10.0 ENVIRONMENTAL PROTECTION

10.1 CONDUCT OF REVIEW

This chapter of the draft Safety Evaluation Report (DSER) contains the staff's review of environmental protection measures described by the applicant in Chapter 10 of the Construction Authorization Request (CAR). The objective of this review is to determine whether principle structures, systems, and components (PSSCs) and their design bases identified by the applicant provide reasonable assurance of protection of the public and the environment against natural phenomena and the consequences of potential accidents. The staff evaluated the information provided by the applicant for environmental protection by reviewing Chapter 10 of the CAR, other sections of the CAR, supplementary information provided by the applicant, and relevant documents available at the applicant's offices but not submitted by the applicant. In some cases, the staff also performed independent calculations. The review of environmental protection design bases and strategies was closely coordinated with the review of the accident sequences described in the Safety Assessment of the Design Bases (see Chapter 5.0 of this DSER). The staff notes that this draft evaluation may require revision based on supplements to the CAR and the Environmental Report (ER) that the applicant plans to submit in October and July 2002, respectively, to reflect U. S. Department of Energy (DOE) changes to the Surplus Disposition Program.

The staff reviewed how the environmental protection information in the CAR addresses or relates to the following regulations:

- Section 70.23(b) of 10 CFR states, as a prerequisite to construction approval, that the design bases of the PSSCs and the quality assurance program be found to provide reasonable assurance of protection against natural phenomena and the consequences of potential accidents.

In the CAR, the applicant described its commitment to environmental protection in three areas: (1) radiation safety (as low as reasonably achievable [ALARA]) goals for effluent control and waste minimization, (2) design of effluent and environmental monitoring for normal and off-normal operations, and (3) design bases for PSSCs derived from the safety assessment, as necessary to ensure environmental protection. The staff focused its review on the applicant's safety assessment of the design bases for environmental protection PSSCs, which is discussed below in DSER Section 10.1.3. The staff also evaluated preliminary information provided by the applicant on ALARA goals and effluent and environmental monitoring programs. In regards to the design bases for environmental and public protection, this DSER chapter addresses the applicant's consequence methodology and results used to identify PSSCs that are relied upon to meet the public health and environmental performance requirements of 10 CFR 70.61(b)(2) and 70.61(c)(2)-(3). The staff used Chapter 10.0 in NUREG-1718 as guidance in performing the review.

10.1.1 Radiation Safety

The staff evaluated the applicant's radiation safety measures for environmental protection on the applicant's methods to maintain public doses ALARA in accordance with 10 CFR 20.1101 and the applicant's waste minimization practices.

10.1.1.1 ALARA Design Goals for Effluent Control

The applicant defined ALARA design goals for effluent control in CAR Section 10.1.1. The first goal is for airborne radioactive effluents released from the MFFF. This goal is 20 percent of the effluent concentration limits in 10 CFR Part 20, Appendix B, Table 2, Column 1, as determined at the restricted area boundary. The human dose corresponding to this goal, assuming an individual were present continuously over a year at the restricted area boundary, is 10 mrem TEDE. Therefore, this goal affords an initial level of protection for members of the public in the controlled area of 10 percent of the 100 mrem TEDE limit described in 10 CFR 20.1301(b). This fraction is consistent with staff expectations that an initial goal of 10 to 20 percent of Appendix B values or less can be achieved by almost all materials facility licensees, as stated in Regulatory Guide 8.37 (Reference 10.3.10), and therefore, is acceptable to the staff.

The applicant has also committed to a dose limit for an individual member of the public in the unrestricted area likely to receive the highest dose from the facility. This goal is 1 mrem per year total effective dose equivalent, or 10 percent of the 10 mrem constraint on air emissions specified in 10 CFR Part 20. This fraction is also consistent with staff expectations for an initial goal of 10 to 20 percent of the 10 CFR Part 20 constraint, as described in NUREG-1718 (Reference 10.3.6, Section 10.4.3), and therefore, is acceptable to the staff.

The applicant has not defined liquid effluent ALARA goals because the proposed MFFF will not discharge liquid effluent directly to the environment. This is acceptable because the applicant's proposal is to transfer low-level waste containing NRC-licensed material to DOE at SRS. DOE will perform additional treatment prior to discharge of this material. Therefore, these discharges would be regulated by DOE and would be subject to DOE ALARA considerations.

10.1.1.2 Air Effluent Controls to Maintain Public Doses ALARA

The confinement ventilation systems are described in DSER section 11.4. In summary, there are five major sources of ventilation exhaust that would contribute to air emissions from the facility stack. The following ventilation and air-conditioning systems are PSSCs or have individual components that are PSSCs:

- Process cell off-gas treatment system:
  - Final filters.
  - Pressure boundary downstream of the final filters.

