5.0 SAFETY ASSESSMENT OF THE DESIGN BASIS

5.1 CONDUCT OF REVIEW

This chapter of the revised Draft Safety Evaluation Report (revised DSER) contains the staff's review of the safety assessment of the design bases of the principal structures, systems and components (PSSCs) performed by the applicant in Chapter 5 of the revised Construction Authorization Request (revised CAR) (Reference 5.3.8). The objective of this review is to determine whether the PSSCs and their design bases identified by the applicant provide reasonable assurance of protection against natural phenomena and the consequences of potential accidents. The staff evaluated the information provided by the applicant by reviewing Chapter 5 of the revised CAR, other sections of the revised CAR, supplementary information provided by the applicant, and relevant documents available at the applicant's offices but not submitted by the applicant. The review of PSSCs and their design bases and strategies was closely coordinated with the review of evaluations performed in other chapters of the revised DSER.

The staff reviewed how the safety assessment information in the revised CAR addresses or relates to the following regulations:

- Section 70.23(b) of 10 CFR (Reference 5.3.5) 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."

- Sections 70.61(b-c) of 10 CFR set forth performance requirements addressing specified "high-consequence" events, and "intermediate-consequence" events. For such events, controls must be identified and eventually implemented sufficient to either lessen the likelihood that such events will occur, and/or make the consequences of such events less severe.

- Section 70.62(c)(2) of 10 CFR requires the applicant to have a team with expertise in engineering and process operations. The team must have at least one person who has experience and knowledge specific to each process being evaluated, and persons who have experience in nuclear criticality safety, radiation safety, fire safety and chemical process safety. One member of the team must be knowledgeable in the specific analysis methodology being used. The NUREG-1718 , "Standard Review Plan (SRP) for the Review of an Application for the Construction of a Mixed Oxide Fuel Fabrication Facility," (Reference 5.3.9) guidance (Section 5.4.3.1) recommends that a review of team qualifications be made during the safety assessment of the design bases (construction authorization review), as well as during review of the application for a license to possess and use special nuclear material.

- Section 70.64 of 10 CFR requires that baseline design criteria (BDC) and defense-in-depth practices be incorporated into the design of new facilities. It specifically addresses quality standards; natural phenomena hazards; fire protection; environmental conditions and dynamic effects; chemical protection; emergency capability; inspection, testing, and maintenance; criticality control; and instrumentation and controls.

The staff used Chapter 5.0 in NUREG-1718 as guidance in performing the review. NUREG-1718 states that, " the steps the applicant follows to develop the safety assessment for the design bases should be analogous to the steps that the applicant will use to develop the ISA; however the reviewer should expect the application of these steps to be adjusted according to the level of design when the applicant applies for construction approval." NUREG-1718 also states that the description of PSSCs should include "the functional relationship of each principal SSC to the top-level safety function for a process. . ."

The review for this construction approval focused on the design basis of systems, their components, and other related information. For each PSSC, the staff reviewed information provided by the applicant for the safety function, system description, and safety analysis. The review also encompassed proposed design basis considerations such as redundancy, independence, reliability, and quality. The staff reviewed descriptions of the systems to assure that the facility can be designed to meet the performance requirements of 10 CFR § 70.61 during operation of the Mixed Oxide Fuel Fabrication Facility (MFFF or the facility). Much of the review was directed at the applicant's hazard assessment (including natural phenomena and external man-made events), the formulation of a strategy and identification of PSSCs to meet the performance requirements, and assuring that the design bases of these PSSCs are adequate in regard to the performance requirements of the regulation.

The safety assessment review was an integrated team approach. Team members with expertise in the various areas of technical review such as engineering, nuclear science, and other disciplines reviewed their respective revised CAR chapters as well as revised CAR Chapter 5. These revised CAR chapters or discipline reviews often identified issues that were recycled to the safety assessment review where they were either resolved or carried as open items based on the hazard assessment or performance strategies.

5.1.1 Plant Site Description Relating to Safety Assessment of the Design Bases

The plant site description includes information to support the safety assessment of the design bases, including:

- Site description. The level of detail should be sufficient to allow an evaluation of natural phenomena and other external accidents. The site description is discussed in Section 1.3 of the revised DSER.

- Facility description. The level of detail should allow an understanding of the relationship between the design bases of the PSSCs and the facility. The facility description is discussed in Section 1.1 of the revised DSER.

- Process description. The process description should provide sufficient detail to allow the evaluation of the process design as it is established through the design bases. The process description is discussed in Section 1.1 of the revised DSER.

5.1.2 Safety Assessment Team Description

The safety assessment team is described in Section 5.2 of the revised CAR. The safety assessment team is described as a team of individuals experienced in hazard identification, hazard evaluation techniques, accident analysis including dose consequence assessment, and probabilistic analysis. The team members possess operational experience at similar facilities, specific discipline knowledge (e.g., mechanical; electrical; heating, ventilation, and air conditioning) and specific knowledge of the processes to be used in the facility. In addition the team has safety analysis experience that is MOX process and aqueous polishing specific. The

Integrated Safety Analysis (ISA) manager is described as having overall responsibility for preparation of the safety assessment. The ISA manager reports to the facility Licensing & Safety Analysis Manager. The ISA manager provides overall direction for the analysis, organizes and executes safety analysis activities, and facilitates team meetings. The technical analysis which supports the safety assessment is the responsibility of the ISA team leader who reports to the ISA Manager. The ISA team leader is knowledgeable in the specific safety assessment methodologies chosen for the hazard and accident analyses and has an understanding of process operations and the hazards under evaluation. Based on the above description the staff concludes that the applicant's safety assessment team satisfies the criteria of SRP Section 5.4.3.1 (Reference 5.3.9) at the Construction Authorization stage.

5.1.3 Chemical Standards and Consequences

Duke, Cogema, Stone & Webster (DCS) provided chemical concentration limits to evaluate the potential consequences to the public and workers for an accidental release of chemicals. The applicant based these limits on the Acute Exposure Guideline Level (AEGL) values and the Emergency Response Planning Guideline (ERPG) values. For chemicals which do not have AEGL or ERPG value, limits are based on Temporary Emergency Exposure Limits (TEELs) adopted by the U. S. Department of Energy (DOE), Subcommittee on Consequence Assessment and Protective Action (SCAPA). A discussion of the chemical consequences and the applicant's consequence analysis is provided in Section 8.1.2.3 of the revised DSER. A summary of the staff's review of chemical events is provided in Section 5.1.6.3.6 of the revised DSER.

5.1.4 10 CFR §70.61 Performance Requirements

As discussed in the revised DSER Introduction, 10 CFR §70.61(b) sets forth the performance requirements for "credible high-consequence events," *i.e.*, potential accidents involving high levels of radiation or hazardous chemicals, and its provisions pertain to the protection of both on-site workers and off-site individuals. 10 CFR §70.61(b) requires the use of controls sufficient to either make the occurrence of such accidents "highly unlikely," or make the consequences of such accidents less severe than (1) an acute 100 rem total effective dose equivalent (TEDE) to a "worker" (defined term in 10 CFR §70.4); (2) an acute 25 rem TEDE to a person outside the "controlled area" (defined term in 10 CFR §20.1003); (3) an intake of 30 mg of soluble uranium to a person outside the controlled area; or (4) either an acute chemical exposure that could endanger the life of a worker, or an acute chemical exposure that could lead to irreversible or other serious long-lasting health effects to a person outside the controlled area. *See* 10 CFR §70.61(b)(1-4).

Section 70.61(c) of 10 CFR sets forth the performance requirements for "credible intermediate-consequence events," *i.e.*, potential accidents involving lower levels of radiation or hazardous chemicals than referenced in 10 CFR §70.61(b), and its provisions pertain to environmental protection as well as to protecting the health of on-site workers and off-site individuals. 10 CFR §70.61(c) requires the use of controls sufficient to either make the occurrence of such accidents "unlikely," or make the consequences of such accidents less severe than (1) an acute 25 rem TEDE to a worker; (2) an acute 5 rem TEDE to a person outside the controlled area; (3) 24 hour average release of radioactive material outside the "restricted area" (defined term in 10 CFR §20.1003) into the environment in concentrations exceeding 5000 times the values in Table 2 of Appendix B to 10 CFR §20; or (4) either a chemical exposure that could lead to irreversible or other serious long-lasting health effects to a worker, or a chemical exposure that could cause mild transient health effects to a person outside the controlled area. *See* 10 CFR §70.61(c)(1-4).

Under both 10 CFR §70.61(b) and 10 CFR §70.61(c), properly identifying and implementing the required controls -- which are later designated as items relied on for safety (IROFS) pursuant to 10 CFR §§70.61(e) and 70.65(b) -- ensures that an acceptable level of risk will be maintained during any operation of the proposed facility. This goal is met through a combination of limiting the chance that high-consequence or intermediate-consequence events would occur (prevention), and reducing the consequences of such events (mitigation).

The starting point for the applicant's demonstration of acceptable control over the risk of credible high-consequence and intermediate-consequence events, and the risk of nuclear criticality accidents, is its safety assessment of the facility design bases. In Section 5.1.6, the staff evaluates the hazards that have so far been addressed by DCS, and finds that most, but not all, of these hazards are adequately controlled by the PSSCs designated by DCS.

5.1.5 Safety Assessment of Design Basis Methodology

The objective of the staff's review of the methodology was to determine if the safety assessment was complete by assuring that all appropriate natural phenomena, external man-made, and internal process hazards were considered. The review of natural phenomena and external man-made hazards consisted of evaluating the DCS screening criteria to determine if it was appropriate for identifying all credible events. To evaluate whether the internal process hazards were sufficiently addressed, the staff reviewed the proposed plant processes, reviewed the operating experience and hazard analyses of other similar facilities, and considered feedback from the discipline specific revised DSER reviews.

The DCS safety assessment of the design bases consisted of the identification and assessment of natural phenomena hazards, external man-made hazards and process hazards. Section 70.61 of 10 CFR requires that high consequence events be highly unlikely and intermediate consequence events be unlikely. In the revised CAR, the applicant has provided qualitative definitions of the terms "not unlikely, unlikely, highly unlikely, credible," and "not credible". (Quantitative likelihood values are not required in 10 CFR §70.) All initiating events were assumed to have a likelihood of "not unlikely" which the applicant has defined as events that may occur during the life of the facility. Because of the high probability associated with postulated events, PSSCs will be selected and designed such that the accident sequences with regard to above threshold doses to the facility worker, site worker, and the public will be highly unlikely. The applicant has defined "highly unlikely" as "Events originally classified as not unlikely or unlikely to which sufficient principal SSCs are applied to further reduce their likelihood to an acceptable level." The applicant has proposed deterministic design criteria to assure that the consequences from postulated events that will exceed the threshold limits of 10 CFR §70.61(c) are highly unlikely. These criteria are:

- Application of the single failure criterion or double contingency principle
- Application of 10 CFR 50 Appendix B, NQA-1
- Application of industry codes and standards
- Management measures including IROFS failure detection (IROFS failure detection and repair or process shutdown capability.)

In addition, the applicant committed to a supplemental likelihood assessment for event sequences that could exceed the 10 CFR §70.61(c) criteria for site workers and public. Only the deterministic criteria would apply to facility workers and the environment. According to the applicant, "This supplemental likelihood assessment will be based on the guidance provided in the NUREG-1718 (Reference 5.3.9) and will demonstrate a target likelihood index comparable to a 'score' of -5 as defined in Appendix A of the SRP."   In regard to probability, this statement is a commitment to select and design IROFS so as to keep the accident sequence to a likelihood of approximately 10^{-5} per year, or less. The staff finds the applicant's definition of "highly unlikely" to be acceptable.

In regard to the environmental protection requirements of 10 CFR §70.61(c)(3), PSSCs will be selected and designed so as to ensure that the accident sequence is unlikely, as discussed in revised DSER Chapter 10. In the revised CAR, "unlikely" is defined as "Events that are not expected to occur during the lifetime of the facility but may be considered credible." In that there were no accident sequences that resulted in over-the-threshold consequences for the environment only, this classification of events ("unlikely") was not used in the safety assessment to demonstrate a compliance strategy with the performance requirements of 10 CFR §70.61.

Another definition provided by the applicant in the revised CAR to support the safety assessment is "not credible" defined as "Natural phenomena or external man-made events with extremely low initiating frequency and process events that are not possible." The application of this definition is explained in the revised CAR in the discussions of screening criteria for natural phenomena and external man-made external events. The staff found the applicant's definition of credible to be acceptable in its review of the natural and man-made event screening criteria in revised DSER Sections 5.1.5.1 and 5.1.5.2.

As indicated above, controlling facility risks entails the identification and assessment of potential facility hazards (*i.e.*, accident scenarios). Based on this hazards assessment, PSSCs and the safety functions of the PSSCs can then be identified. The applicant's methodology for developing the PSSCs and their functions is presented graphically in the flowchart in revised CAR Figure 5-4.1, Safety Assessment of the Design Bases." The basic inputs to the selection process are the site description from which credible natural phenomena and external man-made hazards are determined from a screening process and preliminary design information from which credible internal hazards are identified. The results of the external event screening and internal hazard screening are inputs to a preliminary accident analysis.

