Duke Cogema Stone & Webster

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

Docket Number 070-03098

Prepared by
Duke Cogema Stone & Webster
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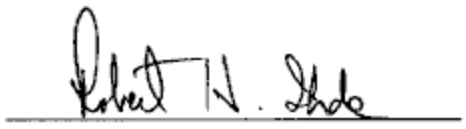

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Form PP7-4A
Revision 2

Duke Cogema Stone & Webster

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Docket Number 070-03098

Prepared by
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UCNI Yes ☐ No ☒
Proprietary Yes ☐ No ☒

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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 R2
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 R2
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 R2
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.

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 R2
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.

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 R1
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.

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
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

R2

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

°C	degrees Celsius (Centigrade)
°F	degrees Fahrenheit
46°26'07"	46 degrees, 26 minutes, 7 seconds
ac	acre
AFS	alternate feedstock
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

R2

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
ton	short ton

R1

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
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

R2

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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 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. R2

DCS is a Limited Liability Company (LLC) owned by Duke Project Services Group, COGEMA, 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. R2

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

[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, as well as nonproliferation considerations, and agreements with Russia and other nations. [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. 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 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 office in January 1993. The results of the CISAC study were published in *Management and Disposition of Excess Weapons Plutonium* (NAS 1994). R1 R1 R1

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
- Standby Generator Building
- Secured Warehouse Building
- Administration Building
- Technical Support Building
- Receiving Warehouse Building.

R1

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. 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. R1

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 buildings. R1

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 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 Facilities and personnel support facilities, such as the locker and change rooms, toilet facilities, R1 R1

[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

[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.

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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. 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 the different confinement zones. R1 R1

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 phenomena 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. 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. | R1

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. 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. R2

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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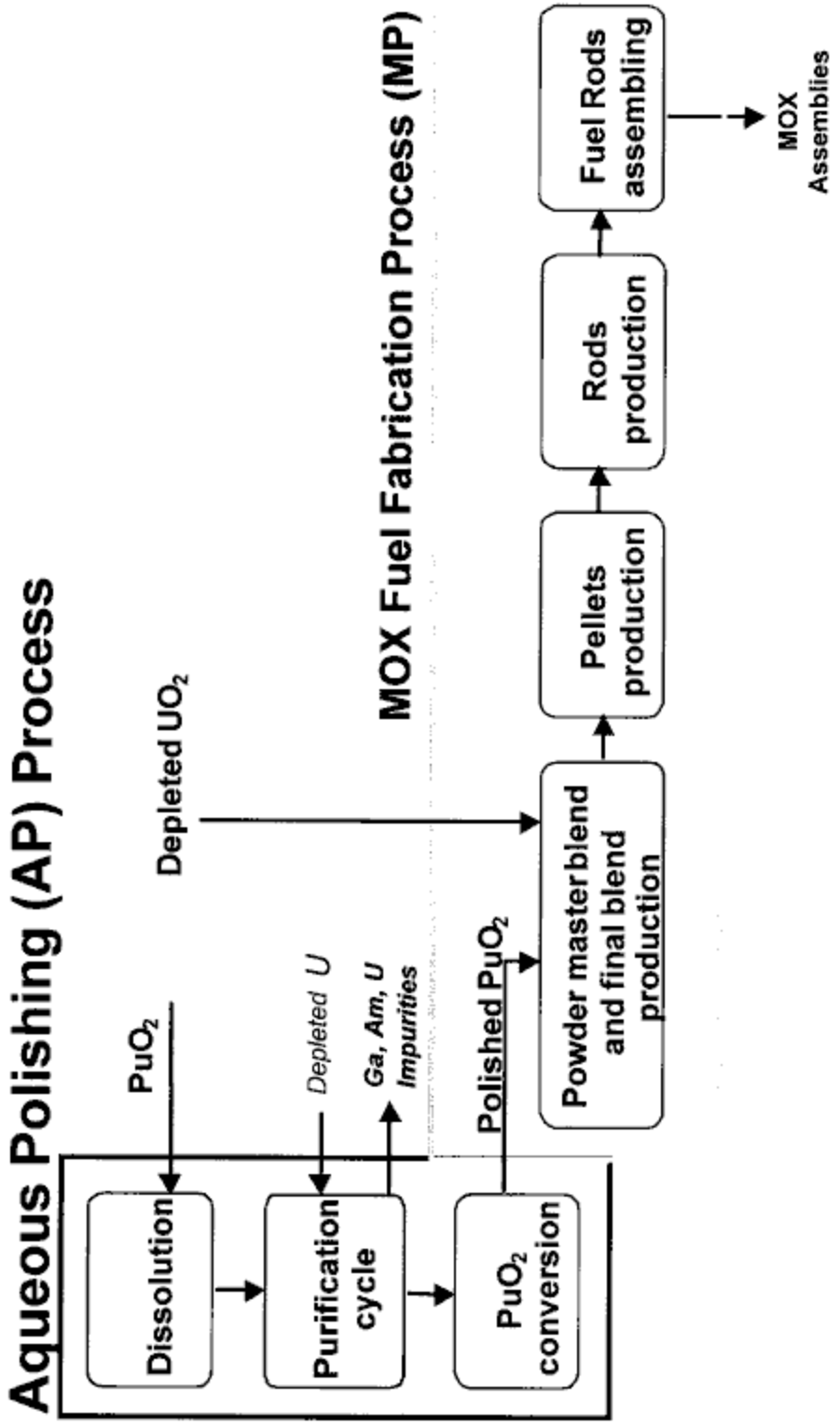

