of the high activity waste processing cells, and access control program to minimize the potential for workers to be present in the cell with the evaporator. Given these features, the consequences to the site worker and facility worker as a result of this hydrogen deflagration event would be low with negligible consequences to the offsite public (see Table G-13).

G.4.2.5 Direct Radiation Exposure

A direct radiation hazard arises from the presence of radioactive material within the WSB. Direct radiation exposure events include those events that result in a radiation dose from radiation sources external to the body. Due to the nature of the radioactive material present in the WSB (within tanks, process vessels and containers), there are no accidents at the WSB that produce a direct radiation exposure hazard to the public or site workers from routine operations. A number of events were postulated that result in high radiation to the facility worker as a result of either entering a high activity cell during process operations or performing maintenance on process equipment. The probability and consequences of these events is controlled through adequate shielding provided by the tank walls, and administrative controls to control access to these radiation areas and a radiation protection program.

G.4.2.6 Nuclear Criticality

Because the waste streams processed in the WSB have low concentrations of fissile material, criticality is not a concern.

G.4.2.7 Chemical Releases

A chemical hazard arises mainly from the use of chemicals in the waste processing operations - aluminum nitrate, dry cement, nitric acid, and sodium hydroxide. Chemicals evaluated include those used during all modes of operation. Accidental chemical releases are postulated to occur from human error and equipment failures.

Consequences of chemical releases were determined for a potential release of each chemical. For evaporative releases, the chemical consequence analysis modeling for public consequences used the ALOHA code (ALOHA 2000), the ARCON96 code (ARCON96 1997), and the MACCS2 code (MACCS2 1998) to calculate the maximum airborne chemical concentration at the SRS boundary (approximately 5 miles from the WSB). Calculated concentrations were compared to TEELs. TEELs describe temporary or equivalent exposure limits for chemicals for which official Emergency Response Planning Guidelines have not yet been developed.

An evaporation model extracted from the ALOHA code was used to calculate a release from a spilled or leaked chemical, which is assumed to form a puddle one-cm deep. The entire anticipated onsite inventory of individual chemicals in the WSB was assumed to be in a single tank and a spill or leak was modeled. No credit was taken for an enclosure (such as a building) or a dike or containment/impoundment basin. For leaks or spills of nitric acid, credit was taken for the partial pressure of the nitric acid in a 13.6 N solution. For leaks or spills of aluminum nitrate, dry cement, and sodium hydroxide, which have negligible partial pressures in a solution, an airborne release fraction was applied in a direct release calculation.

The results indicate that the concentration of all chemicals at the SRS boundary following a release from the WSB is low. The results also indicate that the maximum chemical concentration for an site worker is low. The release due to a leak or spill of the entire anticipated onsite inventory of chemicals in the Waste Solidification Building is calculated to not exceed the applicable TEEL-2 concentration at 328 ft (100 m).

WSB features to reduce the frequency and magnitude of a chemical release include at least the following: vessel level indications, leak detection, sumps, drains, operating procedures, emergency procedures, operator training, hazardous material control, and ventilation systems.

Given the low consequences and/or small likelihood of this type of accident, the risk from chemical releases is low.

G.4.3 Evaluation of Facility Workers

The risk to workers is qualitatively evaluated for all WSB events. Sufficient engineering design features and administrative controls have been incorporated into the WSB design to ensure that any unacceptable consequence is highly unlikely.

Key design features include confinement systems, the robust construction of the high activity waste tanks and processing cells, explosion mitigation structures, systems, and components (SSCs), radiation monitoring systems, and fire protection systems. Key administrative controls include operator training, radiation protection, fire safety, and industrial hygiene programs. In addition, workers are trained and qualified and perform their work in accordance with approved procedures.

Given the low consequences and/or low likelihood of events, the overall radiological risk to the WSB worker is low.

G.4.4 Conclusions

The impacts that have been considered include potential radiation and chemical exposures to individuals and to the population as a whole, and the risk of near- and long-term adverse health effects that such exposures could entail. The evaluation demonstrates that the environmental risk associated with potential accidents at the WSB is low.

G.5 TRANSPORTATION

The PDCF Laboratory Concentrates and the MFFF High Alpha Waste will be treated separately for processing at the WSB. However, both wastes will be neutralized and mixed with a solidification additive and placed in 55-gallon steel waste drums and sampled to assure that the WIPP waste acceptance criteria are met for the TRU waste. The wastes will be loaded in a TRUPACT II shipping container for transport via truck to WIPP. Approximately 35 shipments of this TRU waste will be sent to WIPP annually.