An early step in the preliminary hazard analysis (PHA), the correlation of process units with facility workshops and process support units is shown in revised CAR Tables 5.5-1 and 5.5-2. The radioactive material inventory in each facility location is shown in revised CAR Table 5.5-3a and the radioactive material inventory by fire area is shown in revised CAR Table 5.5-3b. The summary hazard identification matrix of hazards versus workshops and process support groups is shown in revised CAR Table 5.5-4. This segmentation and correlation with hazards allowed a comprehensive hazard identification for each individual area. A consequence analyses was then performed by the applicant to evaluate the bounding unmitigated consequences for each type of accident within a workgroup. If the unmitigated consequences exceeded the dose thresholds for 10 CFR §70.61(c)[1] , then the group was further evaluated. For the event scenarios which exceed the 10 CFR §70.61(c) thresholds, a safety strategy for prevention or

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[1] Five rem total TEDE to any individual outside controlled area, 25 rem TEDE to a facility worker, 24 hour concentrations exceeding 5,000 times the values in Table 2 of Appendix B to 10 CFR §20, or the chemical safety criteria.

mitigation was established and PSSCs at the structure and system level were identified. The selection of safety strategies was facilitated by segregating events which had common features that would allow similar prevention or mitigation strategies into event groups. This simplified the analysis by allowing for the development of common safety strategies and PSSCs for multiple events such that the PSSCs that cover bounding events also cover non-bounding events. In the context of the applicant's analysis, a bounding event is the event which results in the largest consequence in each group and the greatest risk, because the likelihood of all of the events is considered to be the same.

After the PSSCs have been determined, their design bases are developed and, if the accident consequence is mitigated, the resulting bounding mitigated consequence is compared against the performance requirements of 10 CFR §70.61(c). If mitigation is successful at sufficiently reducing the consequences, or if the accident scenario is prevented, the developed PSSCs and support functions become input to the final design. If not, the evaluation is repeated with a different set of PSSCs (or a change in design bases values). The applicant, in revised CAR Section 5.4.4.3, pursuant to 10 CFR §70.61(c)(3), also performed analyses of the potential radioactive release to the environment by calculating the 24-hour average effluent concentration of each radionuclide released in an accident sequence and comparing this with 5,000 times the values specified in Table 2 of Appendix B to 10 CFR §20 (Reference 5.3.4). This is required to show compliance with 10 CFR §70.61(c)(3).

5.1.5.1 Natural Phenomena Hazards (NPH) Methodology

Natural phenomena having a credible potential effect on facility operations were identified through a screening process where NPHs having a frequency of occurrence of less than 10^{-6} per year were designated as incredible and screened from further consideration. Deterministic methods were also used to screen out events that would not be physically appropriate for the site. For example, debris avalanching was ruled out because of the relatively level nature of the surrounding topography. The staff considers the NPHs screening methodology in accordance with the criteria of SRP Section 5.4.5.2 (Reference 5.3.9) and is acceptable for the purpose of meeting the performance requirements of 10 CFR §70.61. A comprehensive list of NPH's were initially evaluated and the rationale for further considering or excluding each NPH is provided in revised CAR Table 5.5-5.

5.1.5.2 External Man-Made Events Methodology

DCS considered external man-made hazards (EMMHs) to be those hazards that are caused by events originating from operation of nearby public, private, government, industrial, chemical, nuclear, and military facilities and vehicles. The major categories of events that could result from EMMHs that were considered by DCS are as follows:

- A release of radioactive material resulting in exposures to facility personnel.
- A release of hazardous chemicals resulting in exposures to facility personnel.
- Explosions or other events that directly impact facility PSSCs.
- Events that result in a loss of offsite power.
- Events that result in a fire (and/or resulting smoke) that spreads to the facility.

Events in these categories were screened using applicable criteria from NUREG/CR-4839, "Methods for External Event Screening Quantification: Risk Methods Integration and Evaluation Program (RMIEP) Methods Development," 1992; NRC Regulatory Guide 1.91, "Evaluations of Explosions Postulated to Occur on Transportation Routes Near Nuclear Power Plants,"; NRC

Regulatory Guide 1.78, “Assumptions for Evaluating the Habitability of a Nuclear Power Plant Control Room during a Postulated Hazardous Chemical Release,” 1974; and NUREG-0800, “Standard Review Plan,” 1981. A summary of the EMMH screening is provided in Table 5.5-8 of the revised CAR.

External man-made events that were evaluated and screened out as not applicable to the site or of having too low a probability for consideration include:

- Roadway accidents
- Rail accidents
- Aircraft accidents
- Barge/shipping traffic accidents
- Industrial facility accidents, except for F-Area
- Military facility accident

The staff performed an in-office review of the applicant’s calculation of future flight activities over the life of the facility to confirm the aircraft accident analysis. The staff found these calculations and previously submitted calculations (Reference 5.3.7, Enclosure A, Reference 5.3.11) to be acceptable. The staff considers the EMMHs screening methodology to be in accordance with NRC guidance and is acceptable for the purpose of meeting the performance requirements of 10 CFR §70.61.

5.1.5.3 Process Hazards Methodology

DCS evaluated the potential for and consequences of process related internal events. These events were divided into six major categories:

- Loss of Confinement/Dispersal of Nuclear Material Events
- Fire Events
- Load Handling Events
- Explosion Events
- Criticality
- Chemical

In the revised CAR submittal, DCS only presented numerical radiological consequence values for the most severe event in each of the above major categories (except for Chemical). Chemical consequences are discussed in Chapter 8 of the revised CAR and the staff’s evaluation is provided in Chapter 8.0 of the revised DSER. The staff reviewed the accident scenarios developed by the applicant and has determined that these are a complete and bounding set based on the preliminary design and description of the processes projected for use at the proposed facility.

5.1.5.4 Baseline Design Criteria

Sections 70.64(a)(1-10) of 10 CFR set forth the following baseline design criteria (BDC) which are applicable to the proposed facility: (1) quality standards and records, requiring that the facility design be developed and implemented in accordance with management measures and IROFS, and that records of the IROFS be maintained for the life of the facility; (2) natural phenomena hazards, requiring that the facility design adequately protect against natural phenomena, and take into consideration the most severe historical events documented at the facility site; (3) fire protection, requiring that the facility design adequately protect against fires and explosions; (4) environmental and dynamic effects, requiring that the facility design adequately protect against internal environmental conditions and dynamic effects from normal operations, maintenance, testing, and accidents; (5) chemical protection, requiring that the facility design adequately protect against specified chemical risks and internal conditions affecting the safety of licensed material; (6) emergency capability, requiring that the facility be designed to provide emergency capability to control (i) licensed material and hazardous chemicals produced from licensed material, (ii) evacuation of on-site personnel, and (iii) specified on-site emergency facilities and services; (7) utility services, requiring that the facility be designed so that essential utility services will continue to operate; (8) inspection, testing and maintenance, requiring that IROFS designs provide for adequate inspection, testing and maintenance, to ensure that IROFS will be available and will reliably perform their functions when needed; (9) criticality control, requiring that the facility be designed to provide for criticality control, including adherence to the double contingency principle; and (10) instrumentation and controls, requiring that the facility be designed to provide for inclusion of instrumentation and control systems to monitor and control the behavior of IROFS.

In the revised DSER sections referenced below, the staff states whether or not the facility preliminary design satisfies the BDC, pursuant to 10 CFR §70.64(a). In the review of the revised CAR, meeting the 10 CFR §70.61 performance requirements was the primary criteria considered by the staff for satisfying the BDC.

(1) Quality Standards and Records. The design must be developed and implemented in accordance with management measures, to provide adequate assurance that IROFS will be available and reliable to perform their function when needed. Appropriate records of these items would have to be maintained by or under the control of the licensee throughout the life of the proposed facility. This BDC is satisfied at the construction authorization stage as discussed in revised DSER Section 15.1.

(2) Natural Phenomena Hazards. The design must provide for adequate protection from natural phenomena with consideration of the most severe documented historical events for the site. This BDC is satisfied at the construction authorization stage as discussed in revised DSER Sections 1.3, 5.1.6.1, 11.1, and 11.12.

(3) Fire Protection. The design must provide for adequate protection against fires and explosions. This BDC is not completely satisfied for fires at the construction authorization stage, due to two open items discussed in revised DSER Section 7.1.2. This BDC is not met for explosions, as reflected in the summary of open items listed in revised DSER Section 11.2.2.

(4) Environmental and Dynamic Effects. The design must provide for adequate protection from environmental conditions and dynamic effects associated with normal operations, maintenance, testing, and postulated accidents that could lead to loss of safety functions. In revised DSER Section 11.11, this BDC is satisfied at the construction authorization stage, as discussed.

(5) Chemical Protection. The design must provide for adequate protection against chemical risks produced from licensed material, facility conditions which affect the safety of licensed material, and hazardous chemicals produced from licensed material. This BDC is not met, as reflected in the summary of open items listed in revised DSER Sections 8.2 and 11.2.2.

(6) Emergency Capability. The design must provide for emergency capability to maintain control of:

(i) Licensed material and hazardous chemicals produced from licensed material;
(ii) Evacuation of on-site personnel; and
(iii) Onsite emergency facilities and services that facilitate the use of available offsite services.

This BDC is satisfied at the construction authorization stage as discussed in revised DSER Chapter 14.

(7) Utility Services. The design must provide for continued operation of essential utility services. Based on the safety assessment of the proposed facility, the only utility with safety significance is electrical power. This BDC is satisfied at the construction authorization stage as discussed in revised DSER Section 11.5.

(8) Inspection, Testing, and Maintenance. The design of IROFS must provide for adequate inspection, testing, and maintenance, to ensure their availability and reliability to perform their function when needed. This BDC is satisfied at the construction authorization stage as discussed in revised DSER Sections 15.1 and 15.3.

(9) Criticality Control. The design must provide for criticality control including adherence to the double contingency principle. This BDC is only partially met at the CAR stage as discussed in revised DSER Section 6.1.4.2.

(10) Instrumentation and Controls. The design must provide for inclusion of instrumentation and control systems to monitor and control the behavior of IROFS. This BDC is satisfied at the construction authorization stage as discussed in revised DSER Section 11.6.

5.1.5.5 Defense-in-Depth

Under 10 CFR §70.64(b), the facility design and layout must be based on defense-in-depth practices. As used in 10 CFR §70.64, defense-in-depth practices at new facilities means a design philosophy, applied from the outset and through completion of the design, that is based on providing successive levels of protection such that health and safety will not be wholly dependent upon any single element of the facility design. The net effect of incorporating defense-in-depth practices is a conservatively designed facility that will exhibit greater tolerance to failures and external challenges. 10 CFR §70.64(b) further requires that, to the extent practicable, the facility design must incorporate (1) a preference for engineered controls over administrative controls, to increase overall system reliability; and (2) features that will enhance safety by reducing challenges to items which will be relied upon for safety.

In Section 5.5.5 of the revised CAR, the applicant describes its general design philosophy and defense-in-depth practices. In this section the applicant describes a hierarchy of controls in its general philosophy of design that has been established as follows (the most favored control listed first):

- Protection by a single passive safety device, functionally tested on a pre-determined basis.
- Independent and redundant active engineered features, functionally tested on a pre-determined basis.
- Single hardware system/engineered feature, functionally tested on a pre-determined basis.

- Enhanced administrative controls.
- Simple administrative controls or normal process equipment.

The staff has determined that the above hierarchy of controls demonstrates a preference for engineered controls as required by 10CFR §70.64(b)(1). Also, the applicant's incorporation of additional protection features into the design of the proposed facility will enhance safety by reducing challenges to items which will be relied upon for safety as required by 10 CFR §70.64(b)(2).

In addition, the applicant has described its defense-in-depth practices as consisting primarily of meeting double contingency (for protection against criticality events) and the single failure criterion. The staff's evaluation of the applicant's implementation of double contingency is provided in Section 6.1.4.2 of the revised DSER. The applicant's implementation of single failure criterion as described in Section 5.5.5.2 of the revised CAR consists of (1) the use of redundant equipment or systems, (2) independence, (3) separation, and (4) the fail safe principle.

The staff concludes that the applicant's strategy for defense-in-depth meets the requirements of 10 CFR §70.64.

5.1.6 Safety Assessment Results

The safety assessment methodology, as described above, resulted in the identification of accident scenarios, PSSCs, and their functions. The PSSCs identified by the applicant through its safety assessment are summarized in Tables 5-1a and 5-1b of the revised DSER. Table 5-2 lists the design bases associated with the safety functions of the PSSCs, and references the revised DSER sections which describe and evaluate each of the PSSCs in more detail.

In each referenced revised DSER section, the staff makes either a preliminary or a conditional 10 CFR §70.23(b) safety finding on the applicable PSSCs being evaluated, depending on the nature and extent of the relevant open items which have not been resolved.

5.1.6.1 Natural Phenomena Design Basis Events and Related PSSCs

As stated in revised DSER Section 5.1.5.1, the staff has determined the screening methodology for NPHs to be acceptable. The screening methodology identified design basis natural events and their related PSSCs. The likelihood of any such design basis event occurring should be sufficiently low to assure that any adverse consequences are highly unlikely because structural failures due to natural phenomena were assumed to have the potential for high consequences. The adequacy of the PSSCs to prevent releases are evaluated using normally accepted industry practice as a criterion.

Natural phenomena that were not screened out were:

- Extreme wind
- Earthquake (including liquefaction)
- Tornado (including tornado missiles)
- External fire
- Rain, snow, and ice
- Lightning
- Temperature extremes

The design basis wind selected for the facility has an annual exceedance probability of 10^{-4} per year (Reference 5.3.8, Section 5.5.2.6.5.1). The PSSCs identified to provide protection against the design basis wind are the MOX fuel fabrication building, emergency diesel generator building, associated missile barriers, and the waste transfer line. The safety function of the structures and missile barriers are to withstand design basis wind loads and wind-driven missiles and to provide protection for internal structures, systems, and components (SSCs). Although the exceedance probability of 10^{-4} does not, by itself, preclude a consequence which is highly unlikely, the design for wind loadings is controlled by the tornado at low frequencies of occurrence. Hence, the staff concludes that the design basis established by the applicant for extreme wind satisfies the performance requirements of 10 CFR §70.61.