Figure 3-4. MOX Fuel Fabrication Production Process Flow

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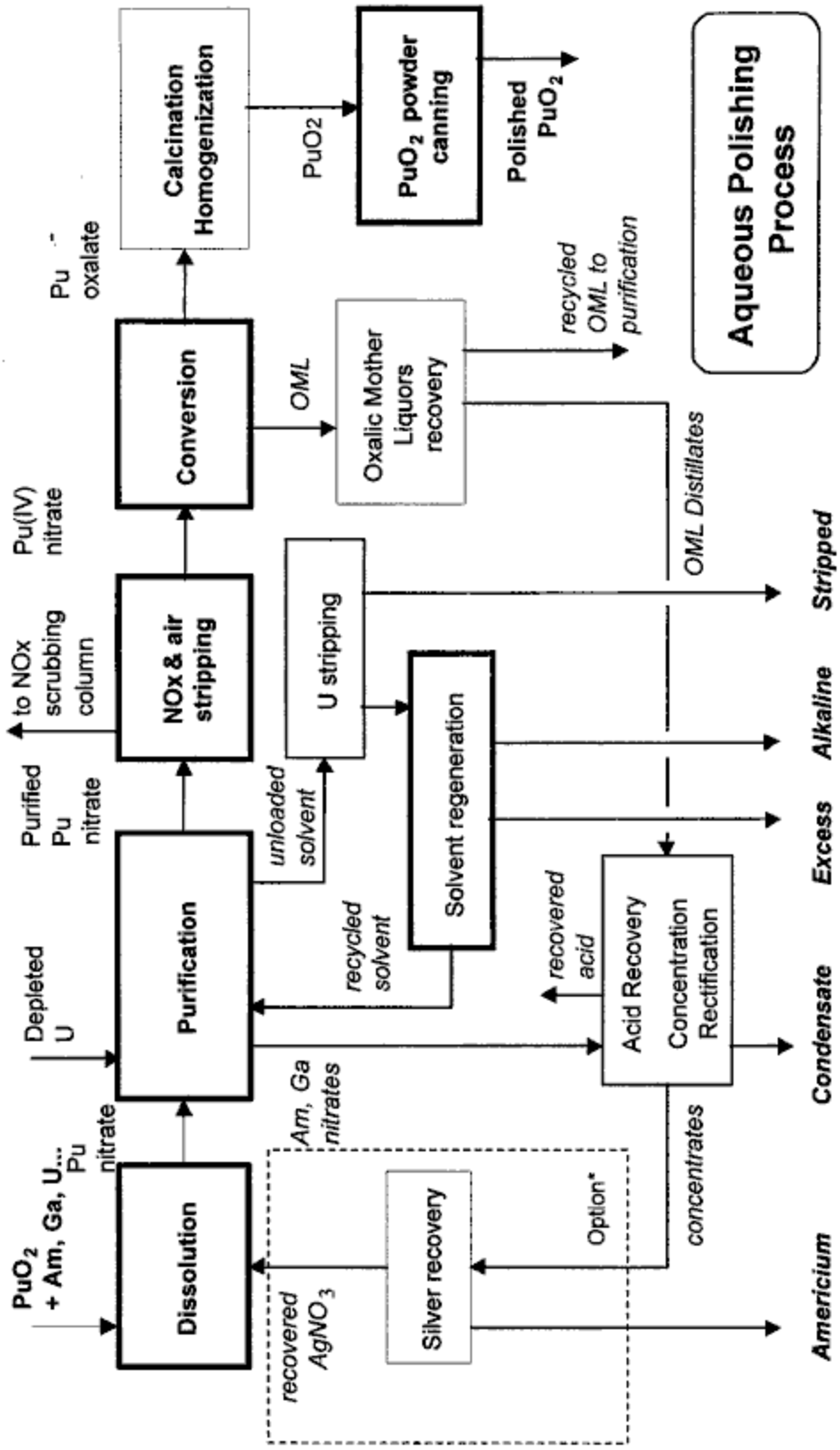

Figure 3-5. Plutonium Polishing Block Diagram

* DOE is evaluating elimination of silver recovery.