The environmental impacts of transportation of waste from the SRS waste management facilities to ultimate disposal sites are documented in the Waste Management PEIS (DOE 1997a) and the SRS Waste Management Final EIS (DOE 1995b). This included the transportation of TRU waste from the SRS site to WIPP for disposal. Although the waste volumes cited in the Waste Management PEIS are different than that being analyzed for the WSB (up to 35 shipments), a dose per shipment value can be calculated from the Waste Management PEIS and applied to the WSB shipments to WIPP. The Waste Management PEIS calculated the cumulative dose and lifetime risk to a Maximally Exposed Individual (MEI) living along the SRS site entrance who is assumed to be present for all the shipments. The dose per shipment[5] to this MEI is 1.5E-04 mrem (based on DOE 1997a). For 35 shipments of TRU waste, the total additional dose to the MEI is 5.3 E-03 mrem which equates to an increase in lifetime cancer risk of 2.6E-09. The consequences from the most severe transportation accidents involving the transport of the TRU waste were also evaluated by DOE in the Waste Management PEIS. The transportation accidents involving TRU waste shipments from the WSB at SRS to WIPP are bounded by those analyzed in the Waste Management PEIS. The consequences from the most severe transportation accidents are summarized in Table G-14. For the accident analysis, the MEI is assumed to be located at the point of maximum exposure. The locations of maximum exposure were 160 m (525 ft) from the accident site under neutral atmospheric conditions, and 400 m (1,312 ft) for stable atmospheric conditions.

G.6 IMPACTS SUMMARY

The WSB will convert the radioactive liquid wastes from the MFFF and PDCF into solid waste that will be disposed as transuranic waste or low-level radioactive waste. The environmental impacts of constructing and operating the WSB are less than the projected impacts from the construction and operation of the Plutonium Immobilization Plant evaluated in the SPD EIS but subsequently cancelled.

The WSB will be constructed on five acres of the existing PDCF site. Potential impacts to local air quality and water quality during construction of the WSB are anticipated to be bounded by the impacts presented in the SPD EIS (DOE 1999c) for the immobilization plant. Any scrub vegetation located on the site will be removed. There should be no direct impacts on non-sensitive aquatic habitats because best-management practices for soil erosion and sediment control will be used to prevent construction runoff to these habitats, and direct construction disturbance would be avoided. There are no sensitive habitats located on the WSB site. The WSB will use the same roads and utility headers as the MFFF. Less than one acre of land will be used for new roads within the WSB boundary, beyond those described for the MFFF.

Construction wastes for the WSB are expected to be bounded by the values projected in the SPD EIS for the immobilization plant. It is anticipated that no TRU waste, LLW, or mixed LLW would be generated during the construction period. Hazardous wastes generated during construction would be typical of those generated during the construction of an industrial facility. Any hazardous wastes generated during construction would be packaged in DOT-approved containers and shipped offsite to permitted commercial recycling, treatment, and disposal facilities.

Maximum air pollutant concentrations resulting from operation of the WSB are anticipated to be bounded by the concentrations projected for the immobilization plant in the SPD EIS, with the

[5] DOE 1997a, Table E-27 projects a dose of 3.6E-04 Rem for 2,370 shipments passing the MEI located at the site entrance for SRS in the decentralized option. This yields an average dose of 1.5E-07 Rem (1.5E-04 mrem) per shipment.

exception of NO_X. The WSB offgas system design will include NO_X emission control equipment as needed to cost effectively control the WSB emissions so that SRS site boundary NO_X concentrations due to the WSB are less than 10% of the most stringent standard or guideline for total SRS site emissions. The potential airborne chemical emissions from waste processing are comprised of aluminum nitrate, nitric acid, sodium hydroxide and dry cement. A chemical consequences analysis was performed and determined that the airborne releases from the WSB at both 100 m and the SRS boundary are well below the TEEL limits for each chemical.

The WSB does not discharge any process liquid directly to the environment. The WSB design will include discharges of water (HVAC condensate, storm water, etc.) to an NPDES outfall. All liquid discharges to NPDES outfalls will meet state and federal regulations. All liquid wastes are transferred to SRS waste management facilities for treatment and ultimate disposal. The WSB will generate a maximum of 235,000 gallons (890 m^3) of liquid LLW annually from the processing of the MFFF and PDCF high radioactivity waste streams. This waste will be transferred to the ETF. This volume would be less than 0.1% of the 1,930,000 m^3/yr capacity of the ETF.