The design basis earthquake selected for the facility also has an annual exceedance probability of 10^{-4} (Reference 5.3.8, Section 5.5.2.6.5.2). The PSSCs identified to provide protection against the design basis earthquake are the waste transfer line, MFFF building, emergency diesel generator building, fluid transport system, and seismic monitoring and associated isolation valves. The primary safety function of the first four PSSCs is to withstand the effects of the design basis earthquake and to assure that seismic effects on non-PSSCs will not result in the prevention of PSSCs from performing their safety function. The safety function of the seismic monitoring and isolation valves is to prevent fire and/or criticality as a result of an uncontrolled release of chemicals and water within the MFFF building. For Nuclear Regulatory Commission (NRC) licensed facilities, such as nuclear power plants, the conservatism between design and performance arise from factors such as prescribed analysis methods, specification of material strengths, and limits on inelastic behavior following nuclear design criteria and NRC Standard Review Plans (SRPs). Conservatism in the NRC seismic standard review plans are not explicitly keyed to risk reduction values. Nevertheless, the risk reduction factors achieved by applying NRC guidelines to evaluation of commercial reactor SSCs have been shown to be equal to or even higher than those prescribed by Department of Energy (DOE) STD-1020-94 (Reference 5.3.6). For example, the average mean annual probability of exceedance (MAPE) for the design ground motions at existing nuclear power plants is approximately 1×10^{-4} (Reference 5.3.10), yet the mean annual seismic core damage frequency of nuclear power plants is estimated to range between 6×10^{-6} and 1×10^{-5} (Reference 5.3.3). Thus, an effective risk reduction for nuclear power plants is 10× or greater. In additional information provided to NRC (Reference 5.3.7, Enclosure B, Reference 5.3.11), DCS provided the results of calculations which showed that, taking into account the building and component designs, the performance of structures, systems, and components in the facility will meet the availability (or failure) criteria necessary to make high consequences highly unlikely. The staff concludes that the applicant's selection of the design basis earthquake satisfies the performance requirements of 10 CFR §70.61.

The design basis tornado selected for the facility has an annual exceedance probability of 2×10^{-6} (References 5.3.8, Section 5.5.2.6.5.3). The PSSCs identified to provide protection against the design basis tornado are the MFFF Building, emergency diesel generator building, associated missile barriers, waste transfer line, and tornado dampers. The safety functions of these PSSCs are to withstand the design basis tornado wind loads, tornado-generated missiles, differential pressure, and to provide protection for internal SSCs. The staff concludes that the applicant's selection of the design basis tornado satisfies the performance requirements of 10 CFR §70.61.

The design basis for external fire was assumed to be a forest fire near the facility (Reference 5.3.8, Section 5.5.2.6.5.4). The plant exterior is designed to withstand a fire duration of at least

2 hours (further information may be found in section 7.1.5.4 of the revised DSER). This is considered by the staff to be adequate based on the availability of an onsite fire brigade and the fuel loading provided by natural growth around the building. The principal SSCs identified to provide protection against the external fire are the MFFF building structure, the emergency generator building structure, the emergency control room air conditioning system, and the waste transfer line. The safety functions of the PSSCs are to withstand the effects of the external fire, to provide protection for internal SSCs, and to ensure habitable conditions for operators as necessary. The staff concludes that the applicant's selection of the design basis external fire is an acceptable strategy for meeting the performance requirements of 10 CFR §70.61.

The design basis rainfall has an annual exceedance probability of 10^{-5} (Reference 5.3.8, Section 5.5.2.6.5.5). This will meet the likelihood requirements for high and intermediate consequence events. The snow and ice loading have an annual exceedance probability of 10^{-2}. DCS has stated that effects of snow and ice loads that have a lower annual exceedance probability are bounded by the design for other live loads. DCS determined that a 10,000 year snow and ice load would be less than one-half of the design load for live loads. The PSSCs and design basis safety functions associated with rain, snow, and ice are the MOX Fuel Fabrication Building Structure and Emergency Diesel Generator Building Structure which will be designed to withstand the effects of rain, snow, and ice without failing and will protect internal SSCs from the effects of rain, snow, and ice. The staff considers the applicant's strategy and selection of PSSCs to be acceptable for meeting the performance requirements of 10 CFR §70.61.

The design basis for lightning protection was in accordance with National Fire Protection Association (NFPA) 780-1997 (Reference 5.3.8, Section 5.5.2.6.5.6). Design basis temperature extremes for the ventilation system were based on observed temperatures at SRS over a 35-year period (1961 to 1996). Both of these design bases are appropriate because neither lightning nor severe temperature are expected to cause a significant consequence by themselves. No PSSCs are required for protection against lightning or extreme temperatures. The staff agrees with the applicant's rationale for not requiring additional PSSC's to protect against these events.

The staff considers the results of the evaluation of NPHs to be acceptable for meeting the performance requirements of 10 CFR §70.61. The PSSCs identified by DCS to control the risks of natural phenomena at the proposed facility will, if properly implemented, ensure that such risks will be acceptably low during any facility operation. In addition, the staff considers the applicant's evaluation to be adequate to satisfy the requirements of 10 CFR §70.64 (a)(2) (baseline design criteria, NPHs) which states that the design must provide for adequate protection against natural phenomena with consideration of the most severe documented historical events for the site.

5.1.6.2 External Man-Made Events and Related PSSCs

As stated in revised DSER Section 5.1.5.2, the staff has determined the screening methodology for external man-made hazards to be acceptable. The screening methodology identified man-made external design basis events and their related PSSCs. The likelihood of any such design basis event occurring should be sufficiently low to assure that any adverse consequences are highly unlikely because structural failures due to such events were assumed to have the potential for high consequences. The adequacy of the PSSCs to prevent releases are evaluated using normally accepted industry practice as a criteria.

Man-made external events that were not screened out include:

- Potential hazardous chemical or radioactive releases from Savannah River Site (SRS) facilities or vehicles. SRS documentation provides the radiological/chemical consequences of accidents at existing facilities. The applicant has reviewed these analyses and determined that there are no credible accidents that could potentially impact facility operations personnel. However, personnel in the emergency control room will be protected by the emergency control room air-conditioning system which is considered a PSSC for other evaluated events. In addition, based on existing DOE requirements, it is not expected that facilities to be designed and operated by DOE to support the MOX facility will present a significant risk for the facility. The staff will consider possible risks from these facilities during the review for a license to possess and use special nuclear material (SNM).

- Potential explosions at a nearby facility or an explosion involving a vehicle, particularly one in the F-area. DCS stated that the main MOX building (BMF) and the emergency diesel generator buildings can withstand the impacts of explosions in the F-area. The staff performed an in-office review of the applicant's calculations of vapor cloud explosions and found the applicant's bounding over-pressure determinations to be within the design limits for the structures.

- Loss of offsite power from EMMHs is considered similar in potential for consequences as loss of offsite power from NPHs. PSSCs requiring power are supplied with emergency power upon loss of offsite power and failure of the Standby Alternating Current (AC) Power System. The adequacy of the power supply in terms of the baseline design criteria and the performance requirements has been evaluated in revised DSER Section 11.5.1.3. The staff considers the applicant's strategy and selection of PSSCs to be acceptable for meeting the performance requirements of 10 CFR §70.61 in regard to loss of offsite power.

- External man-made fires are fires resulting from a vehicle crash, train crash/derailment, barge/shipping accident, or SRS facility fire that engulfs neighboring grasslands or forests. This event has the same consequences as the design basis external fire listed as an NPH. The ability of the facility to withstand the effects of external fires is discussed in revised DSER Section 7.1.5.4. The staff also considers the applicant's strategy and selection of PSSCs to be acceptable for meeting the performance requirements of 10 CFR §70.61.

The staff considers the results of the evaluation of man-made events to be acceptable for meeting the performance requirements of 10 CFR §70.61. The PSSCs identified by DCS to control the risks of such man-made events at the proposed facility will, if properly implemented, ensure that such risks will be acceptably low during any facility operation.

5.1.6.3 Internal Process Hazard Design Basis Events and Related PSSCs

As stated in revised DSER Section 5.1.5.3, the staff found that the screening methodology for internal process hazards was adequate. With respect to the internal process hazards which DCS evaluated, the staff's review of those hazards was primarily an evaluation of the strategy and PSSCs at a conceptual level in regard to their potential to guide the development of a design which will meet the 10 CFR §70.61 performance requirements. Criteria used in the staff evaluation consisted of a comparison against normally accepted industry practice, consideration of the applicant's design criteria, consideration of a probability index using the NUREG-1718 Table A-5 descriptions (primarily for protection of the public and site workers), and/or deterministic arguments primarily for protection of facility workers and/or the environment. Table

A-5 of NUREG-1718 provides a table equating types of controls to approximate probabilities of failure on demand (PFOD). Controls were described as:

- Exceptionally robust passive engineered control (PEC) or an inherently safe process (index -4 or -5; PFOD 10^{-4} - 10^{-5}).
- A single PEC or an active engineered control (AEC) with high dependability (index -3 or -4; PFOD 10^{-3} - 10^{-4}).
- A single AEC, an enhanced administrative control, or an administrative control for routine planned operations (index -2 or -3; PFOD 10^{-2} - 10^{-3}).
- An administrative control that must be performed in response to a rare, unplanned demand (index -1 or -2; PFOD 10^{-1} - 10^{-2}).

For the purposes of this review, the staff considered the revised CAR description of a high dependability AEC (such as the C4 confinement system) and assigned it an index of -4 or -5. In addition to the base dependabilities that the staff determined for the PSSCs based on their descriptions in the revised CAR, the staff also took into account the impact of surveillance intervals on the overall reliability. The assumption was made that as long as the PSSC was capable of being part of a surveillance program, surveillance intervals would be adjusted at the ISA preparation stage to achieve the desired dependability. Also, enhanced administrative controls such as combustible loading controls, for example, are assigned a lower PFOD in the staff review because of the incorporation of features such as fire modeling, quantifiable margins, and surveillances in their implementation.

In addition to the dependability of the safety strategy, the staff also independently evaluated the applicant's consequence assessment for those event sequences where the consequences for one or more of the potential receptors was determined by the applicant to be less than the 10 CFR §70.61(c) threshold value. These independent calculations are described in revised DSER Section 9.1.1.4.

Feedback from the technical reviews was also used to evaluate the practicality and appropriateness of the PSSCs or safety strategy to the event being evaluated. This feedback was used to assure that the proposed strategies did not significantly deviate from accepted nuclear industry practice, taking into account historical events as well as successful operation at other chemical or nuclear facilities.

An area of discussion with DCS was the protection of facility workers during accident events. It was the position of DCS that the index method and its implied numerical probability may not be applicable to protection of the facility worker. Reliance on worker actions for mitigation in many of the worker protection scenarios requires a deterministic rather than a probabilistic evaluation. The accident scenarios which rely on prevention (such as most explosions, some fires, and some of the materials handling accidents) do not require an evaluation for the facility worker separate from the one performed for protection of the environment, site worker, and public. If the specific prevention measures are considered sufficient to make the release of radioactive material from the accident sequence highly unlikely, dose to the worker does not need to be evaluated. Also, some of the fires are not prevented to a low probability of occurrence but are considered sufficiently slow growing events such that a worker may take a course of action such as leaving the area and/or donning a respirator that would make the workers dose effectively zero or negligible. For some of the load handling events, the staff questioned the ability of the worker to don a mask or vacate the area in sufficient time to keep the worker dose below 10 CFR §70.61(c) threshold levels. In these cases, the staff requested the applicant to perform dose calculations which were reviewed on site (Reference 5.3.2). These were found to be acceptable, because the doses were low enough to allow the worker to take protective action within a reasonable time.

The following six subsections (5.1.6.3.1 through 5.1.6.3.6) discuss the accident sequences developed to evaluate internal process hazards. Due to the open items identified in these subsections, the staff finds that the evaluation of internal process hazards at the proposed facility do not meet the performance requirements of 10 CFR §70.61.

5.1.6.3.1 Confinement Events

Confinement of radioactive material at the facility is provided by static confinement boundaries in conjunction with ventilation systems and sealed confinement barriers (e.g., containers and fuel rods).

Thirty-one separate events with potentially significant consequences were analyzed by DCS to determine the bounding consequences from a potential loss of confinement event. These events were assigned to twelve groups as follows with a unique prevention or mitigation strategy:

- Over-temperature
- Corrosion
- Glovebox breaches or backflows
- Leaks in the aqueous polishing (AP) process vessels or pipes
- Backflow from a process vessel through utility lines
- Rod handling operations
- Breaches in containers outside of gloveboxes due to handling
- Over- or under-pressurization of glovebox
- Excess temperature due to radioactive decay
- Glovebox dynamic exhaust failure
- Process fluid line leak in a C3 area outside a glovebox
- Sintering Furnace confinement boundary failure

These twelve groups are discussed below:

<u>Over-Temperature (Confinement)</u>
The bounding event for the over-temperature event group in the confinement events accident category was determined by the applicant to be excessive temperature of the AP electrolyzer resulting in high temperature damage to and breach of the AP electrolyzer and damage to glovebox panels and dispersal of radioactive material. The material at risk was the maximum inventory of radioactive material in the electrolyzer glovebox. Such an event could be caused by control system failure, electrical isolation failure, or loss of cooling to process equipment. The applicant determined this to be an above the 10 CFR §70.61(c) threshold consequence event for facility workers, site workers, members of the public, and the environment, and has opted to protect potentially affected workers and members of the public through a strategy of prevention and mitigation. The PSSC identified for protection of the facility worker and the environment for this event is the process safety control subsystem, which will shut down process equipment prior to exceeding a temperature safety limits. The PSSC for public and site worker protection is the C3 confinement system, which will provide filtration to mitigate dispersions from the C3 area. In

addition, the process safety control subsystem provides defense-in-depth for protection of the site worker and public. Based on the applicant's deterministic criteria and the NUREG-1718 Table A-5 descriptions[2] (high availability AEC), the staff considers this to be an acceptable strategy for meeting the 10 CFR §70.61 performance requirements.