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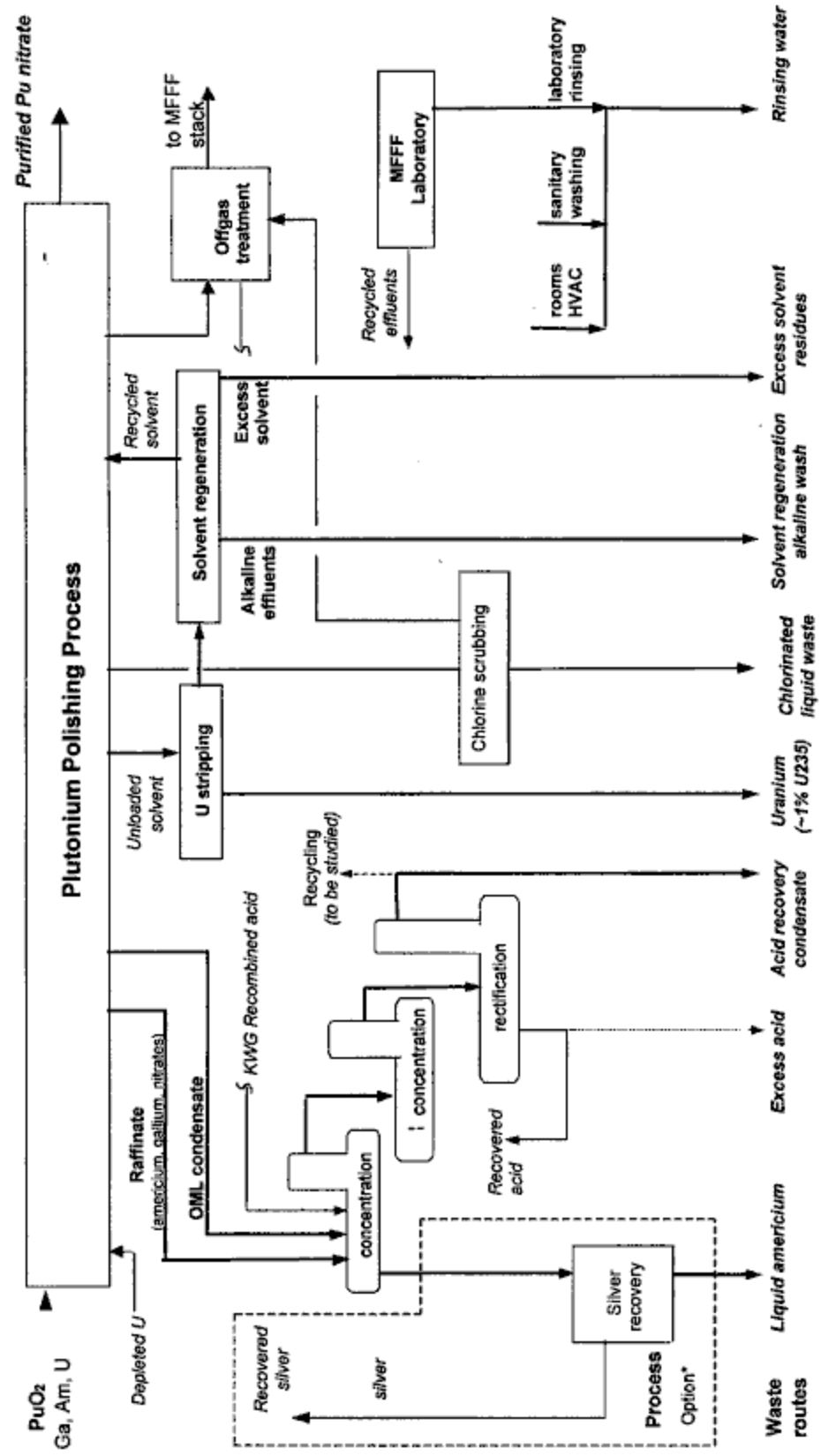