The dose to the public and site workers from WSB operations are bounded by the conservative estimate of dose for the MFFF (1.5E-03 mrem/yr). The annual dose to facility workers in the WSB is estimated to be below 200 person-rem/yr). The average annual dose will be below the current SRS guideline of 500 mrem/year.

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Figures

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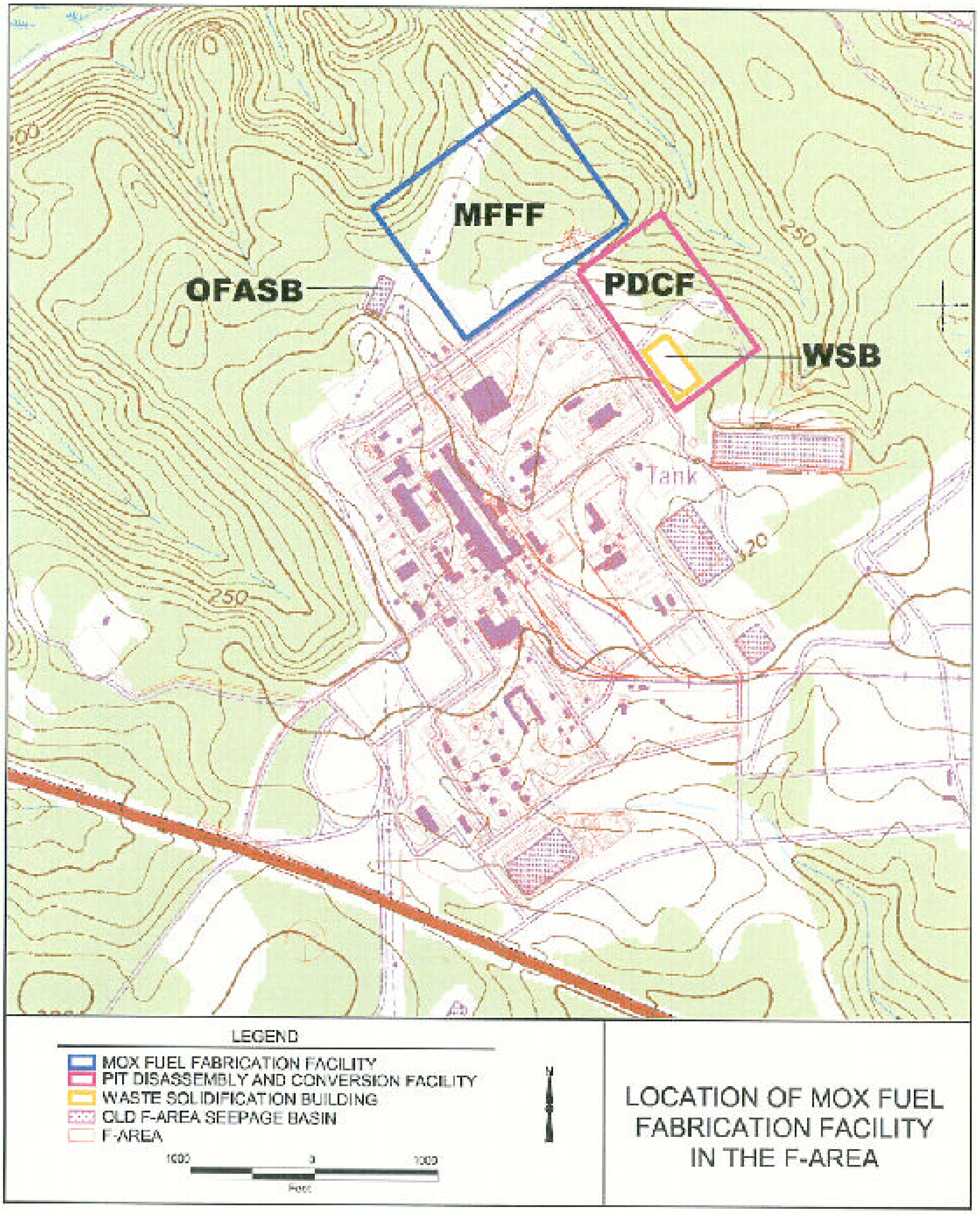

Figure G-1. Location of Waste Solidification Building in the F Area

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Tables

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Table G-1. Liquid Waste Streams Processed by the Waste Solidification Building