Corrosion (Confinement)
The corrosion event group is defined as catastrophic failure of a primary confinement boundary (i.e., a laboratory or an AP glovebox containing corrosive chemicals, AP fluid transport systems, a pneumatic transfer line, or ducting of the C4 confinement system) postulated as due to corrosion. Loss-of-confinement events caused by corrosion within process cells are included in the event group, "Leaks of AP Process Vessels or Pipes Within Process Cells." Loss-of-confinement events caused by corrosion of pipes containing process fluids within C3 areas not enclosed within a glovebox are discussed in the event group, "Process Fluid leak in C3 area Outside of Glove Box." The bounding event for the corrosion event group in the confinement events accident category was determined by the applicant to be corrosion of the pneumatic pipe automatic transfer system from corrosive chemicals resulting in a breach of confinement and dispersal of radioactive materials. The material at risk was the maximum inventory in the pneumatic pipe automatic transfer system. The applicant determined this to be an above the 10 CFR §70.61(c) threshold consequence event for the facility worker and the environment and a below the 10 CFR §70.61(c) threshold consequence event for the public and site worker. The staff independently evaluated this accident sequence and agrees to its categorization. The applicant has opted to protect the facility worker and the environment through a strategy of prevention and mitigation. The PSSCs identified for facility worker protection and protection of the environment are the material maintenance and surveillance programs, which will detect and limit the damage resulting from corrosion. No PSSCs are identified by the applicant as being necessary to adequately protect the public and site worker. However, the C4 and C3 confinement systems, and the C2 confinement system passive boundary provide defense-in-depth protection for the public and the site worker. Based on the nature of this event (mitigated by slow development or prevented by administrative controls), the staff considers this to be an acceptable strategy for meeting the 10 CFR §70.61 performance requirements.

Small Breaches in Glovebox Confinement Boundary (Confinement)
The bounding event for small breaches in a glovebox confinement boundary or backflow in the confinement events accident category was determined to be backflow through the interfacing gas line (e.g. nitrogen, helium) to the interfacing system followed by the opening of this interfacing system during a maintenance operation. The material at risk was the maximum inventory of radioactive material in a glovebox. Loss of gas flow through a supply line was listed as a possible cause. The applicant determined this to be an above the 10 CFR §70.61(c) threshold consequence event for the facility worker and the environment, and a below the 10 CFR §70.61(c) threshold consequence event for the public and site worker. The staff independently evaluated this accident sequence and agrees to its categorization. The applicant has opted to protect the facility worker through a strategy of mitigation. The PSSC identified for

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[2]NUREG-1718 Table A-5 is used to estimate a probability index number for the strategy based on the type of control(s) being described. The applicant's deterministic design criteria commitments were also considered. The staff considers these commitments sufficient to lower the PFOD and the probability of the accident sequence often by at least an order of magnitude based on the type of control(s) proposed. If the probability index of the sequence can achieve a value of -5 or less, the staff considered the strategy to be acceptable. This will be demonstrated by the applicant in a supplemental likelihood assessment to be conducted in conjunction with the ISA when specific IROFS are developed.

protection of the facility worker and the environment is the C4 confinement system which maintains a negative glovebox pressure differential between the glovebox and the interfacing systems and will also maintain a minimum inward flow through small glovebox breaches. No PSSCs are identified by the applicant as being necessary to adequately protect the public and site worker. In addition, the C3 confinement system provides defense-in-depth protection for the public and the site worker. Based on the nature of this event (mitigated by a high availability AEC), the staff considers this to be an acceptable strategy for meeting the 10 CFR §70.61 performance requirements.

Leaks of AP Process Vessels or Pipes within Process Cells (Confinement)

The bounding event for leaks in AP process vessels or pipes within process cells in the confinement events accident category is a break or leakage of a tank/vessels inside the process cell containing a portion of the purification cycle resulting in a breach of confinement, and the dispersal of radiological materials. The material at risk was the maximum inventory of radioactive materials in the effected equipment in the AP Process cell. Corrosion and mechanical failure were listed as potential causes. The applicant determined this to be an above the 10 CFR §70.61(c) threshold consequence event for the facility worker and the environment, and a below 10 CFR §70.61(c) threshold consequence event for the public and the site worker. The staff independently evaluated this accident sequence and agrees to its categorization. The applicant has opted to protect the facility worker through a strategy of prevention. The PSSCs identified for facility worker protection are the process cells, which contain fluid leaks within the cells and the process cell entry controls, which prevent the entry of personnel into process cells during normal operation. The PSSC for protection of the environment is the process cell ventilation system passive boundary. No PSSCs are identified by the applicant as being necessary to adequately protect the public and site worker. However, the process cell ventilation system passive boundary provides defense-in-depth protection for the public and the site worker. The staff independently evaluated this accident sequence and concludes that the applicant has not evaluated the effects of toxic chemicals (evolved from licensed materials) released through the process cell ventilation system using an acceptable chemical consequence level standard. Also, additional information on indoor airspeed values and the evaporation model is needed. The staff considers this to be an open item which is further discussed in revised DSER Section 8.1.2.3.1 (Open Item CS-5b).

Backflow From a Process Vessel Through Utility Lines (Confinement)

The bounding event for backflow from a process vessel through utility lines confinement events accident category is backflow of radioactive material from a waste tank containing americium. This backflow is postulated to flow through an interfacing supply line that is subsequently breached or opened during a maintenance operation. The material at risk was the maximum radioactive material in the waste tank. Loss of gas flow through the supply lines and failure of pipes and/or valves are identified as potential causes. The applicant determined this to be an above the 10 CFR §70.61(c) threshold consequence event for the facility worker, site worker, and the environment; and a below 10 CFR §70.61(c) threshold consequence event for the public. The staff independently evaluated this accident sequence and agrees to its categorization. The applicant has opted to protect the facility worker, site worker and the environment through a strategy of prevention. The PSSC identified for protection of the facility worker, site worker, and the environment are backflow prevention features which will prevent process fluids from backflowing into interfacing systems. No PSSCs were identified by the applicant as being necessary to adequately protect the public. However, the C2 confinement system passive boundary provides defense-in-depth protection for the public, site worker and the environment. Based on the applicant's deterministic criteria and the NUREG-1718 Table A-

5 descriptions (PEC), the staff considers this to be an acceptable strategy for meeting the 10 CFR §70.61 performance requirements.

Rod Handling Operations (Confinement)
The bounding event for rod handling operations in the confinement events accident category was determined to be the fracture of one or more fuel rods while utilizing fuel rod handling equipment resulting in a breach of confinement, and dispersal of radiological materials. The material at risk was the maximum inventory of radioactive material in a tray of fuel rods. Human error or equipment failure were listed as potential causes. The applicant determined this to be an above the 10 CFR §70.61(c) threshold consequence event for the facility worker and a below the 10 CFR §70.61(c) threshold consequence event for the public, site worker, and the environment. The staff independently evaluated this accident sequence and agrees to its categorization. The applicant has opted to protect the facility worker through a strategy of prevention and mitigation. The PSSCs identified for protection of the facility worker are facility worker actions which ensure that facility workers take proper actions to limit radiological exposure; materials handling controls which ensure proper handling of primary confinements outside of gloveboxes; and material handling equipment to limit damage to fuel rods/assemblies during handling operations. No PSSCs were identified by the applicant as being necessary to adequately protect the public, site worker, and the environment. The combination of rod cladding (primary confinement), materials handling controls, and facility worker actions are intended to make the likelihood of above the 10 CFR §70.61(c) threshold consequences from the rod handling accident sequence highly unlikely. However, because a release could occur without warning, the applicant provided dose calculations which were reviewed onsite and found to be acceptable (Reference 5.3.2). The C2 confinement system passive boundary provides defense-in-depth protection for the public, site worker, and the environment. Based on the nature of this event (mitigated by limited initial release and immediate worker responses), the staff considers this to be an acceptable strategy for meeting the 10 CFR §70.61 performance requirements.

Breaches in Containers Outside of Gloveboxes (Confinement)
The bounding event for breaches in containers outside of gloveboxes due to handling operations in the confinement events accident category was the failure of a 3013 canister, transfer container containing plutonium-bearing waste, or other primary confinement types within the C2 or C3 areas outside of a glovebox. The material at risk is the maximum inventory of radioactive material in the container. The applicant determined this to be an above the 10 CFR §70.61(c) threshold consequence event for the facility worker, public, site worker and environment. The applicant has opted to protect the facility worker, public, site worker, and environment using a strategy of prevention and mitigation. PSSCs identified to protect the facility worker are material handling controls; 3013 canister to withstand the effects of design basis drops without breaching; transfer container which will also withstand the effects of design basis drops without breaching; and facility worker controls for bag-out operations in C3 areas. The staff has requested the applicant to perform a dose calculation to determine the unmitigated dose to the worker from the drop of a container other than a 3013 canister. This calculation was provided and reviewed on site and found to be acceptable. PSSCs identified as required for protection of the public, site workers, and the environment are material handling controls to ensure proper handling of primary confinement types outside of gloveboxes; and transfer container, 3013 canister, and the C3 confinement system, which will provide filtration to mitigate dispersions from the C3 areas. The C2 confinement system passive boundary and the preventive features utilized to reduce the risk to the facility worker and the environment provide defense-in-depth protection for the public and site worker. Based on the applicant's deterministic criteria and the NUREG-1718 Table A-5 descriptions, (PEC, AEC, and administrative controls), the staff

considers this to be an acceptable strategy for meeting the 10 CFR §70.61 performance requirements.

Over/under Pressurization of Glovebox (Confinement)
The bounding event for over/under pressurization of a glovebox (i.e., C4 dynamic confinement) in the confinement events accident category was determined by the applicant to be a rapid over-pressurization of the calcining furnace glovebox. The material at risk was the maximum inventory of radioactive material in the glovebox. Potential causes of this event were identified as rupture of a high flow or a high pressure supply line or a clogged outlet high efficiency particulate air (HEPA) filters. The applicant determined this to be an above the 10 CFR §70.61(c) threshold consequence event for the facility worker and the environment, and a below the 10 CFR §70.61(c) threshold consequence event for the public and site worker. The staff independently evaluated this accident sequence and agrees to its categorization. For a rapid over- or under-pressurization event, a prevention strategy is used. The PSSC identified for protection of the facility worker is glovebox pressure controls, which will maintain glovebox pressure within design limits. For a slow pressurization event, a mitigation strategy is used. The PSSCs identified for facility worker protection are facility worker actions and the process safety control subsystem, to warn operators of glovebox pressure discrepancies prior to exceeding differential pressure limits. The PSSCs identified for protection of the environment are the C3 and C4 confinement systems. No PSSCs were identified by the applicant as being necessary to adequately protect the public or site worker. However, the C3 confinement system will provide defense-in-depth protection for the public and site worker. Based on the nature of this event (mitigated by a warning system and immediate worker responses or prevented by an AEC), the staff considers this to be an acceptable strategy for meeting the 10 CFR §70.61 performance requirements.

Excess Temperature Due to Decay Heat from Radioactive Materials (Confinement)
Thermal calculations have been performed to evaluate the effects of temperature on confinement structural materials. Thermal sources considered in the calculation include radioactive decay of nuclear materials, spontaneous heating of UO_2 due to oxidation (burnback), operation of electrical/mechanical equipment, and process equipment (calcining furnace). However, only the 3013 storage area was found to require long-term cooling to mitigate the effects of decay heat. The material at risk was the maximum inventory of radioactive material in the powder storage area in the plutonium dioxide (PuO_2) 3013 storage unit. The applicant determined this to be an above the 10 CFR §70.61(c) threshold consequence event for the facility worker, site worker, public and the environment. The applicant has opted to protect these receptors through a strategy of prevention. The PSSC identified for protection of the facility worker, site worker, public, and environment is the high depressurization exhaust system (part of the C3 confinement system) which will ensure that temperatures in the 3013 canister storage structure are maintained within design limits. Based on the applicant's deterministic criteria and the NUREG-1718 Table A-5 descriptions (high availability AEC), the staff considers this to be an acceptable strategy for meeting the 10 CFR §70.61 performance requirements.

Glovebox Dynamic Exhaust Failure (Confinement)
The bounding event for the glovebox dynamic exhaust failure event group in the confinement event accident sequence is a loss of negative pressure or a flow perturbation involving the C4 dynamic confinement system resulting in a ventilation air flow reversal into a C3 area. The material at risk is the maximum inventory of airborne radioactive material in all connected gloveboxes. Potential causes of this event are loss of normal control system, loss of all power, or mechanical failure of ventilation system. The applicant determined this to be an above the 10

CFR §70.61(c) threshold consequence event for the facility worker, the site worker, and the environment, and a below the 10 CFR §70.61(c) threshold consequence event for the public. The applicant has opted to protect the facility worker, site worker and the environment through a strategy of prevention. The staff independently evaluated this accident sequence and agrees to its categorization. The PSSC identified for protection of the site worker, facility worker and the environment is the C4 confinement system. No PSSCs were identified by the applicant as being necessary to adequately protect the public. However, the C3 and C2 confinement system passive boundaries provide defense-in-depth protection of the public, site worker, and the environment. Based on the applicant's deterministic criteria and the NUREG-1718 Table A-5 descriptions (high availability AEC), the staff considers this to be an acceptable strategy for meeting the 10 CFR §70.61 performance requirements.