- Process cell ventilation system:
  - Final filters.
  - Pressure boundary downstream of the final filters.
  - Tornado dampers.

- Medium depressurization exhaust system (which maintains the C2 confinement zone):
  - Final filters.
  - Pressure boundary downstream of the final filters.
  - Tornado dampers.

- High depressurization exhaust system (C3 confinement zone).

- Very high depressurization exhaust system (C4 confinement zone).

The applicant’s proposed design bases for these systems relies on NRC Regulatory Guide 3.12 (see Reference 10.3.9) American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), “Design Guide for Department of Energy Nuclear Facilities” (see Reference 10.3.1), for guidance. Additional design bases are described in DSER section 11.4.

The staff conclude that a commitment to these codes and standards should ensure that engineered effluent controls will be designed and constructed to meet the requirements for capacity, compartmentalization, safe shutdown, corrosion resistance, and efficiency required during normal and likely facility conditions to maintain public doses ALARA. The staff will review the applicant’s process controls and procedures that will augment these engineered controls and form the basis for a complete ALARA program during review of the Operating License application.

10.1.1.3 Liquid Effluent Controls to Maintain Public Doses ALARA

The proposed MFFF would not have liquid effluents that discharge directly to the environment. There are, however, four categories of liquid waste that must be managed. These waste streams are transferred to the Savannah River Site prior to final treatment and disposal. The four waste streams are the high alpha activity waste, solvent wastes, low-level liquid waste and nonhazardous liquid waste. Estimated volumes of each waste type are provided in DSER Table 10.1-1. Waste minimization practices identified by the applicant are discussed in DSER Section 10.1.1.5. PSSCs required to safety handle, store and transfer liquid wastes are discussed in DSER Chapter 5.0 and DSER Section 11.8.

10.1.1.4 ALARA Review and Reports to Management

The applicant has committed to a program of measuring trends in environmental monitoring and surveillance data against the effluent ALARA goals on a quarterly basis. The goals will be reevaluated and new goals will be established for the following year.

The staff has reviewed the applicant's brief description of the operational ALARA program. The applicant’s safety assessment of the design bases did not identify PSSCs or management measures within the purview of this program. The staff has reviewed the applicant's safety assessment and concur with this determination for the purpose of the construction authorization. However, the regulations in 10 CFR Parts 20 contain specific requirements for such a program that must be fully and adequately addressed in the applicant's subsequent license application to in order for the staff to make a licensing decision.

10.1.1.5 Waste Minimization

The applicant has provided an overview of their commitment to waste minimization practices in Section 10.1.4 of the CAR. The applicant’s proposal for incorporating waste minimization practices into the design process focuses on recycling and reuse of materials. During

Table 10.1-1
Potential for Intermediate Consequence Events Involving Liquid Waste Streams

Waste Category	Maximum Volume (gallons/year)	Normal Volume (gallons/year)	Representative Radionuclide	Maximum Concentration µCi/mL	5000 times Table2, Appendix B, to Part 20	Potential to Exceed Environmental Performance Requirement?	Disposition (1)
High Alpha Activity Waste	~57,000	~47,600	Am-241	470	1×10^{-4}	Yes	FOF
Excess Acid	1,321	1,321	Am-241	9.6×10^{-3}	1×10^{-4}	Yes	FOF
Stripped Uranium	42,350	35,400	U-238	5.4×10^{-3}	1.5×10^{-3}	Yes	FOF
Liquid Americium	10,000	8,350	Am-241	2.7×10^{3}	1×10^{-4}	Yes	FOF
Alkaline Wash	2,980	2,483	Pu-239	8.5×10^{-2}	1×10^{-4}	Yes	FOF
Solvent LLW	2,800	2,330	Pu-239	1.2×10^{-4}	1×10^{-4}	Yes	SRS Solvent Storage
Low-Level Aqueous Waste							
Rinsing Water	158,000	132,000	alpha	1×10^{-7}	1×10^{-4}	No	LLW or CSWTF
Distillate	101,500	85,540	Am-241	8.9×10^{-6}	1×10^{-4}	No	recycle or ETF
Nonhazardous Liquid Waste (1)	1,700,000	1,700,000	*Radionuclide concentrations in nonhazardous liquid waste are far below levels that could cause an intermediate consequence event.*				

(1) FOF - F Area Outside Facility; CSWTF - Central Sanitary Waste Treatment Facility; ETF - Effluent Treatment Facility
(2) Includes Non-contact HVAC condensate, Sanitary Waste and Contaminated Drains

operations, the applicant proposes to rely on waste management procedures to separate and segregate solid and liquid wastes and remove packaging and shipping materials prior to entry into contaminated areas.