Waste Stream	Source	Nominal Characteristics	Annual Volume w/o flush (gallons)
High Alpha	MFFF	Am-241: < 24.5 kg/yr (0.7% maximum Pu content) (84,000 Ci/yr) Pu: < 221 g/yr U: < 13 g/yr [H+] = 3 N Nitrate salts = 1500 kg/yr Silver: 300 kg/yr Na: 147 kg/yr	14,301 21,841 (max)
Stripped Uranium	MFFF	Pu: < 0.1 mg/L U: < 5000 kg/yr [~1% U-235] [H+] = 0.1 N	42,530 46,000 (max)
Lab Liquids	PDCF	3% HNO_3, 5 g Pu, 4 g U, 1.2 kg Fl, 1 kg Cl, 1,200 kg nitrates, 0.5 kg sulfates	11,000 17,000 (max)
Lab Concentrated Liquid	PDCF	10% HNO_3, 600 g U, 800 g Pu, 11 kg nitrates	25 60 (max)

Table G-2. Waste Treatment Chemicals

Chemical	Annual Consumption	Anticipated Onsite Inventory
Aluminum Nitrate (34%)	50 gal	<1,000 gal
Dry Cement	<500,000 lb	<100,000 lb
Nitric acid (64%)	2,000 gal	2,000 gal
Sodium hydroxide (50%)	<7,000 gal	<1,500 gal

Table G-3. Emissions (kg/yr) from Construction of the Waste Solidification Building

Pollutant	Diesel Equipment	Construction Fugitive Emissions	Concrete Batch Plant	Vehicles
Carbon Monoxide	20,300	0	0	48,700
Nitrogen dioxide	52,700	0	0	14,100
Sulfur dioxide	24,400	0	0	0
Volatile organic compounds	3,900	<1	0	6,520
Total suspended particulates	3,930	21,600	2,610	49,900

Source: DOE 1999c, Table G-61

Table G-4. Maximum Additional Site Infrastructure Requirements for WSB Construction in F Area at SRS

Resource	WSB	Availability[a]
Transportation[b] Roads (mi)	1	142
Electricity (MWh)	32,000	482,700
Diesel Fuel (gal/yr)	30,000	NA[c]
Water (gal/yr)	25,000,000	321,000,000

Source: DOE 1999c, Table E-12

[a] Capacity minus current usage

[b] WSB will use roads constructed for MFFF

[c] Not applicable due to the ability to procure additional resources.

Table G-5. Wastes Generated During Construction

Waste Type	Estimated Additional Waste Generation (m^3/yr)	Disposal Capacity (m^3/yr)
Hazardous	35	74
Nonhazardous		
Liquid	21,000	1,033,000 [a]
Solid	2,200	6,670

Source: DOE 1999c, Table H-29.

[a] Capacity of CSWTF.

Table G-6. Increments to Ambient Concentrations ($\mu g/m^3$) from MFFF Operation

Pollutant	Averaging Period	Most Stringent Standard or Guideline [a]	SRS Maximum Concentration[b]	WSB Contribution	Total
Carbon monoxide	8 hours	10,000	66	0.152	66
	1 hour	40,000	254	0.657	254
Nitrogen dioxide	Annual	100	17.2	10	27.2
PM_{10}	Annual	50	7	0.00181	7
	24 hours	150	97	0.032	97
Sulfur dioxide	Annual	80	24	0.042	24
	24 hours	365	337	0.61	337
	3 hours	1,300	1,171	1.63	1,172
Total suspended particulates	Annual	75	46	0.00181	46

[a] The more stringent of the federal and state standards is presented if both exists for the averaging period.

[b] Hunter (2001), Includes background plus SRS emissions

Table G-7. Volume of WSB Tanks and Vessels

Tank/Vessel	Number of Tanks/Vessels	Contents	Volume (gal)
PDCF Lab Liquids Storage Tank	2	Unprocessed Waste	2500
MFFF Stripped Uranium Storage Tank	2	Unprocessed Waste	4000
MFFF High Alpha Storage Tank	2	Unprocessed Waste	2500
PDCF Lab Concentrate	TBD	Unprocessed Waste	16
High Activity Head Tank (Evaporator Feed)	1	Unprocessed Waste	4500
High Level Evaporator	1	HA Bottoms	528
High Activity Bottoms Collection Tank	1	HA Bottoms	528
High Activity Neutralization Tank	1	HA Bottoms	1000
High Activity Condensate Hold Tank (Overheads)	1	HA Overheads	4000
Low Activity Head Tank (Evaporator Feed)	1	Unprocessed Waste	5600
Low Level Evaporator	1	LA Bottoms	1000
Low Activity Bottoms Collection Tank	1	LA Bottoms	150
Low Activity Neutralization Tank	1	LA Bottoms	200
Effluent Head Tank	1	LA Overheads	6000
Effluent Polishing Evaporator	1	Effluent Bottoms	1000
Effluent Holding Tank	1	Effluent Overheads	6000