Figure 3-6. Aqueous Polishing Waste Streams

* DOE is evaluating elimination of silver recovery

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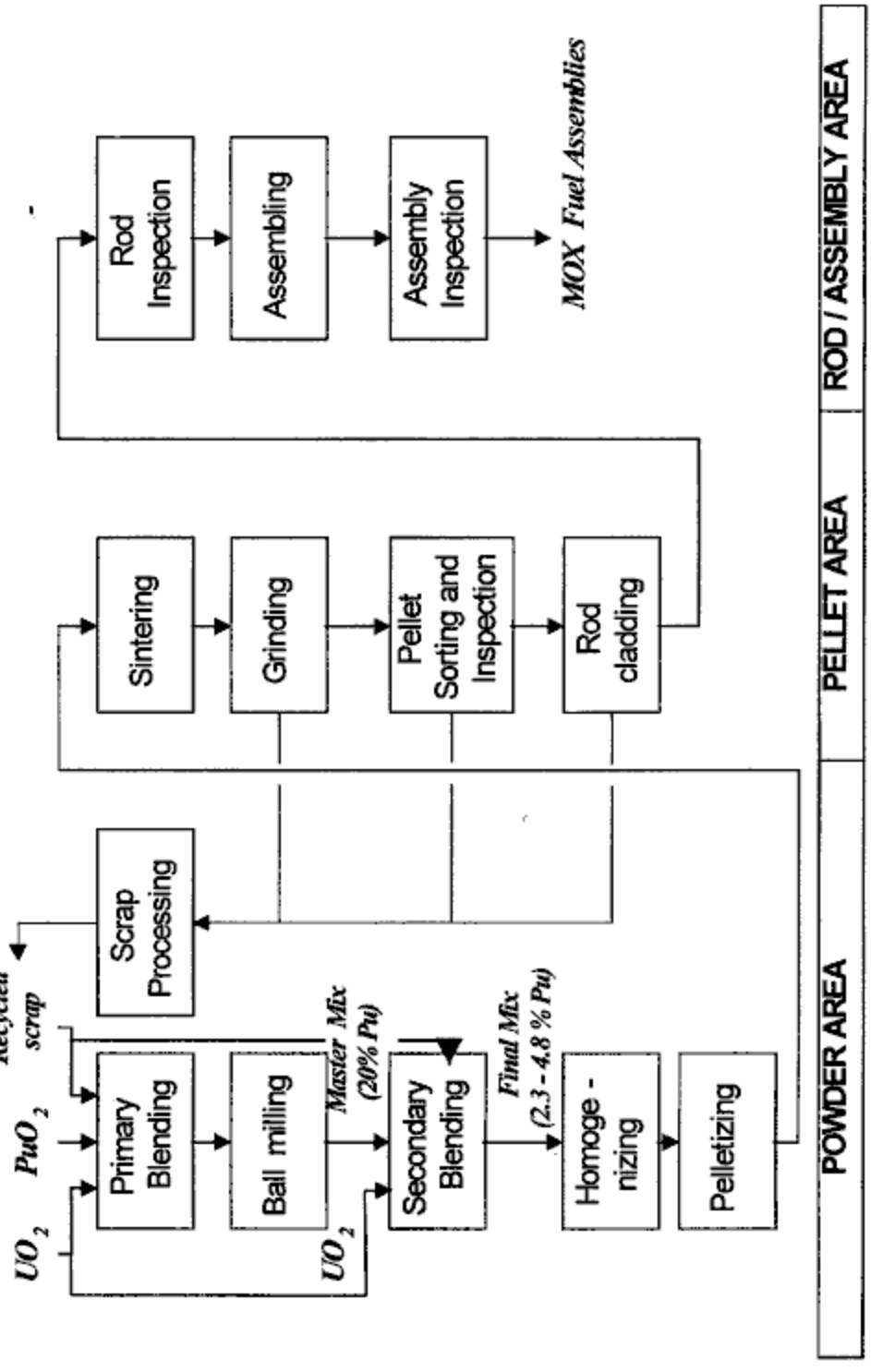