The applicant will use active and passive confinement systems and vacuum systems inside gloveboxes. These systems are designed to allow recycling of materials from the secondary waste streams in the aqueous polishing (AP) process and mixed oxide process (MP) scraps back to the main processes. Specific AP process waste minimization steps include acid recovery, silver recovery, and solvent regeneration.

The applicant's safety assessment of the design basis has considered hazards in these areas. However, specific waste minimization practices and program commitments are not relied upon in the safety assessment to reduce the risk of these hazards. PSSCs relied upon to reduce the risks of hazards in the acid recovery, silver recovery, and solvent regeneration systems are described in Chapter 5, 8 and 11 of this CAR.

10.1.2 Effluent and Environmental Monitoring

The staff has reviewed the applicant's brief description of the Effluent and Environmental Monitoring Programs. The applicant's safety assessment of the design bases did not identify PSSCs or management measures within the purview of this program. The staff has reviewed the applicant's safety assessment in Chapter 5 and concur with this determination for the purpose of the construction authorization. However, the regulations in 10 CFR Part 20 contain specific requirements for such a program that must be fully and adequately addressed in the applicant's subsequent application for a 10 CFR Part 70 license.

The following sections describe the staff's evaluation of the Effluent and Environmental Monitoring Programs, to the extent that such information was provided by the applicant in the Environmental Report (see Reference 10.3.1) and CAR.

10.1.2.1 Concentrations of Radionuclides in Air Effluents and Public Doses

The applicant provided an estimate of maximum controlled area radionuclide concentrations (Reference 10.3.4. page 52), which is based on annual releases described in their Environmental Report (Reference 10.3.2, Table D-7), a 50 percent atmospheric dispersion parameter value (X/Q) of 2.5×10^{-4} seconds per cubic meter, a distance to a receptor from the plant stack of 52 meters, and the assumption that releases occur from ground level. This calculation demonstrates that the average controlled area concentration immediately outside the restricted area would be less than 34 percent of their ALARA goal. The staff performed an independent calculation using the methodology described in National Council on Radiation Protection and Measurements, Report 123, as described in NUREG-1718. The staff assumed a 28 meter stack height, no plume rise and a site-specific 3.6 meter per second annual average windspeed (see Reference 10.3.1), and that the wind blows downwind toward a receptor 100 percent of the time. The staff's estimate of the X/Q is 5×10^{-5} s m^{-3} at a distance of 400 meters. The staff's calculation demonstrates that the controlled area concentration would be less than 7 percent of the applicant's ALARA goal. The staff's analysis is summarized in DSER Table 10.1-2.

The applicant's estimate of the maximum potential dose to an individual member of the public in the unrestricted area is 4.1×10^{-4} mrem per year. The staff performed an independent analyses using GENII, the Hanford Environmental Radiation Dosimetry software system. The staff's result is 2.5 x 10^{-4} mrem per year, which is in good agreement with the applicant's value, given the uncertainties inherent in the assumptions related to environmental dosimetry analyses. The staff's value is 0.025% of the design ALARA goal.

Based on the staff's independent calculation, the known or expected concentrations of radioactive material in airborne effluents from the MFFF would be below the limits in 10 CFR Part 20, Appendix B, Table 2, and forms an acceptable basis for future ALARA evaluations as required by 10 CFR 20.1101(b).

Table 10.1-2, Air Effluent Concentrations from the MFFF

Radionuclide	Annual Releases [1]	NRC Average RABC [2]	DCS Average RABC[3]	20% of Part 20, App. B	NRC Ratio	DCS Ratio
Pu-236	1.3 x 10^{-8}	2.1 x 10^{-26}	1.0 x 10^{-25}	1 x 10^{-14}	1.7 x 10^{-12}	1.0 x 10^{-11}
Pu-238	8.5 x 10^{0}	1.3 x 10-^{17}	6.8 x 10^{-17}	4 x 10^{-15}	3.4 x 10^{-3}	1.7 x 10^{-2}
Pu-239	9.1 x 10^{1}	1.4 x 10^{-16}	7.6 x 10^{-16}	4 x 10^{-15}	3.6 x 10^{-2}	1.8 x 10^{-1}
Pu-240	2.3 x 10^{1}	3.6 x 10^{-17}	1.8 x 10^{-16}	4 x 10^{-15}	9.1 x 10^{-3}	4.6 x 10^{-2}
Pu-241	1.01 x 10^{2}	1.6 x 10^{-16}	8.1 x 10^{-16}	2 x 10^{-13}	8.0 x 10^{-4}	5.0 x 10^{-3}
Pu-242	6.1 x 10^{-3}	9.7 x 10^{-21}	4.9 x 10^{-20}	4 x 10^{-15}	2.4 x 10^{-6}	1.2 x 10^{-5}
Am-241	4.8 x 10^{1}	7.6 x 10^{-17}	3.8 x 10^{-16}	4 x 10^{-15}	1.9 x 10^{-2}	9.6 x 10^{-2}
U-234	5.1 x 10^{-3}	8.1 x 10^{-21}	4.1 x 10^{-20}	1 x 10^{-14}	8.1 x 10^{-7}	4.1 x 10^{-6}
U-235	2.1 x 10^{-4}	3.3 x 10^{-22}	1.7 x 10^{-21}	1 x 10^{-14}	2.8 x 10^{-8}	1.4 x 10^{-7}
U-238	1.2 x 10^{-2}	1.9 x 10^{-20}	9.6 x 10^{-20}	1 x 10^{-14}	1.6 x 10^{-6}	8.0 x 10^{-6}
				Totals	**0.07**	**0.34**