Table G-8. PDCF Lab Liquids Waste Radionuclide Concentration

Radionuclide	Concentration (g/l)
Pu-238	1.48E-07
Pu-239	2.74E-04
Pu-240	1.93E-05
Pu-242	2.96E-07
Am-241	2.96E-06
U-234	2.50E-06
U-235	2.33E-04
U-236	1.25E-06
U-238	1.35E-05

Table G-9. PDCF Lab Concentrated Liquid Waste Radionuclide Concentration

Radionuclide	Concentration (g/l)
Pu-238	1.27E-02
Pu-239	2.34E+01
Pu-240	1.64E+00
Pu-242	2.53E-02
Am-241	2.53E-01
U-234	1.91E-01
U-235	1.78E+01
U-236	9.55E-02
U-238	1.03E+00

Table G-10. MFFF Stripped Uranium Waste Stream Radionuclide Concentration

Radionuclide	Concentration (g/l)
Pu-238	5.00E-08
Pu-239	9.00E-05
Pu-240	9.00E-06
Pu-241	1.00E-06
Pu-242	1.00E-07
U-232	1.34E-06
U-233	1.34E-02
U-234	2.68E-01
U-235	7.77E+00
U-236	5.36E+00

Table G-11. MFFF High Alpha Waste Stream Radionuclide Concentration

Radionuclide	Concentration (g/l)
Pu-238	8.00E-07
Pu-239	1.44E-03
Pu-240	1.44E-04
Pu-241	1.60E-05
Pu-242	1.60E-06
Am-241	1.80E-01
U-232	9.54E-12
U-233	9.54E-08
U-234	1.91E-06
U-235	5.53E-05
U-236	3.82E-06

Table G-12. High Activity Evaporation Process Concentrations

Radionuclide	Feed Concentration (with 3X dilution) (g/L)	Bottoms Concentration (g/L)	Overhead Concentration (g/L)
Pu-238	1.74E-06	1.48E-05	1.99E-10
Pu-239	3.12E-03	2.66E-02	3.57E-07
Pu-240	3.12E-04	2.66E-03	3.57E-08
Pu-241	3.47E-05	2.96E-04	3.97E-09
Pu-242	3.47E-06	2.96E-05	3.97E-10
Am-241	5.75E-02	4.90E-01	6.57E-06
U-232	3.00E-10	2.56E-09	3.43E-14
U-233	3.00E-06	2.56E-05	3.43E-10
U-234	6.00E-05	5.12E-04	6.86E-09
U-235	1.74E-03	1.48E-02	1.99E-07
U-236	1.20E-03	1.02E-02	1.37E-07

Table G-13. Summary of Consequences for WSB Bounding Credible Events

Accident Event	Maximum Impact to Site Worker (rem)	Maximum Impact to Site Worker (probability of cancer deaths)	Maximum Impact to Public at SRS Boundary (rem)	Maximum Impact Public at SRS Boundary (probability of cancer deaths)
Loss of Confinement (Spill)	9.0	3.6E-03	0.03	1.5E-05
Fire	2.4	9.6E-04	0.01	5.0E-06
Hydrogen Explosion in High Activity Waste Evaporator	5.1	2.0E-03	0.02	1.0E-05

Table G-14. Estimated Consequences for the Most Severe Accidents Involving Truck Shipments of TRU Waste

Accident Location	Neutral Conditions				Stable Conditions			
	Population		MEI		Population		MEI	
	Dose (person-rem)	Risk (cancer fatalities)	Dose (rem)	Risk (cancer fatalities)	Dose (person-rem)	Risk (cancer fatalities)	Dose (rem)	Risk (cancer fatalities)
Urban	4.0E+03	2.0E+00	3.5E+00	1.8E-03	3.2E+04	1.6E+01	1.2E+01	6.0E-03
Suburban	7.4E+02	3.7E-01	3.5E+00	1.8E-03	5.9E+03	3.0E+00	1.2E+01	6.0E-03
Rural	6.5E+00	3.0E-03	3.5E+00	1.8E-03	5.2E+01	3.0E-02	1.2E+01	6.0E-03

Source: DOE 1997a, Table E-26