Figure 3-7. MOX Fuel Fabrication Processes

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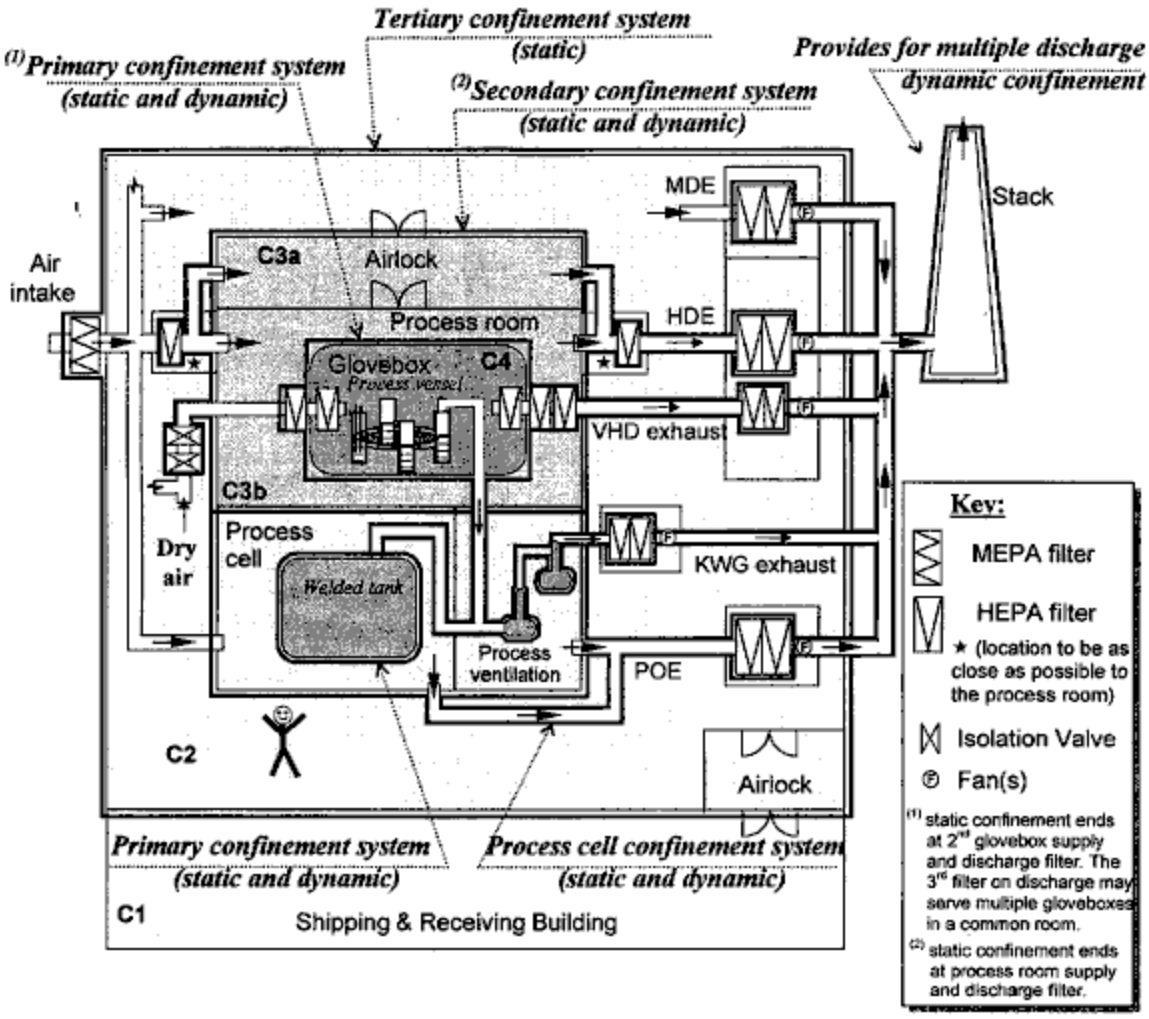