1. Reference 10.3.1.

2. RABC = Restricted Area Boundary Concentration. The atmospheric dispersion factor (X/Q) estimated by the staff for this table is based on a 28 meter stack height, no plume rise, and a site-specific 3.6 meter per second annual average windspeed (Reference 10.3.1). The maximum value is 5 x 10^{-5} seconds per cubic meter at a distance of 400 meters.

3. The atmospheric dispersion factor (X/Q) estimated by the applicant is based on 50% meteorology and a distance to the receptor of 52 meters (Reference 10.3.2). The maximum value is 2.5 x 10^{-4} seconds per cubic meter.

10.1.2.2 Physical and Chemical Characteristics of Radionuclides in Discharges

With regard to the provisions of 10 CFR 20.1302(c), the applicant does not propose to adjust the effluent concentration values that appear in Appendix B to 10 CFR Part 20, Table 2, for members of the public by taking into account the actual physical and chemical characteristics of the effluents (e.g., aerosol size distribution, solubility, density, radioactive decay equilibrium, chemical form). This is because the applicant intends to demonstrate compliance with the annual dose limit of 10 CFR 20.1301 using the dose methodology provided for in 10 CFR

20.1302(b)(1), and not the concentration-based methodology provided for in 10 CFR 20.1302(b)(2).

This approach is consistent with the requirements of 10 CFR Part 20, and therefore, is acceptable to the staff.

10.1.2.3 Air Effluent Discharge Location and Effluent Monitoring

CAR Section 10.2.1.4 indicates that the discharge location for radioactive air effluents from the MFFF is the facility stack located on the roof of the MP process building. This stack would be 28 meters tall and would discharge up to 201,880 cubic feet per minute (CFM) during normal operations. The applicant has committed to use two redundant continuous air monitors (CAMs) and two fixed airborne particulate matter samplers to monitor MFFF air effluent. The applicant has also committed to separately quantify the contributions from the AP and MP processes using two additional CAMs before the two streams are commingled prior to discharge from the single stack. The applicant also proposes to sample air effluent contributions from areas not used for processing special nuclear material.

The applicant has proposed to submit additional information, including, for example, sample collection and analysis procedures, a description of action levels, pathway analyses for public doses and recording and reporting procedures with the license application for possession and use of special nuclear material (SNM).

The staff finds that these commitments are consistent with the regulatory requirements for 10 CFR 20.1302(a) and the staff's review guidance in NUREG-1718, Section 10.4.3.B, and therefore, are acceptable to the staff.

10.1.2.4 Environmental Monitoring Program

The applicant committed to a pre-operational environmental monitoring program in CAR Section 10.3. This program will:

- Establish a baseline of existing radiological, chemical, physical, and biological conditions in the area of the site and develop an understanding of the critical pathways that could transport contaminants to human and other receptors.

- Determine the presence of contaminants that could be a safety concern for construction personnel, and

- Evaluate procedures, equipment, and techniques used in the collection and analysis of environmental data and train personnel in their use.

To accomplish these goals, the applicant commits to making full use of the data provided from the extensive Savannah River Site (SRS) environmental monitoring program and augment the SRS environmental studies with additional sample collections, as necessary. The decision to take additional samples will be based on evaluations in the applicant's Environmental Report and MFFF operating experience.

With regards to expected impacts, the nonradiological impacts to the environment from the construction of the MFFF, if authorized, are expected to be minimal. The applicant expects that nonradiological monitoring prescribed through various environmental permits will be sufficient through construction and operation of the MFFF.

As part of the preoperational program described in CAR section 10.3, the applicant committed to taking direct radiation measurements, air sampling, soil sampling, and vegetation sampling with analyses for uranium and plutonium and other radionuclides of interest. These commitments are consistent with the criteria stated in NUREG-1718, section 10.4.3 (B)(ii) for construction authorization and are acceptable to the staff.