Process Fluid Line Leak In a C3 Area Outside of a Glovebox (Confinement)
This event is postulated due to a leak from a line carrying a process fluid in a C3 area outside of a glovebox or process cell caused by corrosive chemicals or mechanical failure of AP piping. The material at risk is the maximum inventory of radiological material in a single AP vessel. The applicant determined this to be an above the 10 CFR §70.61(c) threshold consequence event for facility workers and the environment, and a below the 10 CFR §70.61(c) threshold consequence event for site workers and the public. The staff independently evaluated this accident sequence and agrees to its categorization. The applicant has opted to use a strategy of prevention to protect the facility worker and the environment. The PSSC identified for this strategy is a double-walled pipe. No PSSCs were identified by the applicant as being necessary to adequately protect the site worker and the public. However, the C3 confinement system provides defense-in-depth protection for the public and the site worker. Based on the nature of this event (prevented by a PEC), the staff considers this to be an acceptable strategy for meeting the 10 CFR §70.61 performance requirements.

Sintering Furnace Confinement Boundary Failure
This event is postulated due to a breach in the sintering furnace confinement boundary. The furnace is postulated to fail either through a slow leakage through the seals or a rapid over-pressurization event. These events could be caused by failure of the control system for the hydrogen/argon supply line, a failure in the sintering furnace exhaust system, or a sintering furnace seal failure. The material at risk is the maximum inventory of radiological material in both sintering furnaces. The applicant determined this to be an above the 10 CFR §70.61(c) threshold consequence event for the facility worker and the environment, and a below the 10 CFR §70.61(c) threshold consequence event for site workers or the public. The staff independently evaluated this accident sequence and agrees to its categorization. For the rapid over-pressurization event, the applicant has chosen a strategy of prevention. The PSSCs for this event are the sintering furnace pressure controls and the sintering furnace which functions as a confinement boundary. For the seal failure event, the applicant has chosen a strategy of mitigation. The PSSC for this event is the sintering furnace which is designed to limit any postulated leakage. No PSSCs were identified by the applicant as being necessary to adequately protect the site worker and the public. However, the C3 confinement system provides defense-in-depth protection for the public, site worker, and environment by mitigating any release that might occur. Based on the nature of this event (mitigated by a combination of PECs and AECs), the staff considers this to be an acceptable strategy for meeting the 10 CFR §70.61 performance requirements.

5.1.6.3.2 Fire Events

The potential consequences of fire events at the facility as listed by DCS include:

- Destruction of confinement barriers
- Destruction of civil structures
- Destruction of equipment contributing to dynamic confinement
- Failure or damage to utility equipment
- Loss of criticality controls
- Loss of other PSSCs

All of the above can lead to the release of nuclear and chemical material to the environment.

Potential causes for fire events within the facility identified by DCS are:

- Short circuits or equivalent event involving electrical equipment.
- Ignition or combustion of fixed or transient combustibles.
- Equipment that operates at high temperatures.
- Ignition of a solvent or other flammable/reactive chemical.

Thirty-five separate events with potentially significant consequences were analyzed by DCS to determine the bounding consequences from a potential fire event. These events were assigned to twelve groups as follows with a unique prevention or mitigation strategy:

- The AP process cells
- AP/MP C3 glovebox area
- C1 and/or C2 areas
  - 3013 canister
  - 3013 transport cask
  - Fuel rod
  - MOX fuel transport cask
  - Waste container
  - Transfer container
  - Final C4 HEPA filter
- Outside MOX fuel fabrication building
- Facility-wide systems
- Facility

These twelve groups are discussed below:

AP Process Cell (Fire)
The bounding event for the AP process cells events group in the fire events accident category was determined to be a fire in the cell containing the dissolution tanks. The material at risk was taken to be the maximum inventory of radioactive material in the cell containing the process tanks. A fire was postulated to occur in the process cell and consequences were evaluated. The applicant determined this to be an above the 10 CFR §70.61(c) threshold consequence event for the facility worker, site worker, the environment, and the public. The applicant has opted to protect these receptors through a strategy of prevention. The PSSC for protection of the facility worker was the process cell fire prevention features, the purpose of which is to ensure that fires in the process cells are highly unlikely. The process cell fire prevention features consist of :

- Elimination of ignition sources including electrical equipment and static electricity
- Fire barriers to protect process cell areas
- Elimination of all combustible materials from process cells containing aqueous solutions
- Elimination of combustibles outside of process equipment in cells containing solvents

- Maintenance of temperatures at levels to prevent creation of flammable vapors.

The process cell fire prevention features are also identified as the PSSC for protection of the public, site worker, and the environment. In addition, the process cell ventilation system passive boundary and the C2 confinement system passive boundary provide defense-in-depth protection to mitigate the potential consequences to the public, site worker, and the environment. Based on the applicant's deterministic criteria and the NUREG-1718 Table A-5 descriptions (enhanced administrative control with active and passive features), the staff considers this to be an acceptable strategy for meeting the 10 CFR §70.61 performance requirements.

<u>AP/MP C3 Glovebox Area (Fire)</u>
The bounding event for a fire in the AP/MP C3 glovebox area in the fire events accident category is a fire within the PuO_2 buffer storage area. The material at risk is the maximum inventory of radioactive material within the fire area. The specific cause of a fire in this area was not addressed, but the bounding event in this event group was identified as a fire originating in a glovebox. The applicant determined this to be an above the 10 CFR §70.61(c) threshold consequence event for the facility worker, site worker, public, and the environment. The applicant has opted to protect potentially affected workers, members of the public, and the environment through a strategy of mitigation. The PSSCs identified for protection of the facility worker were facility worker actions and facility worker controls. The PSSC identified for protection of the public, site worker, and the environment was the C3 confinement system and the active portion of the C4 confinement system. In addition, combustible loading controls is also identified as a PSSC for protection of the site worker, public, and the environment for storage gloveboxes. The primary protection of the worker will be early detection of the fire and the ability to evacuate the area before a release. Although not credited by the accident analysis, there will also be a fire suppression system in areas with dispersable radioactive material. This suppression system will be classified as a PSSC. Consideration of the warning time available from a fire before a breech in containment allows facility worker action to be an acceptable strategy for meeting the 10 CFR §70.61 performance requirements in regard to the facility worker. However, in its review, the NRC staff determined that the applicant did not provide sufficient justification that the C3 and C4 final HEPA filter could perform their safety function under fire/soot conditions. This is an open item, as discussed in revised DSER Section 7.1.5.5 (Open Item FS-1). Fire and soot conditions on filters are also associated with the pyrophoric nature of some UO_2 powders as discussed in revised DSER Section 11.3.1.2.1 (Open Item MP-1).

<u>3013 Canister (Fire)</u>
The bounding event for a fire affecting a 3013 canister event group in the C2 area is a fire in the 3013 storage area. The material at risk for this fire is the maximum inventory of radioactive material in the fire area. The cause of the fire was ignition of transient combustibles. The applicant determined this to be an above the 10 CFR §70.61(c) threshold consequence event for the facility worker, site worker, public, and the environment. The applicant has opted to protect potentially affected workers, members of the public, and the environment through a strategy of prevention. The PSSC identified for protection of the facility worker, site worker, public, and the environment is combustible loading controls, which are intended to limit the quantity of combustibles in a fire area containing 3013 canisters to ensure that the canisters are not adversely impacted by a fire. Based on the applicant's deterministic criteria and the NUREG-1718 Table A-5 descriptions (enhanced administrative control), the staff considers this to be an acceptable strategy for meeting the 10 CFR §70.61 performance requirements.

<u>3013 Transport Cask (Fire)</u>

The bounding event for a fire affecting a 3013 transport cask in the C1 or C2 area was determined to be a fire in the truck bay involving transport packages resulting in an energetic breach of the containers and the dispersal of radioactive materials. The type of fire postulated would be a fuel fire involving a truck. The material at risk was determined to be the maximum inventory in the transport packages. The applicant determined this to be an above the 10 CFR §70.61(c) threshold consequence event for facility workers, site workers, public, and the environment. The applicant has opted to protect potentially affected workers, members of the public, and the environment through a strategy of prevention. The PSSCs identified for protection of the facility worker, site worker, public, and the environment are the 3013 transport cask, which will withstand the design basis fire without breaching, and combustible loading controls, which will limit the quantity of combustibles in a fire area containing 3013 transport casks to ensure that the cask design basis fire is not exceeded. In addition to the identified PSSCs, there will also be a fire suppression system which is considered an additional protective feature. Based on the applicant's deterministic criteria and the NUREG-1718 Table A-5 descriptions (PEC and enhanced administrative control), the staff considers this to be an acceptable strategy for meeting the 10 CFR §70.61 performance requirements.

Fuel Rods (Fire)
The bounding event for a fire affecting fuel rods in the fire event accident category is a fire in the fuel assembly storage area. The material at risk for this fire is the maximum inventory of radioactive materials in the assembly storage area. Combustible loading in this area is low, but the fire is still assumed to involve all of the radioactive materials in the storage area. The source of the fire is considered to be electrical equipment and transient combustibles. The applicant determined this to be an above the 10 CFR §70.61(c) threshold consequence event for the facility worker, site worker, public, and the environment, and has opted to protect the potential receptors through a strategy of prevention. The PSSC identified for protection of the facility worker, site worker, public, and the environment is combustible loading controls which will limit the quantity of combustibles in a fire area containing fuel rods to ensure that the fuel rods are not adversely impacted by a fire. Based on the applicant's deterministic criteria and the NUREG-1718 Table A-5 descriptions (enhanced administrative control), the staff considers this to be an acceptable strategy for meeting the 10 CFR §70.61 performance requirements.

MOX Fuel Transport Cask (Fire)
The bounding event for a fire affecting the MOX fuel transport cask in the fire event accident scenario was determined to be a fire in the fuel assembly truck bay. The source of the fire is considered to be electrical equipment and transient combustibles. The material at risk was the radioactive material in the transport casks. The applicant determined this to be an above the 10 CFR §70.61(c) threshold consequence event for the facility worker, site worker, and the environment, but a below the 10 CFR §70.61(c) threshold consequence event for the public. The staff independently evaluated this accident sequence and agrees to its categorization. The applicant has opted to protect potential receptors through a strategy of prevention. The PSSC identified for protection of the facility worker, site worker, and the environment is the MOX fuel transport cask, which will withstand the design basis fire without breaching and combustible loading controls which are intended to limit the quantity of combustibles in a fire area containing MOX fuel transport casks to ensure that the cask design basis fire is not exceeded. No PSSCs were identified by the applicant as being necessary to adequately protect the public. In addition to the identified PSSCs, there will also be a fire suppression system which is considered an additional protective feature. Based on the applicant's deterministic criteria and the NUREG-1718 Table A-5 descriptions (PEC and enhanced administrative control), the staff considers this to be an acceptable strategy for meeting the 10 CFR §70.61 performance requirements.

Waste Container (Fire)
The bounding event for a fire affecting a waste container in the C1, C2 or C3 area event group in the fire event accident category was determined to be a fire located in the assembly packaging area. The material at risk is the maximum inventory of radioactive material in the waste container. The source of the fire is considered to be electrical equipment and transient combustibles. The applicant determined this to be an above the 10 CFR §70.61(c) threshold consequence event for the facility worker, but a below the 10 CFR §70.61(c) threshold consequence event for the public, site worker, and the environment. The staff independently evaluated this accident sequence and agrees to its categorization. The applicant has opted to limit the dose to the facility worker using a strategy of mitigation. The PSSC identified for protection of the facility worker is facility worker action to ensure that facility workers take proper actions to limit dose. No PSSCs were identified by the applicant as being necessary to adequately protect the public, site workers, and the environment. Based on the nature of this event (mitigated by rapid detection of fire and immediate worker responses), the staff considers this to be an acceptable strategy for meeting the 10 CFR §70.61 performance requirements.

Transfer Container (Fire)
The bounding event for a fire affecting a transfer cask within the C1, C2, or C3 areas event group in the fire event accident category was determined to be a fire in either the air locks, corridors, stairways, safe areas, or liquid waste reception areas. The material at risk is the maximum inventory in a transfer container. The source of the fire was identified as electrical equipment, transient combustibles or a HEPA filter. The applicant determined this to be an above the 10 CFR §70.61(c) threshold consequence event for the facility worker and the environment. but a below the 10 CFR §70.61(c) threshold consequence event for the public and site worker. The staff independently evaluated this accident sequence and agrees to its categorization. The applicant has opted to limit dose to the facility worker and the environment using a strategy of prevention. The PSSC identified for protection of the facility worker and the environment is combustible loading controls, which limit the quantity of combustibles in a fire area containing transfer containers to ensure that the containers are not adversely impacted by a fire. No PSSCs were identified by the applicant as being necessary to adequately protect the public or site worker. Based on the nature of this event (prevented by an enhanced administrative control), the staff considers this to be an acceptable strategy for meeting the 10 CFR §70.61 performance requirements.

C4 HEPA Filter (Fire)
The bounding event for a fire affecting the final C4 HEPA filter in the fire event accident category is a fire which breaches the HEPA filter housing and allows material from the HEPA filters to pass directly to the stack. The material at risk for this event is based on a conservative estimate of material present on the C4 HEPA filters. The applicant determined this to be an above the 10 CFR §70.61(c) threshold consequence event for the facility worker, site worker, and the environment but a below the 10 CFR §70.61(c) threshold consequence event for the public. The staff independently evaluated this accident sequence and agrees to its categorization. The applicant has opted to limit dose to the facility worker, site worker, and the environment using a strategy of prevention. The PSSCs identified for protection of the facility workers, site workers and the environment are combustible loading controls. No PSSCs were identified by the applicant as being necessary to adequately protect the public. Based on the applicant's deterministic criteria and the NUREG-1718 Table A-5 descriptions (enhanced administrative control), the staff considers this to be an acceptable strategy for meeting the 10 CFR §70.61 performance requirements.