Figure 3-8. Ventilation Confinement for Aqueous Polishing

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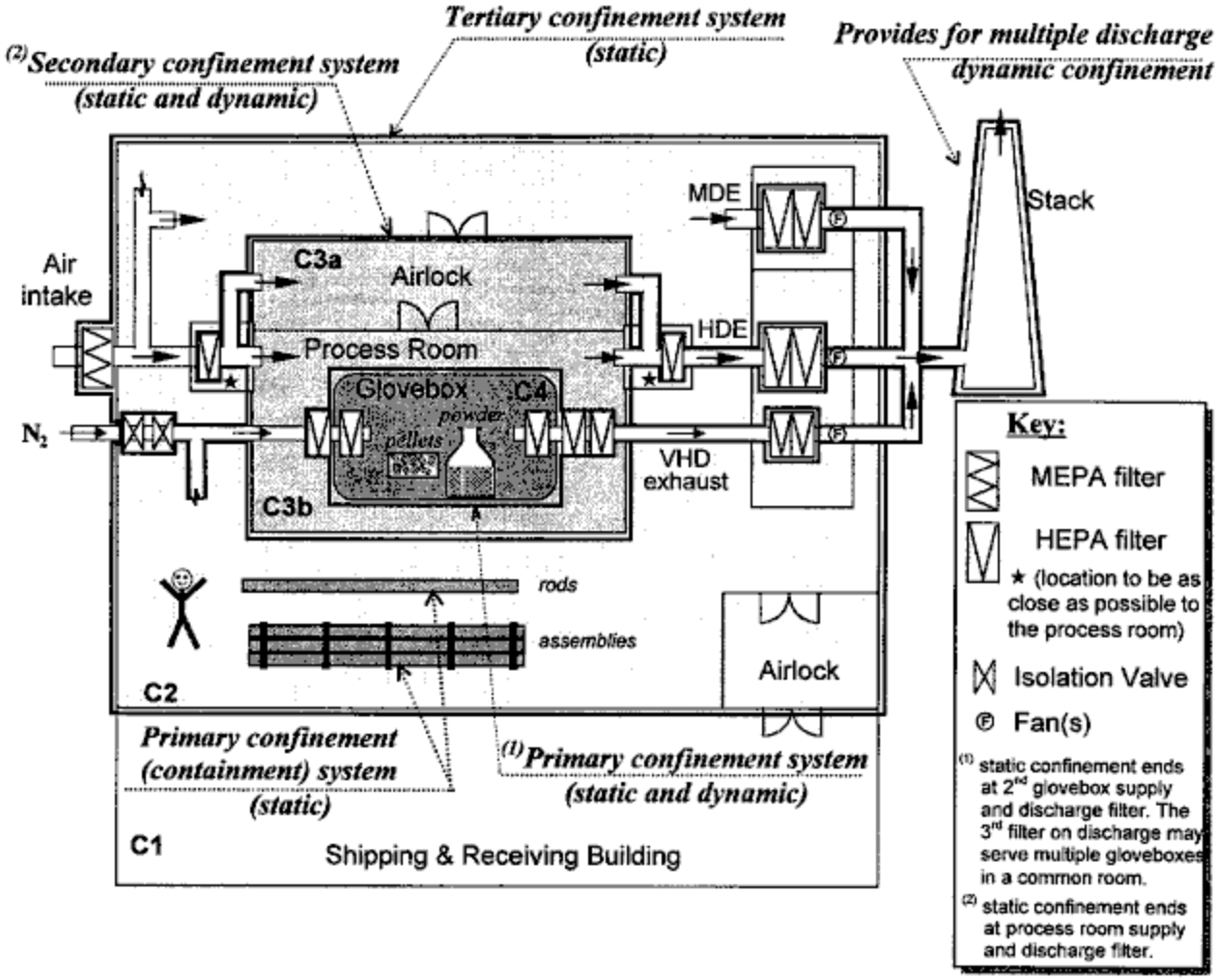