10.1.3 Safety Assessment of the Design Bases

The staff's evaluation of the applicant's environmental protection measures at the construction authorization stage focuses on the potential accident sequences that result in radiological releases to the environment, the PSSCs relied upon for safety that are specified by the applicant to reduce the risk of these accidents, and the associated management measures that provide reasonable assurance that the PSSCs will perform their designated safety functions as required by 10 CFR Part 70.

10.1.3.1 Consequence Assessment Methodologies

In their safety assessment, the applicant calculated committed doses to individuals outside the controlled area (i.e., the public) and concentrations of radioactive material in the environment outside the restricted area from each accident to demonstrate risks from event consequences were reduced to acceptable levels. The consequence assessment methodology used by the applicant for dose consequences at the controlled area boundary is the same methodology used for the site worker, as described in Chapter 9.0 of this DSER, with the exception of the value of the atmospheric dispersion factor. The atmospheric dispersion factor that the applicant derived for the distance from the MFFF to the controlled area boundary is 3.7×10^{-6} seconds per cubic meter. This value was confirmed by the staff using MACCS2 (see Reference 10.3.7) and site-specific meteorological data.

The consequence assessment methodology used to comply with the 10 CFR 70.61(c)(3) performance requirement is also similar to the methodology presented for site workers in Chapter 9.0 of this DSER. However, the use of the respirable fraction (RF) as a reduction factor in calculations demonstrating that concentrations fall below the 10 CFR 70.61(c)(3) intermediate consequence threshold is not acceptable to the staff. This is because the 10 CFR 70.61(c)(3) concentration pertains to total concentrations in the environment, and not doses to human receptors resulting from intake of respirable particles.

The restricted area boundary is approximately 52 meters from the MFFF discharge stack. The atmospheric dispersion factor that the applicant derived for this location is 8.39×10^{-4} seconds per cubic meter. The applicant also derived an atmospheric dispersion factor for the Secured Warehouse, which contains stocks of depleted uranium. This value is 2.71×10^{-3} seconds per cubic meter, based on a distance from the warehouse to the restricted area boundary of approximately 28 meters.

As a result, the equation used to calculate environmental consequences is:

$$[EC]_x = \{[\text{Source Term} / RF] \times [X/Q]^{RA} \times [f]_x\} / (3600 \text{ s hr}^{-1} \times 24 \text{ hr})$$

where Source Term is the same as described in Chapter 9.0 of this DSER, RF is the respirable fraction (which is divided back into the source term to negate the reduction applied for human consequence source terms), the f_x is the specific activity and the fraction of the total quantity of the MAR that is the radionuclide X, and $[X/Q]^{RA}$ is the value of the atmospheric dispersion factor for either the MFFF stack or the Secured Warehouse, as described above.

The use of this equation is consistent with the staff's guidance in NUREG/CR-6410 and the regulations in 10 CFR 70.61(c)(3), and therefore, is acceptable to the staff.

10.1.3.2 Applicant's Exceptions in the Environmental Consequence Assessment

In the CAR submitted in February 2001, the applicant proposed a safety strategy for environmental protection that would be based entirely on measures taken to reduce the risk to individuals outside the controlled area. In response to staff's comments on the methodology employed by the applicant to calculate environmental consequences, the applicant revised their safety assessment and submitted a revised safety assessment summary in March 2002 (see Reference 10.3.4). In the assessment of event consequences affecting the environment, the applicant took exception to the use of certain values for parameters used in the human dose consequence assessment. For example, for the purposes of estimating environmental consequences, the applicant adjusted quantities of material at risk in specific events. The applicant also modified atmospheric release fractions, damage ratios and leak path factors by choosing values that were generally lower than previously assumed for human dose consequences.

The staff continues to evaluate the applicant's exceptions to ensure that the applicant maintained reasonable conservatism in their analyses.

10.1.3.3 Radiation Doses to Members of the Public from Accidents

In Chapter 5 of the CAR, the applicant presents the mitigated bounding event consequences for the five major categories of events: fire, explosion, loss of confinement, load handling events and criticality. The staff performed independent calculations for these bounding events and the bounding events within each event group from which the overall event type bounding event was selected. The results are provided in DSER Table 10.1-3.

The staff has not accepted the applicant's use of a leak path factor equal to 10^{-4} for the final two high efficiency particulate air (HEPA) filters for events in which the performance of the final filters would be challenged by conditions posed by the event. For these events, which include fires and explosions, the staff has used a value of 10^{-2}, which corresponds to a removal efficiency of 99 percent across the two stage HEPA filters system, as described in Section 11.4 of this DSER.

With the exception of fire and explosion events, the staff's values are in close agreement with the applicant's values, both of which are based entirely on the methodology presented in NUREG/CR-6410 (NRC, 1998). Therefore, with the exception of the leak path factors used by the applicant for fires and explosions, the staff find that the applicant's methodology for public consequence analysis is acceptable. Leak path factor adequacy is identified as an open item in DSER Section 11.4.