Fire Outside of MFFF Building (Fire)
The bounding event for a fire originating outside of the MFFF building event group in the fire event accident category was determined to be a fire involving diesel fuel storage, gasoline storage, or the Reagents Processing Building such that the MFFF building structure is damaged and radioactive material is released. The material at risk is the maximum inventory of radioactive material in the MFFF which is susceptible to the effects of external fires. The applicant determined this to be an above the 10 CFR §70.61(c) threshold consequence event for the facility worker, site worker, public, and the environment, and has opted to meet the performance requirements using a strategy of prevention. The PSSCs identified to protect the facility worker, site worker, public and the environment were the MFFF building structure, which is designed to maintain structural integrity and prevent damage to internal PSSCs from external fires; the emergency diesel generator building structure, which is designed to maintain structural integrity and prevent damage to internal PSSCs from fires external to the structure; the emergency control room air conditioning system, which will ensure habitable conditions for operators; and the waste transfer line ,which will prevent damage to the line from external fires. Based on the applicant's deterministic criteria and the NUREG-1718 Table A-5 descriptions (PECs and an AEC), the staff considers this to be an acceptable strategy for meeting the 10 CFR §70.61 performance requirements.

Fire Affecting Facility Wide Systems (Fire)
The bounding event for a fire affecting facility wide systems (fires involving systems that cross fire areas) in the fire event accident category was determined to be a fire involving the pneumatic pipe automatic transfer system and results in a breach of confinement and the dispersal of radioactive material. The material at risk is the maximum inventory of radioactive material in the pneumatic pipe automatic transfer system. The fire is postulated to be caused by electrical equipment and transient combustibles. The applicant determined this to be an above the 10 CFR §70.61(c) threshold consequence event for the facility worker and the environment, but a below the 10 CFR §70.61(c) threshold consequence event for the public and the site worker. The staff independently evaluated this accident sequence and agrees to its categorization. The applicant has opted to limit the dose to the facility worker using a strategy of mitigation. The PSSCs identified for protection of facility workers is facility worker actions and combustible loading controls. The primary protection of the worker will be early detection of the fire and evacuation of the area before a release. The PSSC identified for protection of the environment is combustible loading controls. No PSSCs were identified by the applicant as being necessary to adequately protect the public and site worker. Based on the nature of this event (mitigated by enhanced administrative controls and immediate worker responses), the staff considers this to be an acceptable strategy for meeting the 10 CFR §70.61 performance requirements.

Facility (Fire)
The bounding event for a facility fire which involves more than one fire area in the fire event accident scenario was determined to be a fire in all process units and support units with radioactive materials present. The source term is the maximum inventory in the facility susceptible to a facility-wide fire. The applicant determined this to be an above the 10 CFR §70.61(c) threshold consequence event for the facility worker, site worker, public, and the environment and has opted to meet the performance requirements using a strategy of mitigation and prevention. The PSSCs identified for protection of the facility worker are worker actions and fire barriers that will contain the fires within the fire area. The PSSC identified for protection of the site worker, public and the environment is fire barriers. In addition to the identified PSSCs, there will also be a fire suppression system designated as a PSSC where dispersable radioactive material is present. However, the applicant has not demonstrated that an adequate

margin of safety has been provided for the fire barriers as discussed in revised DSER Section 7.1.5.6. (Open Item FS-2.)

5.1.6.3.3 Load Handling Events

Load handling events may occur during the operation of load handling or lifting equipment during normal operations or maintenance activities. Load handling events may occur due to the failure of handling equipment to lift or support the load; failure to follow designated load paths; or toppling of loads. Consequences of load handling events include possible damage to handled loads, resulting in dispersal of radioactive and/or chemical materials; possible damage to nearby equipment or structures, resulting in a loss of confinement and/or a loss of subcritical conditions; and possible damage to process equipment or structures relied on for safety.

Twenty-eight separate events with potentially significant consequences were analyzed by DCS to determine the bounding consequences from a potential load handling event. These events were assigned to twelve groups as follows with a unique prevention or mitigation strategy:

- The AP process cells
- AP/MP C3 glovebox area
- C1 and/or C2 areas
  - -3013 Canister in the C2 confinement area
  - -Fuel rod in the C2 confinement area
  - -MOX fuel transport cask
  - -Transfer container
  - -Waste container
  - -Final C4 HEPA filter
- C4 Confinement
- Outside MFFF building
- Facility-wide systems

These twelve groups are discussed below:

<u>AP Process Cells (Load Handling)</u>
The bounding event for load handling events in the AP process cells event group in the load handling event accident category was determined to be an event in the cell containing the dissolution tanks. The material at risk was the maximum inventory of radioactive material in the AP Process cell containing the dissolution tanks. The load handling event is postulated to result in a breach of AP dissolution tanks and subsequent release of unpolished PuO_2 in solution due to vessels in the process cell being impacted by a lifting device or a lifted load. The applicant determined this to be an above the 10 CFR §70.61(c) threshold consequence event for the facility worker and the environment, but a below the 10 CFR §70.61(c) threshold consequence event for the public and the site worker. The applicant has opted to meet the performance requirements using a strategy of mitigation. The staff independently evaluated this accident sequence and agrees to its categorization. The PSSCs for the protection of facility workers are the process cells which contain fluid leaks using drip trays and the process cell entry controls which will prevent entry during normal conditions and assure that worker dose limits are not exceeded during maintenance operations. The PSSC for protection of the environment is the process cell ventilation system passive boundary. No PSSCs were identified by the applicant as being necessary to adequately protect the public and site workers. However, the process cell ventilation system passive boundary provides defense-in-depth protection for the public, site workers, and the environment. Based on the nature of this event (mitigated by a PEC and an

administrative control), the staff considers this to be an acceptable strategy for meeting the 10 CFR §70.61 performance requirements.

AP/MP C3 Glovebox (Load Handling)

The bounding event for load handling events in the AP/MP C3 glovebox area event group in the load handling accident category was determined to be an event which occurs within the gloveboxes that contain jar storage and handling of the MOX Powder Workshop from a breach of the glovebox. The material at risk is the maximum inventory of radioactive material in the glovebox. The breach of the glovebox is from a lifting device or a lifted load. The applicant determined this to be an above the 10 CFR §70.61(c) threshold consequence event for the facility worker, site worker, public, and the environment, and has opted to meet the performance requirements using a strategy of prevention and mitigation. The PSSCs for protection of the facility worker and the environment are material handling controls, which are intended to prevent impacts to the glovebox during normal operations from loads outside or inside the glovebox that could exceed the glovebox design basis; material handling equipment, which is engineered to prevent impacts to the glovebox; the glovebox, which maintains confinement integrity for design basis impacts; and facility worker controls (facility worker during maintenance operations). An additional safety function of the material handling controls is to prevent potential over-pressurization of the reusable plutonium dioxide cans, due to radiolysis or oxidation of Pu(III) oxalate, and its subsequent impact to the glovebox. The PSSC for protection of the public and site workers is the C3 confinement system. The C2 confinement system provides defense-in-depth protection for the site worker and the public. Based on the applicant's deterministic criteria and the NUREG-1718 Table A-5 descriptions (AEC, PEC, and administrative controls), the staff considers this to be an acceptable strategy for meeting the 10 CFR §70.61 performance requirements.

3013 Canister (Load Handling)

The bounding event for the 3013 canister event group (C2 area) in the load handling accident category was the drop of one 3013 container onto another 3013 container each containing unpolished PuO_2 in powder form. The material at risk was the amount of radioactive material in two 3013 canisters. The cause of the event would likely be human error or equipment failure during a hoisting operation. The applicant determined this to be an above the 10 CFR §70.61(c) threshold consequence event for the facility worker, site worker, and the environment, but a below the 10 CFR §70.61(c) threshold consequence event for the public. The applicant has opted to meet the performance requirements using a strategy of prevention. The staff independently evaluated this accident sequence and agrees to its categorization. The PSSCs identified for protection of the facility worker, site worker, and the environment are the 3013 canister and material handling controls. No PSSCs were identified by the applicant as being necessary to adequately protect the public. However, the C2 confinement system passive boundary also provides defense-in-depth for the site worker, public, and the environment. Based on the applicant's deterministic criteria and the NUREG-1718 Table A-5 descriptions (administrative control and PEC), the staff considers this to be an acceptable strategy for meeting the 10 CFR §70.61 performance requirements.

3013 Transport Cask (Load Handling)

The bounding event for the 3013 transport canister event group (C1 or C2 area) in the load handling accident category was the drop of a 3013 transport cask containing unpolished PuO_2 in powdered form onto another 3013 transport cask. The material at risk was the maximum inventory of radioactive material in two 3013 transport canisters. The applicant determined this to be an above the 10 CFR §70.61(c) threshold consequence event for the facility worker, site worker, and the environment, but a below the 10 CFR §70.61(c) threshold consequence event for the public. The applicant has opted to meet the performance requirements using a strategy of prevention. The staff independently evaluated this accident sequence and agrees to its categorization. The PSSCs identified for protection of the facility worker, site worker, and the environment are the 3013 transport cask and material handling controls. No PSSCs were identified by the applicant as being necessary to adequately protect the public. However, the C2 confinement system passive boundary also provides defense-in-depth for the site worker, public, and the environment. Based on the applicant's deterministic criteria and the NUREG-1718 Table A-5 descriptions (PEC and administrative controls), the staff considers this to be an acceptable strategy for meeting the 10 CFR §70.61 performance requirements.

Fuel Rods in C2 Area (Load Handling)
The bounding event for the fuel rods in the C2 area event group in the load handling accident category was the drop of one fuel assembly onto another fuel assembly each containing 6 percent MOX. The material at risk was the maximum inventory of two fuel rod assemblies. The cause of this event would probably be human error or equipment failure. The applicant determined this to be an above the 10 CFR §70.61(c) threshold consequence event for the facility worker, but a below the 10 CFR §70.61(c) threshold consequence event for the public, site worker, and the environment. The staff independently evaluated this accident sequence and agrees to its categorization. The applicant has opted to use a strategy of mitigation to protect the facility worker. The PSSC identified for protection of the facility worker is facility worker actions. No PSSC were identified by the applicant as being necessary to adequately protect the public, site worker, and the environment. However, the C2 confinement system passive boundary provides defense-in-depth for the public, site worker and the environment. Because a release could occur without warning, the applicant provided dose calculations which were reviewed onsite and found to be acceptable (Reference 5.3.2). Based on the nature of this event (limited initial release and immediate worker response), the staff considers this to be an acceptable strategy for meeting the 10 CFR §70.61 performance requirements.

MOX Fuel Transport Cask (Load Handling)
The bounding event for the MOX fuel transport cask event group (C1 or C2 areas) in the load handling accident category was determined to be the drop of one MOX fuel transport cask containing up to three MOX fuel assemblies. The cause of this event would probably be human error or equipment failure. The material at risk was determined to the maximum inventory of one fuel assembly transport package. The applicant determined this to be an above the 10 CFR §70.61(c) threshold consequence event for the facility worker and the environment but a below the 10 CFR §70.61(c) threshold consequence event for the public and the site worker. The staff independently evaluated this accident sequence and agrees to its categorization. The applicant has decided to meet the performance requirements of 10 CFR §70.61 for the facility worker and the environment using a strategy of prevention. The PSSCs identified for protection of the facility worker and the environment are the MOX fuel transport cask and material handling controls. The MOX fuel transport cask also provides defense-in-depth protection to the public and site worker. No PSSCs were identified by the applicant as being necessary to adequately protect the site worker and the public. However, the MOX fuel transport cask provides defense-in-depth protection for the public and site worker. Based on the nature of this event (prevented by a PEC and administrative controls), the staff considers this to be an acceptable strategy for meeting the 10 CFR §70.61 performance requirements.

Waste Container (Load Handling)
The bounding event for the waste container event group (C1, C2, or C3 area) in the load handling accident category is a damaged waste drum in the assembly packaging (Truck Bay) area due to human error or equipment failure. The material at risk was determined to be the

maximum inventory of radiological material in a waste container. The applicant determined this to be an above the 10 CFR §70.61(c) threshold consequence event for the facility worker but a below the 10 CFR §70.61(c) threshold consequence event for the public, site worker and the environment. The staff independently evaluated this accident sequence and agrees to its categorization. The applicant has decided to meet the performance requirements of 10 CFR §70.61 for the facility worker using a strategy of mitigation. The PSSCs identified for protection of the facility worker are worker actions. No PSSCs were identified by the applicant as being necessary to adequately protect the site worker, public, and the environment. For drops in the C2 area, the C2 confinement passive boundary provides defense-in-depth protection for the site worker, public, and the environment. However, because a release could occur without warning, the applicant provided dose calculations which were reviewed onsite and found to be acceptable (Reference 5.3.2). Based on the nature of this event (mitigated by limited initial release and immediate worker responses), the staff considers this to be an acceptable strategy for meeting the 10 CFR §70.61 performance requirements.

Transfer Container (Load Handling)
The bounding event for the transfer container event group (C2 area) in the load handling accident category was the drop of a transfer container containing a HEPA filter with PuO_2 in powdered form. The material at risk was determined to be the maximum inventory in a HEPA filter. The applicant determined this to be an above the 10 CFR §70.61(c) threshold consequence event for the facility worker, site worker and the environment, and a below the 10 CFR §70.61(c) threshold consequence event for the public. The applicant has opted to meet the performance requirements using a strategy of prevention. The staff independently evaluated this accident sequence and agrees to its categorization. The PSSCs identified for protection of the facility worker, site worker and the environment are the transfer container and material handling controls. No PSSCs were identified by the applicant as being necessary to adequately protect the public. However, the C2 confinement passive boundary provides defense-in-depth protection. Based on the applicant's deterministic criteria and the NUREG-1718 Table A-5 descriptions (PEC and administrative control), the staff considers this to be an acceptable strategy for meeting the 10 CFR §70.61 performance requirements.