Figure 3-9. Ventilation Confinement for Fuel Fabrication

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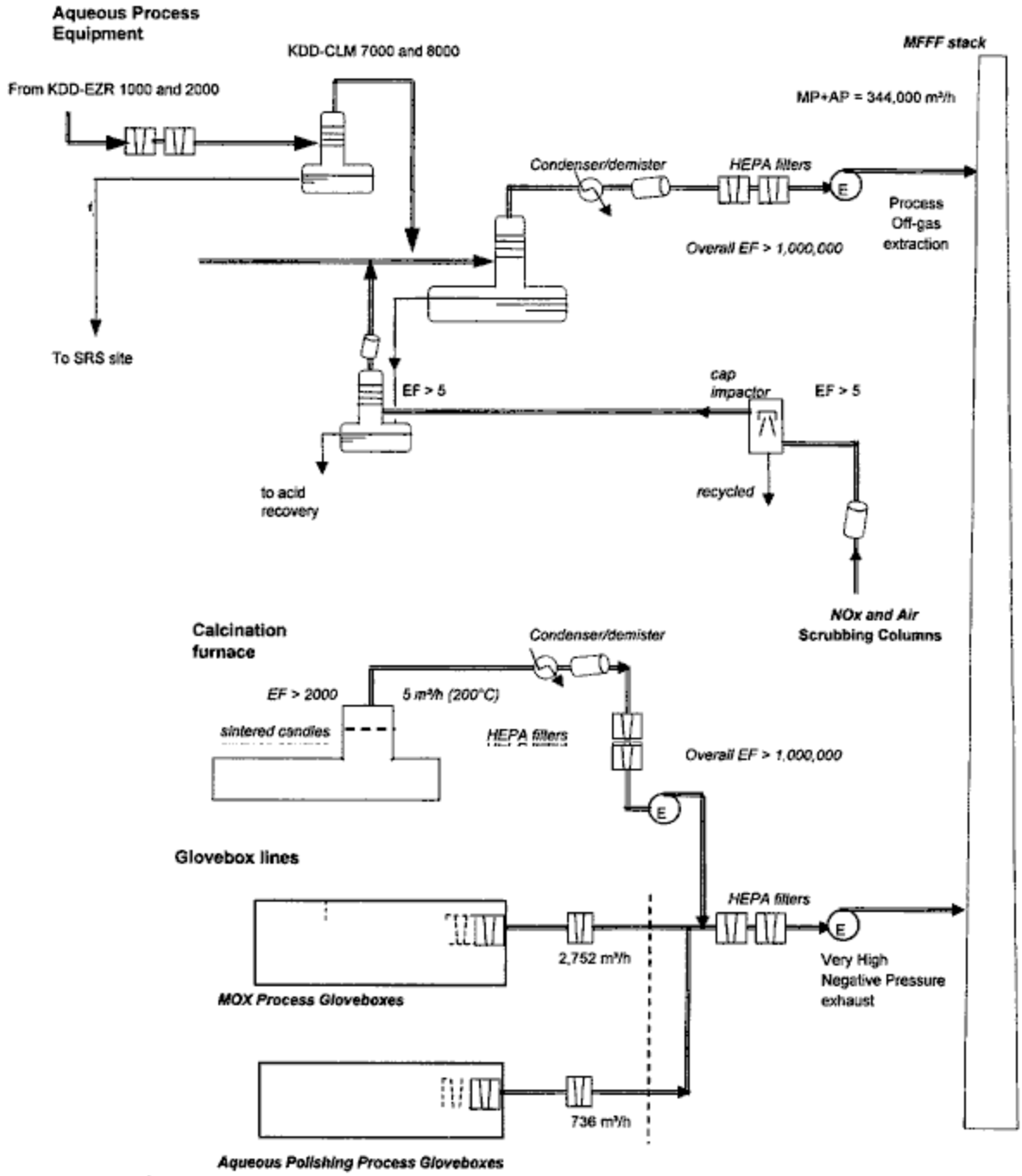

Figure 3-10. MFFF Airborne Waste Treatment Flowsheet

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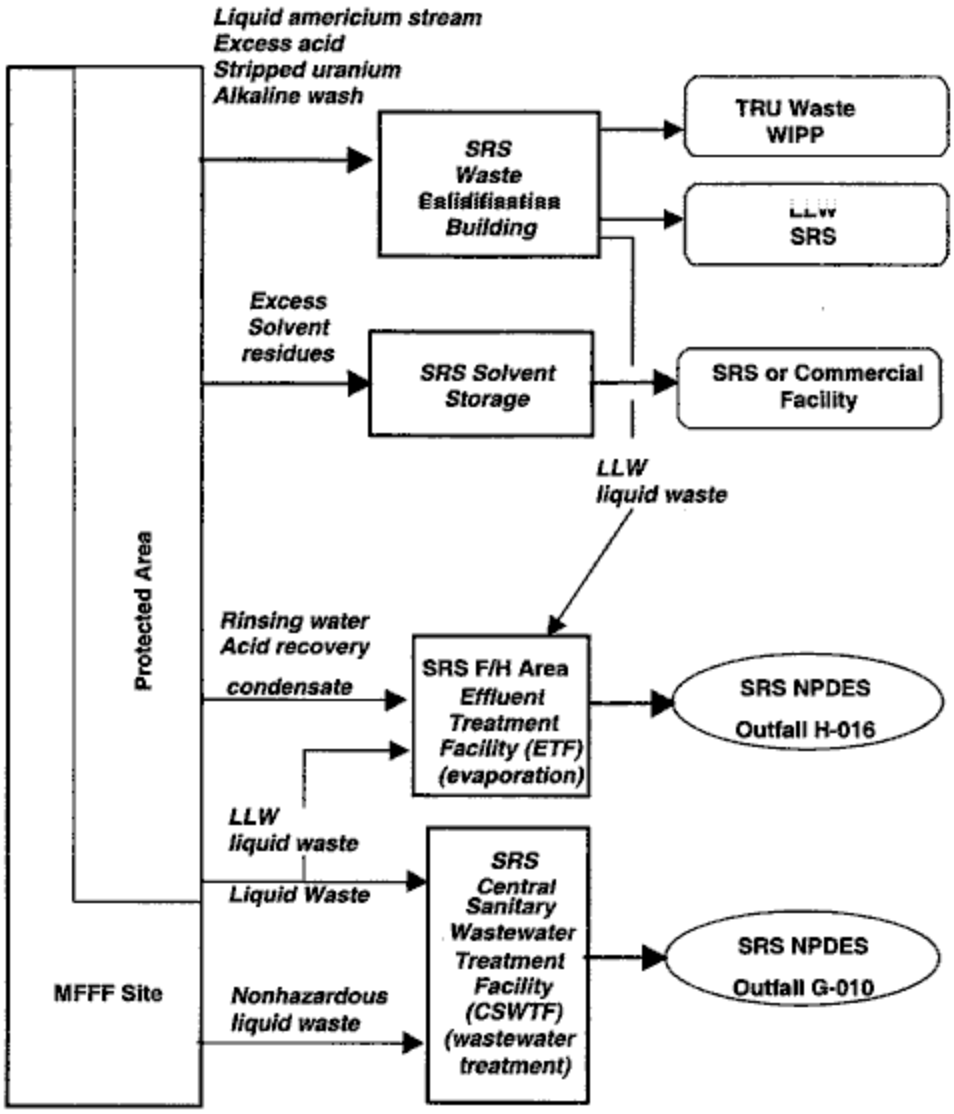