10.1.3.4 Environmental Consequences

The staff has determined that the applicant's estimates of environmental consequences of bounding events provided in the CAR are not accurate for the reasons stated in Section 10.1.3.1 of this DSER. The applicant did not revise these estimates, but has submitted a revised list of PSSCs based on the methodology discussed in Section 10.1.3.1 of this DSER and the exceptions to the safety assessment consequence parameter values evaluated in DSER Section 10.1.3.2. The staff's evaluation of consequences for event groups using the DSER Section 10.1.3.1 methodology is provided in DSER Table 10.1-3.

With regard to hazards posed by liquid wastes, the staff found that the applicant has not considered the unmitigated spill of solvent wastes outside the restricted area as an intermediate consequence event. The staff's evaluation of radioactivity concentrations in the solvent waste (shown in DSER Table 10.1-1) indicates that concentrations exceed the 10 CFR 70.61(c)(3) performance requirement. Therefore, the applicant should identify PSSCs and design bases for this event or justify why none are necessary.

Table 10.1-3. Controlling Hazard Event Consequences for the Public and the Environment

Event	Event Description	MAR	MAR, kg	DR	ARF	RF	LPF	Public Dose, rem (1)	Environmental Consequence (1)
Loss of Confinement Events									
AP-11	Electrolyzer fire	PuO_2	14	1	2×10^{-3}	1	0	P	P
FW-11	Pneumatic failure affecting PuO_2 in buffer pot	PuO_2	2.7	1	2×10^{-3}	0.3	10^{-4}	4.5×10^{-6}	0.0037
GB-5	Glovebox backflow to interfacing supply line	PuO_2	19	1	4×10^{-5}	1	10^{-4}	2.1×10^{-6}	0.00052
AP-42	Silver Recovery Leak	Am	0.97	1	4×10^{-7}	1	1	1.3×10^{-3}	0.40
RC-7	3013 Can Breach	PuO_2	2.4	1	4×10^{-5}	1	1	2.9×10^{-3}	0.70
RD-11	Fuel Rod Tray Drop	PuO_2	63	0.001	3×10^{-5}	1	1	5.2×10^{-5}	0.013
MA-5	C3 area filter transfer container breach	PuO_2	9	1	10^{-2}	1	10^{-4}	2.5×10^{-4}	0.062
MA-5	C2 area filter transfer container breach	PuO_2	9	1	10^{-2}	1	0	P	P
GB-3	Rapid overpressurization of calciner	PuO_2	1.2	1	5×10^{-3}	0.3	10^{-4}	5.0×10^{-6}	0.0041
RC-5	3013 can storage	PuO_2	8,300	1	4×10^{-5}	1	0	P	P
HV-5	C4 glovebox loss of negative pressure	PuO_2	0.0002	1	1	0.3	10^{-4}	9.1×10^{-10}	7.3×10^{-7}
Fire Events									
AP-4	Dissolution Tanks Room	PuO_2	60	1	2×10^{-3}	1	0	P	P
GB-1	PuO_2 Buffer Storage Area	PuO_2	390	1	6×10^{-3}	0.1	0	P	P
RC-1	PuO_2 3013 Storage	PuO_2	8300	1	6×10^{-3}	0.1	0	P	P
RC-3	3013 transport cask	PuO_2	120	1	6×10^{-3}	0.1	0	P	P
AS-1	Fuel Assembly Storage Area	6MOX	59000	1	5×10^{-4}	1	0	P	P
AS-11	MOX fuel transport cask	6MOX	1500	1	5×10^{-4}	1	0	P	P
AS-13	Waste container	PuO_2	0.04	1	5×10^{-4}	1	1	6.1×10^{-4}	0.15
MA-2	Transfer container	PuO_2	9	1	6×10^{-3}	0.1	0	P	P