Final C4 HEPA Filter (Load Handling)
The bounding event in the final C4 HEPA filter event group in the load handling accident category was determined to be the impacting of the final C4 filters by a load that breaches the HEPA filter housing and allows material from the HEPA filters to pass directly to the stack. The cause of this event would probably be human error or equipment failure around the ventilation system. The material at risk was determined to be the radiological material contained in the heating, ventilation and air-conditioning (HVAC) system and filters. The applicant determined this to be an above the 10 CFR §70.61(c) threshold consequence event for the facility worker, site worker, and the environment and a below the 10 CFR §70.61(c) threshold consequence event for the public. The staff independently evaluated this accident sequence and agrees to its categorization. The applicant has decided to meet the performance requirements of 10 CFR §70.61 for the facility worker, site worker, and the environment using a strategy of prevention. Material handling controls were identified as the PSSC for protection of these receptors. In addition, the applicant stated that in the current design and operations, there are no cranes or heavy equipment in the vicinity of the C4 final filters that could cause a load handling event. Thus, there are no credible load handling events during normal operations. During maintenance operations, maintenance will only be performed on out-of-service trains which will prevent a release to the stack. No PSSCs were identified by the applicant as being necessary to adequately protect the public. However, the C2 confinement system passive boundary provides defense-in-depth protection for the public. Based on the applicant's deterministic criteria and the

NUREG-1718 Table A-5 descriptions (enhanced administrative control), the staff considers this to be an acceptable strategy for meeting the 10 CFR §70.61 performance requirements.

C4 Confinement (Load Handling)
The bounding event in the inside the C4 confinement event group in the load handling accident category was determined to be a spill of unpolished plutonium powder that occurs inside the glovebox but does not result in a breach of the glovebox. The cause of this event would probably be human error or equipment failure during load handling operations inside the glovebox. The material at risk would be the maximum inventory in the glovebox. The applicant determined this to be an above the 10 CFR §70.61(c) threshold consequence event for the facility worker, site worker, and the environment, and a below the 10 CFR §70.61(c) threshold consequence event for the public. The staff independently evaluated this accident sequence and agrees to its categorization. The applicant has decided to meet the performance requirements of 10 CFR §70.61 for the facility worker, site worker, and the environment using a strategy of mitigation. The C4 confinement system is identified as the PSSC for protection of the facility worker, site worker, and the environment. The safety functions of the C4 confinement system in this event are to ensure that the C4 exhaust is effectively filtered and to maintain a negative glovebox differential pressure between the glovebox and the interfacing systems. No PSSCs were identified by the applicant as being necessary to adequately protect the public. Based on the applicant's deterministic criteria and the NUREG-1718 Table A-5 descriptions (high dependability AEC), the staff considers this to be an acceptable strategy for meeting the 10 CFR §70.61 performance requirements.

Outside MFFF Buildings (Load Handling)
The bounding event in the load handling event category outside the MOX fuel fabrication building is an event involving the waste transfer line. The cause of this event would probably be human error or equipment failure. The material at risk was determined to be the maximum inventory in the waste tank. The applicant determined this to be an above the 10 CFR §70.61(c) threshold consequence event for the facility worker, site worker, public, and the environment, and has opted to meet the performance requirements using a strategy of prevention. The PSSC identified for protection of the facility worker, site worker, public, and the environment is the waste transfer line which is double walled and buried. Based on the applicant's deterministic criteria and the NUREG-1718 Table A-5 descriptions (robust PECs), the staff considers this to be an acceptable strategy for meeting the 10 CFR §70.61 performance requirements.

Facility Wide (Load Handling)
The bounding event in the load handling event category for the facility wide event class is the breach of the facility structure from a heavy load resulting in a breach of primary confinement or in a breach of container holding nuclear materials. The cause of this event would probably be human error or equipment failure. The material at risk was determined to be maximum inventory in a container or primary confinement. The applicant determined this to be an above the 10 CFR §70.61(c) threshold consequence event for the facility worker, site worker, public, and the environment, and has opted to meet the performance requirements using a strategy of prevention. The PSSCs identified for protection of the facility worker, site worker, public, and the environment are the MOX fuel fabrication building structure which is designed to withstand the effects of load drops that could potentially impact radiological material and materials handling controls that would prevent load handling events that could breach primary confinements. Based on the applicant's deterministic criteria and the NUREG-1718 Table A-5 descriptions (PEC and administrative control), the staff considers this to be an acceptable strategy for meeting the 10 CFR §70.61 performance requirements.

5.1.6.3.4 Explosion Events

Explosions are postulated to occur inside of the MOX Fuel Fabrication Building from process operations, outside the MOX Fuel Fabrication Building from nearby support facilities and the storage of chemicals on the facility site, and from laboratory operations. The major consequences of explosions are:

- Damage to a confinement boundary
- Damage to equipment contributing to dynamic confinement
- Loss of subcritical conditions
- Damage to civil structures
- Damage to other principal SSCs

All of the above may result in the release of nuclear materials or chemicals to the environment.

Twenty-three separate events with potentially significant consequences were analyzed by DCS to determine the bounding consequences from a potential explosion event. These events were assigned to fifteen groups as follows with a unique prevention or mitigation strategy.

- Hydrogen explosion
- Steam over-pressure explosion
- Radiolysis induced explosion
- HAN explosion
- Hydrogen peroxide explosion
- Solvent explosion
- Tributyl phosphate (TBP)-Nitrate (Red oils) explosion
- AP vessel over-pressurization explosion
- Pressure vessel over pressurization explosion
- Hydrazoic acid explosion
- Metal azide explosion
- Pu (VI) Oxalate explosion
- Electrolysis related explosion
- Laboratory explosion
- Outside explosion

These fifteen groups are discussed below:

Hydrogen (Explosion)
The bounding event for the hydrogen explosion event group is the explosion of hydrogen and oxygen in a sintering furnace or sintering furnace room. The cause of this event would probably be excessive hydrogen in the furnace and air leakage into the furnace or hydrogen accumulation into the room. The applicant determined this to be an above the 10 CFR §70.61(c) threshold consequence event for the facility worker, site worker, public, and the environment, and has opted to meet the performance requirements using a strategy of prevention. The PSSC identified for prevention of this event is the process safety control subsystem with the safety function of preventing an explosive accumulation of hydrogen vapors. Specific control approaches may consist of hydrogen monitors outside the furnace, oxygen monitors inside the furnace, limiting the hydrogen content in the hydrogen-argon mixture, and crediting dilution flow from the High Depressurization Exhaust (HDE) or Very High Depressurization Exhaust (VHD) systems to prevent an explosive mixture of hydrogen. The specific functions and systems selected will be identified as IROFS in the ISA. However, the staff does not consider the

applicant's evaluation to be complete and will require the applicant to provide more information on the design bases of the process safety control subsystem in regard to hydrogen concentration limits around the sintering furnaces as discussed in revised DSER Section 11.3.1.2.4**.** This is an open item similar to the staff's concern about ignition of flammable gases from the electrolyzer as discussed in revised DSER Section 11.2.1.3.3. (Open Item AP-2)

Steam (Explosion)
A steam explosion is postulated to occur in the sintering furnace due to humidifier water in the inlet gas stream. The cause of the event is expected to be a failure of the water level controller in the humidifier. The material at risk was determined to be the maximum inventory of radiological materials in the sintering furnace. The applicant determined this to be an above the 10 CFR §70.61(c) threshold consequence event for the facility worker, site worker, public, and the environment, and has opted to meet the performance requirements using a strategy of prevention. The PSSC identified to protect the facility worker, site worker, public, and the environment is the process safety control subsystem which will ensure the isolation of sintering furnace humidifier water flow on high water level. Because of the design of the water cooling coils of the sintering furnace, water will not enter the sintering furnace through any other path. Based on the applicant's deterministic criteria and the NUREG-1718 Table A-5 descriptions (AEC), the staff considers this to be an acceptable strategy for meeting the 10 CFR §70.61 performance requirements.

Radiolysis (Explosion)
The bounding events in the radiolysis induced explosion event group were explosions due to radiolysis induced hydrogen buildup in the vapor space of an AP vessel tank or piping, radiolysis induced hydrogen buildup in the vapor space of a raffinates tank (in an AP process cell), and radiolysis induced hydrogen accumulation in a waste container containing hydrocarbons. The applicant determined the first two event sequences to be above the 10 CFR §70.61(c) threshold consequence events for the facility worker, site worker, public, and the environment. The applicant determined the last event to be an above the 10 CFR §70.61(c) threshold consequence event for the facility worker, site worker, and the environment only. The applicant has opted to meet the performance requirements using a strategy of prevention. The PSSC identified for protection of the facility worker, site worker, public, and the environment are the offgas treatment system, the instrument air system (scavenging system), and waste containers. The waste container contains a filter to allow the escape of radiolytic hydrogen before explosive mixtures occur as the principal SSC to prevent an explosion inside of the waste container. However, the staff has an open item concerning the design bases of the offgas treatment system regarding allowable hydrogen concentrations as discussed in revised DSER Section 11.2.1.3.10 (Open Item AP-8). Also, considerations for gas generation from radiolysis are similar to considerations for gas generation in the electrolyzer from chemical reactions and/or an overvoltage condition as discussed in revised DSER Section 11.2.1.3.3. (Open Item AP-2).

HAN (Explosion)
The Hydroxyl nitrate (HAN) explosions that could potentially occur within the facility may be characterized by one of the following three cases:

1) Process Vessels containing HAN and hydrazine nitrate without NOx addition
2) Vessels containing HAN and no hydrazine nitrate
3) Process Vessels containing HAN and hydrazine nitrate with NOx addition

The applicant provided a hazard analysis and selected PSSC for each case separately. The material at risk, however, was the same for all three events and consisted of the maximum radiological inventory in AP vessels, tanks, and piping. The applicant has determined that the consequences from this event sequence for each of the cases are an above the 10 CFR §70.61(c) threshold consequence event for the facility worker, site worker, public, and the environment, and has opted to meet the performance requirements using a strategy of prevention. The applicant identified two PSSCs as required for the first case. These are the process safety control subsystem, which ensures that the temperature of the solution containing HAN is limited to temperatures that are within safety limits, and the chemical safety control, which ensures that the concentration of nitric acid, metal impurities, and HAN introduced in the process are within safety limits. For the second case the same PSSCs with the same functions are also identified to protect all receptors. In the third case, the process safety control subsystem is identified with the function of controlling the liquid flowrate into the oxidation column; the chemical safety control is identified to limit the concentration of HAN, hydrazine nitrate, and hydrazoic acid; and the offgas treatment system is identified to provide an exhaust path for off-gases. The staff concludes that the HAN/hydrazine analysis is not complete and that PSSCs and their design bases for preventing HAN/hydrazine explosions are not adequate for all potentially affected units and components as discussed in revised DSER Section 8.1.5.2.3. (Open Item CS-2.)

Hydrogen Peroxide (Explosion)
The bounding event in the hydrogen peroxide explosion class was determined to be an event involving hydrogen peroxide in AP vessels, tanks, and piping which results in an energetic breach of the vessels, tanks, and piping, and results in a loss of confinement and dispersal of nuclear materials. The applicant determined this to be an above the 10 CFR §70.61(c) threshold consequence event for the facility worker, site worker, public, and the environment, and has opted to meet the performance requirements using a strategy of prevention. The PSSC identified to protect the facility worker, site worker, public, and environment is the chemical safety control to ensure that explosive concentrations of hydrogen peroxide do not occur. This administrative control consists of a certified analysis by the manufacturer under an approved Quality Assurance (QA) plan, an analysis upon receipt at the facility, and an analysis after mixing and diluting. Based on the applicant's deterministic criteria and the NUREG-1718 Table A-5 descriptions (enhanced administrative control), the staff considers this to be an acceptable strategy for meeting the 10 CFR §70.61 performance requirements.

Solvent (Explosion)
The bounding event in the solvent explosion class was determined to be a process related explosion involving solvents in AP vessels, tanks, and piping which results in an energetic breach of the vessels, tanks, and piping and results in a loss of confinement and dispersal of nuclear materials. The applicant determined this to be an above the 10 CFR §70.61(c) threshold consequence event for the facility worker, site worker, and the environment, and a below the threshold consequence event for the public. The applicant has opted to meet the performance requirements using a strategy of prevention. The staff independently evaluated this accident sequence and agrees to its categorization. The PSSCs identified to protect the facility worker, site worker, and the environment are the process safety control subsystem to ensure the temperature of the solutions containing solvents do not exceed the temperature at which the gaseous phase becomes flammable; the process cell fire prevention features to ensure that fires in process cells are highly unlikely; and the offgas treatment system which will provide exhaust to ensure that an explosive build-up of explosive vapors does not occur. No PSSCs were identified by the applicant as being necessary to adequately protect the public. The staff has an open item in regard to the design basis for solvent temperature and flammable vapor concentrations in the offgas treatment unit as discussed in revised DSER Section 11.2.1.3.10 (Open Items CS-9, AP-8 and AP-9).

TBP-Nitrate (Red Oils) (Explosion)

The bounding event in the TBP-Nitrate (Red Oil) explosion class is a process related chemical explosion involving red oil formation in the AP boiler, vessel, or tank and results in loss of confinement and dispersal of nuclear materials. The applicant determined this to be an above the 10 CFR §70.61(c) threshold consequence event for the facility worker, site worker, public, and the environment, and has opted to meet the performance requirements using a strategy of prevention. The principal SSCs identified for prevention of this event are process safety control subsystem, chemical safety control, and off-gas treatment system. The purpose of the process safety control subsystem is to ensure that the evaporator process temperature is maintained within safe limits and to control the residence time of organics in the presence of oxidizers, radiation fields, and high temperatures. The chemical safety control ensures that quantities of organics are limited from entering process vessels containing oxidizing agents and at potentially high temperatures and ensures that a diluent is used that is not very susceptible to either nitration or radiolysis. The offgas treatment system provides an exhaust path for the removal of gases in process vessels. However, the staff concludes that the red oil phenomena analysis is not complete and that PSSCs and their design bases for preventing red oil explosions are not adequate for all potentially affected components as discussed in revised DSER Section 8.1.2.5.5. (Open Item CS-1.)