Figure 3-11. MFFF Liquid Waste Management Flow Diagram

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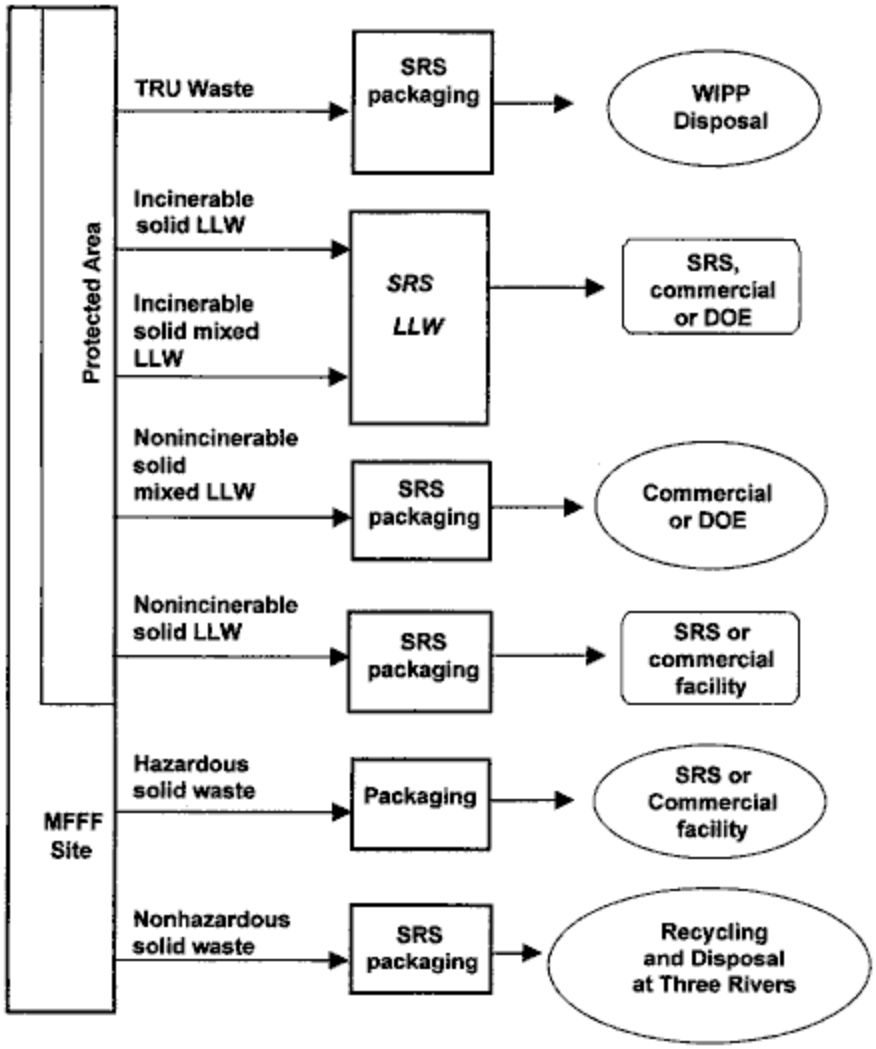

Figure 3-12. Solid Waste Management Flow Diagram

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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*
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

*** 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)	R2
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)		
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	

[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.

R2

R1

R1