Event	Event Description	MAR	MAR, kg	DR	ARF	RF	LPF	Public Dose, rem (1)	Environmental Consequence (1)
HV-1	Final C4 HEPA filter	PuO_2	6	1	6×10^{-3}	0.1	0	P	P
SF-2	Fire in Support Facilities	DUO_2	37,500	1	5×10^{-4}	1	1	8.6×10^{-4}	0.59
FW-2	Pneumatic transfer system	PuO_2	2.7	1	6×10^{-3}	0.1	10^{-4}	4.5×10^{-6}	0.011
FW-1	Entire facility	Event involving entire facility is prevented by fire barrier							P
Load Handling Events									
AP-27	Dissolution Tanks Room	PuO_2	60	1	4×10^{-7}	1	1	7.3×10^{-4}	0.17
GB-9	Load Drop in Jar Storage & Handling	PuO_2	337	1	2×10^{-3}	0.3	10^{-4}	5.6×10^{-4}	0.46
RC-12	3013 canister	PuO_2	9.6	1	2×10^{-3}	0.3	0	P	P
RC-17	3013 transport cask	PuO_2	4.8	1	2×10^{-3}	0.3	0	P	P
AS-7	Fuel Assembly Drop	6MOX	1000	0.02	3×10^{-5}	1	1	1.0×10^{-3}	0.25
AS-14	MOX fuel transport cask	6MOX	1500	0.02	3×10^{-5}	1	0	P	P
AS-12	Waste container	PuO_2	0.04	1	2×10^{-3}	0.3	1	7.3×10^{-4}	0.58
FW-20	Transfer container with glovebox HEPA filters	PuO_2	9	1	10^{-2}	1	0	P	P
HV-15	Final C4 HEPA filter load drop	PuO_2	6	1	10^{-2}	1	0	P	P
AP-36	Full convenience can	PuO_2	2.4	1	2×10^{-3}	0.3	10^{-4}	4.4×10^{-6}	0.0035
SF-14	Waste transfer line breach	Am	2.5	1	2×10^{-5}	1	0	P	P
FW-15	Load drop outside breaches primary confinement	Consequences prevented by MFFF structures and material handling controls							
Explosion Events									
PT-4	H2 Explosion in Sintering Furnace	6MOX	360	1	10^{-2}	1	0	P	P
AP-6	Radiolysis in Dissolved Pu Storage	PuO_2	60	1	1	0.01	0	P	P
AP-8/AP-9	HAN/Hydrazine Explosion	PuO_2	3.3	1	1	0.01	0	P	P

Event	Event Description	MAR	MAR, kg	DR	ARF	RF	LPF	Public Dose, rem (1)	Environmental Consequence (1)
AP-37	Hydrogen Peroxide Explosion	PuO_2	30	1	1	0.01	0	P	P
AP-38	Solvent Explosion	PuO_2	40	1	1	0.01	0	P	P
AP-39	TBP-Nitrate (Red Oil) Explosion	PuO_2	3.3	1	1	0.01	0	P	P
FW-4	AP Vessel Over-Pressurization	PuO_2	60	1	1	0.01	0	P	P
FW-3	Pressure Vessel	PuO_2	60	1	1	0.01	0	P	P
MA-4	Laboratory Explosion	PuO_2	0.005	1	1	0.01	10^{-2}	1.5×10^{-5}	0.36
All	Outside the Facility	*MFFF, Emergency Diesel Generator Building and Waste Transfer Line designed to withstand explosion*							
AP-25	Inadvertent Nuclear Criticality	*Consequence methodology based on Regulatory Guide 3.71 and 3.35*						5.5×10^{-3} (2)	1.4 (2)

(1) "P" indicates an event consequence to the receptor will be prevented. In some cases, the event (e.g., fire) is actually prevented by PSSCs and in other cases the event is prevented from impacting radioactive material. In both cases, the consequences are prevented.

(2) Consequences of the criticality event are provided for completeness. The applicant's safety strategy is to prevent this event.

10.1.3.5 PSSCs for Protection of the Public and the Environment

The PSSCs required for protection of the public and the environment for each of the controlling events within event groups shown in DSER Table 10.1-3 are discussed in Chapter 5.0 of this DSER and in other sections as referenced in DSER Table 5.1. As discussed above, the applicant used acceptable methods for estimating consequences from accident sequences that result in radiological releases to the environment. A comparison of the applicant's and the staff's analysis of bounding consequences from hazard event groups and categories is presented in Table 10.1-4.

Table 10.1-4 Bounding Consequences from Event Groups and Categories

Bounding Event	Public, rem		Environmental Consequences, Ratio	
	Applicant	NRC	Applicant	NRC
Loss of Confinement[a]	7.8×10^{-4}	2.9×10^{-3}	8.8×10^{-4}	0.70
Internal Fire	7.8×10^{-4} [b]	6.1×10^{-4} [c]	8.8×10^{-4} [b]	0.15 [c]
Load Handling[d]	6.7×10^{-4}	1.0×10^{-3}	7.6×10^{-4}	0.25
Criticality[e]	1.2×10^{-2}	1.8×10^{-2}	5.5×10^{-3}	1.4
Explosion[f]	2.7×10^{-3}	1.5×10^{-5}	2.8×10^{-2}	0.36

[a] The bounding event evaluated by the applicant is caused by an internal fire involving the Plutonium Buffer Storage Unit. However, the applicant has committed to make this type of fire unlikely. The staff's value is for the event in which the 3013 inner can is breached while in the C2 confinement zone.

[b] The applicant considers the bounding interval fire event to also be the bounding loss of confinement event.

[c] The Plutonium Buffer Storage Unit fire will be unlikely. Therefore, the staff determined that the waste container fire is the bounding event consequence.

[d] Bounding event evaluated by the applicant is a drop of jars containing plutonium in the Jar Storage and Handling Unit. The staff's analysis indicates that the fuel assembly drop is bounding.

[e] Event type prevented by design. Consequences are provided for completeness.

[f] The applicant considered an explosion in a process cell as bounding. The staff's evaluation excludes prevented events and is limited to the consequences of the laboratory explosion.

10.2 EVALUATION FINDINGS

In Section 10.5 of the CAR, DCS provided design basis information for environmental protection PSSCs that it identified for the proposed MFFF. Based on the staff's review of the CAR and supporting information provided by the applicant relevant to environmental protection, the staff finds that due to the open items discussed above and listed below, the staff cannot conclude, pursuant to 10 CFR 70.23(b), that the design bases of the PSSCs identified by the applicant will provide reasonable assurance of protection against natural phenomena and the consequences of potential accidents.

The staff concludes that:

- The applicant has committed to an acceptable ALARA goal for effluent control for design of the MFFF. Goals for members of the public in both the controlled area and in the unrestricted are equivalent to 10 percent of the limits in 10 CFR Part 20.

- The applicant's commitments to design standards and codes for air effluent controls will ensure public doses are ALARA.

- The staff finds the applicant's commitment to waste minimization practices will meet the requirements of 10 CFR 20.1406.

- The staff conclude that the applicant's description of effluent and environmental monitoring is commensurate with the level of design detail available at the construction authorization stage. The staff accept the applicant's commitment to provide additional detail on this program with the application to possess and use SNM.

The open items are as follows:

- The staff evaluated the environmental consequence methodology used by the applicant in the safety assessment of the design bases and finds the methodology to be acceptable. However, upon initial review of the applicant's calculation, the staff finds that, for certain events, the applicant used less conservative values for some of the parameters used to calculate environmental consequences, as compared to the parameter values used for the site worker and public consequence analysis. The staff finds that these exceptions result in a less conservative analysis; the staff is continuing its review to ensure the results remain sufficiently conservative to ensure an adequate margin of safety. (Section 10.2.3.2) (ES-1)

- The staff has evaluated the extent to which the applicant included liquid waste streams in the safety assessment of the design basis. With the exception of the solvent waste stream, the applicant identified PSSCs that will reduce the risks posed by accidents and natural phenomena hazards impacting these wastes. The applicant's failure to identify solvent wastes as a hazard requiring PSSCs to reduce the risk from spills is an open item in the staff's review. (Section 10.1.3.4) (ES-2)

DCS has stated that it will provide additional information concerning open items identified by the staff as ES-2 (Reference 10.3.11).

10.3 REFERENCES

10.3.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE), "Design Guide for Department of Energy Nuclear Facilities," DOE: Washington, D.C., 1993.

10.3.2 Hastings, P., Duke Cogema Stone & Webster, letter to U.S. Nuclear Regulatory Commission, MFFF Environmental Report, December 19, 2000.

10.3.3 Hastings, P., Duke Cogema Stone & Webster, letter to U.S. Nuclear Regulatory Commission, Clarification of Responses to NRC Request for Additional Information, DCS-NRC-000083, February 11, 2002.

10.3.4 Hastings, P., Duke Cogema Stone & Webster, letter to U.S. Nuclear Regulatory Commission, Clarification of Responses to NRC Request for Additional Information, March 8, 2002.

10.3.5 National Council on Radiation Protection and Measurements (NCRP). No. 123, "Screening Models for Releases of Radionuclides to Atmosphere, Surface Water and Ground, Recommendations of the National Council on Radiation Protection and Measurements." NCRP: Bethesda, Maryland. January 22, 1996.

10.3.6 Nuclear Regulatory Commission (U.S.) (NRC). NUREG-1718, "Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility." NRC: Washington, D.C. August 2000.

10.3.7 _____. NUREG/CR-4691, "MELCOR Accident Consequence Code System (MACCS)." NRC: Washington, D.C. February 1990.

10.3.8 _____. NUREG/CR-6410, "Nuclear Fuel Cycle Facility Accident Analysis Handbook." NRC: Washington, D.C. March 1998.

10.3.9 _____. Regulatory Guide 3.12, "General Design Guide for Ventilation Systems of Plutonium Processing and Fuel Fabrication Plants," NRC: Washington, D.C. 1973.

10.3.10 _____. Regulatory Guide 8.37, "ALARA Levels for Effluents from Materials Facilities," NRC: Washington, D.C. 1973.

10.3.11 Hastings, P., Duke Cogema Stone & Webster, letter to U.S. Nuclear Regulatory Commission, RE Clarification of Responses to NRC Request for Additional Information, April 23, 2002.