AP Vessel Over-Pressurization (Explosion)

The bounding events in AP vessel over-pressurization explosion class were determined to be the over-pressurization of AP tanks, vessels, and piping postulated as a result of increases in the temperature of exothermic chemical reactions of solutions into tanks or vessels within the facility. The applicant determined this to be an above the 10 CFR §70.61(c) threshold consequence event for the facility worker, site worker, public, and the environment, and has opted to meet the performance requirements using a strategy of prevention. The PSSCs identified for prevention of this event are the fluid transport systems that will insure that vessels, tanks, and piping are designed to prevent process deviations from creating over-pressurization events; the offgas treatment system, which will provide an exhaust path for the removal of gases in process vessels; and chemical safety controls to ensure control of the chemical makeup of the reagents and ensure segregation/separation of vessels/components from incompatible chemicals. Based on the applicant's deterministic criteria and the NUREG-1718 Table A-5 descriptions (PECs, AECs and administrative controls), the staff considers this to be an acceptable strategy for meeting the 10 CFR §70.61 performance requirements.

Pressure Vessel Over-Pressurization (Explosion)

The bounding event in the pressure vessel over-pressurization explosion class is an explosion related to the over-pressurization of gas bottles, tanks, or receivers which could impact primary confinements and result in a release of radioactive material. The applicant determined this to be an above the 10 CFR §70.61(c) threshold consequence event for the facility worker, site worker, public, and the environment, and has opted to meet the performance requirements using a strategy of prevention. The PSSCs identified for prevention of this event are the pressure vessel controls which ensure that primary confinement is protected from the impact of pressure vessel failures. Pressure vessels will be located away from PSSCs or otherwise protected so that a failure of any vessel would have no impact on the ability of the PSSC to perform its safety function. Based on the applicant's deterministic criteria and the NUREG-1718 Table A-5 descriptions (PECs and administrative controls), the staff considers this to be an acceptable strategy for meeting the 10 CFR §70.61 performance requirements.

Hydrazoic Acid (Explosion)

The bounding event in the hydrazoic acid explosion sequence is a process related chemical explosion involving HAN/Nitric Acid in AP vessels, tanks, and piping (in AP process cells or gloveboxes) which results in the breach of AP vessels, tanks and piping. The material at risk is the maximum inventory of radiological material in AP vessels, tanks, and piping. The applicant determined this to be an above the 10 CFR §70.61(c) threshold consequence event for the facility worker, site worker, public, and the environment and has opted to meet the performance requirements using a strategy of prevention. The PSSCs identified for protection of the facility worker, site worker, public, and the environment are the chemical safety control and the process safety control subsystem. The function of the chemical safety control is to: (1) assure that the proper concentration of hydrazine nitrate is introduced to the system, limiting the quantity of hydrazoic acid produced, and (2) ensure that hydrazoic acid is not accumulated in the process or propagated into the acid recovery and oxalic mother liquors recovery units by either taking representative samples in upstream units or by crediting the neutralization process within the solvent recovery unit. The safety function of the process safety control subsystem is to limit the temperature of the solution, thereby limiting the evaporation rate and resulting vapor pressure of hydrazoic acid so that an explosive concentration of hydrazoic acid does not occur. However, as discussed in revised DSER section 8.1.5.2.3 the staff concludes that the HAN/Hydrazine analysis of the revised CAR is not complete and that PSSCs and their design bases for preventing hydrazoic acid explosions are not adequate for all potentially affected units and components (Open Item CS-2). Also, the staff concludes that the HAN/Hydrazine analysis of the revised CAR is not complete and that PSSCs and their design basis for preventing azide formation and potential explosions are not adequate for all potentially affected units and components as discussed in revised DSER Section 8.1.5.2.3. (Open Item CS-3)

Metal Azide Explosions

The bounding event in the metal azide explosion category is a process related chemical explosion involving an azide (other than hydrazoic acid) in an AP boiler, vessel, or tank (in an AP cell or glovebox) that results in an energetic breach of the AP boiler, vessel or tank. The material at risk is the maximum inventory of radiological material in AP vessels, tanks and piping. The applicant determined this to be an above the 10 CFR §70.61(c) threshold consequence event for the facility worker, site worker, public, and the environment, and has opted to meet the performance requirements using a strategy of prevention. The PSSCs identified for protection of the facility worker, site worker, public, and the environment are the chemical safety control and the process safety control subsystem. The safety functions of the chemical safety control are to: (1) ensure that metal azides are not added to high temperature process equipment and (2) ensure that the sodium azide has been destroyed prior to transfer of the alkaline waste into the acidic high alpha waste of the waste recovery unit. The safety function of the process safety control subsystem is to ensure that metal azides are not exposed to temperatures that would supply sufficient energy to overcome the activation energy needed to initiate the energetic azide decomposition and limit and control conditions under which dry-out can occur. Based on the applicant's deterministic criteria and the NUREG-1718 Table A-5 descriptions (AEC and enhanced administrative control), the staff considers this to be an acceptable strategy for meeting the 10 CFR §70.61 performance requirements.

Pu (VI) Oxalate Explosion

The bounding event for the Pu (VI) oxalate explosion category is a process related chemical explosion involving plutonium (VI) in the calcining furnace results in an energetic breach of the furnace and glovebox and the dispersal of radiological materials. The material at risk is the maximum inventory of radiological material in AP vessels, tanks, and piping. The applicant determined this to be an above the 10 CFR §70.61(c) threshold consequence event for the facility worker, site worker, public, and the environment, and has opted to meet the performance requirements using a strategy of prevention. The PSSCs identified for protection of the facility worker, site worker, public, and the environment is the chemical safety control. The safety function of the chemical safety control is to perform a measurement of the valency of the plutonium prior to adding oxalic acid to the oxalic precipitation and oxidation unit to ensure that Pu (IV) cannot be formed. In addition, the design basis for the calciner will assure that the rapid decomposition of any plutonium (VI) oxalate that may enter the calciner will not challenge the calciner vessel's integrity. Based on the applicant's deterministic criteria and the NUREG-1718 Table A-5 descriptions (enhanced administrative control), the staff considers this to be an acceptable strategy for meeting the 10 CFR §70.61 performance requirements.

Electrolysis Related Explosion

The bounding event for the electrolysis related explosion category is the explosion of hydrogen in the vapor space of the electrolyzer. The material at risk is the maximum inventory of radiological material in AP vessels, tanks, and piping. The applicant determined this to be an above the 10 CFR §70.61(c) threshold consequence event for the facility worker, site worker, public, and the environment, and has opted to meet the performance requirements using a strategy of prevention. The PSSC identified for protection of the facility worker, site worker, public, and the environment is the process safety control subsystem. The function of the process safety control subsystem is to ensure that the normality of the acid is sufficiently high to ensure that the off-gas is not flammable and to limit excessive generation of hydrogen. However, the analysis of the electrolyzer did not include events involving titanium, such as titanium fires which can be very energetic and result in explosions as discussed in revised DSER Section 11.2.1.3.4 (Open Item AP-3). Additionally, as discussed in revised DSER Section 11.2.1.3.3, the analysis did not consider fires or explosions caused by flammable gases from an overvoltage condition (Open Item AP-2).

Laboratory (Explosion)

The bounding event for the laboratory explosion class is an explosion within the MFFF laboratory involving flammable, explosive, or reactive chemicals which results in a dispersal of radiological material. The radiological material assumed to be dispersed is the maximum inventory in the laboratory. The applicant determined this to be an above the 10 CFR §70.61(c) threshold consequence event for the facility worker, site worker, public, and the environment, and has opted to meet the performance requirements using a strategy of prevention and mitigation. The PSSCs for protection of the facility worker are the chemical safety control, laboratory material controls, and facility worker actions. The function of the chemical safety control is to ensure control of the chemical makeup of the reagents and ensure segregation/separation of vessels/components from incompatible chemicals. The safety function of the laboratory material controls is to minimize quantities of hazardous chemicals in the laboratory and to minimize quantities of radioactive materials in the laboratory. The function of facility worker actions is to ensure that facility workers take proper actions to limit radiological/chemical exposure. The PSSC identified for protection of the public, site worker and the environment is the C3 confinement system which provides filtration to mitigate dispersions from the C3 areas. Based on the applicant's deterministic criteria and the NUREG-1718 Table A-5 descriptions (enhanced administrative controls and AEC), the staff considers this to be an acceptable strategy for meeting the 10 CFR §70.61 performance requirements.

Outside (Explosion)

The bounding events for the outside explosion class were determined to be explosions in the reagent processing building, gas storage area, emergency diesel generator building, standby diesel generator building, and the access control building. The applicant determined this to be an above the 10 CFR §70.61(c) threshold consequence for the facility worker, site worker, public, and the environment, and has opted to meet the performance requirements using a strategy of prevention of a release. The PSSCs identified are the waste transfer line, which is designed to prevent damage to the line during an explosion; MOX fuel fabrication building structure, which is designed to maintain structural integrity and prevent damage to internal PSSCs from explosions external to the structure; and the emergency diesel generator building structure, which is designed to maintain structural integrity and prevent damage to internal PSSCs from explosions external to the structure. Also identified as a PSSC is the hazardous material delivery controls which ensure that the quantity of delivered hazardous material and its proximity to the fuel fabrication building structure, emergency generator building structure, and the waste transfer line are controlled to within the bounds of the values used to demonstrate that the consequences of outside explosions are acceptable. Based on the applicant's deterministic criteria and the NUREG-1718 Table A-5 descriptions (robust PECs and administrative controls), the staff considers this to be an acceptable strategy for meeting the 10 CFR §70.61 performance requirements.

5.1.6.3.5 Criticality Events

A criticality event is characterized by a self-sustaining fission chain reaction and can potentially release a large amount of energy over a short period of time. When fissionable materials, such as ^{235}U or ^{239}Pu are present in sufficient quantities, a self-sustaining fission chain reaction may be attained depending on size and shape of the fissionable materials, the nature of solvents or diluent and the proximity of potential reflectors.

The most immediate potential consequences from a criticality event is direct radiation exposure to the facility worker. Distance from the event normally protects the site worker and members of the public. Shielding materials can also reduce the dose.

Criticality accidents may be caused by violation of safety limits such as:

- Geometry control
- Mass control
- Density control
- Isotopics control
- Reflection control
- Moderation control
- Concentration control
- Interaction control
- Neutron absorber control
- Volume control
- Heterogeneity control
- Process variable control

The applicant will use a strategy of prevention to protect the facility worker from a criticality accident. The applicant identified only criticality control as the PSSC for its prevention strategy. The staff's review and evaluation of the applicant's analysis of criticality events is discussed in Chapter 6 of the revised DSER.

5.1.6.3.6 Chemical Events

The applicant evaluated chemical event scenarios having the potential to affect radiological safety by considering a range of initial conditions and failure modes of storage containers and associated systems. The revised CAR provided the following release scenarios for chemical events.

- Leaks and ruptures involving equipment vessels and piping.
- Evaporating pools formed by spills and tank failures.
- Flashing and evaporating liquified gases from pressurized storage.

Fourteen chemical events with potentially significant radiological consequences were analyzed by DCS to determine the bounding consequences of such events. These events were assigned to two groups with a unique prevention or mitigation strategy. These two groups are discussed below:

Chemical Hazards

Events involving chemical hazards are chemical releases from vessels, tanks, pipes, or transport containers internal or external to the MOX Fuel Fabrication Building. The primary potential for external releases would be from the Reagent Processing Building (BRP). For this group of events, only chemical consequences that impact radiological safety or MFFF operations and may result in a radioactive material release were considered. The applicant determined that the only chemical releases that could result in radiological releases would be chemical releases that could affect workers providing monitoring functions in the control room. The applicant has assumed that such radiological releases could be above threshold levels for receptors and has opted to meet the performance requirements through a strategy of prevention. The PSSC identified to prevent a radioactive release is the emergency control room air-conditioning system. However, as discussed in revised DSER Section 8.1.2.6, a suitable design basis for habitability in the Emergency Control Room has not been identified (Open Item CS-10).

In addition to the potential for radiological releases through the incapacitation of workers performing critical functions, there is also the potential for other facility workers to receive a chemical dose which could be injurious to their health and exceed the 10 CFR §70.61 performance requirements. These releases could occur from pipes and process vessels in the areas containing the dechlorination and dissolution unit electrolyzer and the dissolution unit chlorine offgas scrubbing column. The applicant has opted to meet the performance requirements through a strategy of mitigation. The principal SSCs identified to implement this safety strategy are process cell entry controls, the C4 confinement system and facility worker actions. However, as discussed in revised DSER Section 11.2.1.3.1, parameters have not yet been identified for the plutonium feed for the facility. Thus, if a stream containing large amounts of chloride is directed to the dissolution electrolyzer by mistake, an event involving a hazardous chemical release (chlorine gas) from radioactive material could result (Open Item AP-7).

Radiochemical Hazards

Events involving radiochemical hazards are postulated to occur inside the MOX Fuel Fabrication Facility and involve the aqueous polishing system. The applicant performed bounding consequence analysis to determine the unmitigated consequences to the public and the site worker. The applicant determined that under certain circumstances (a process failure) gases which would normally react with hydrazine, HAN, and hydrazoic acid could be released and result in an unacceptable dose to the site worker. The applicant has opted to satisfy the performance requirements using a strategy of mitigation. The PSSC chosen to protect the site worker is the process safety control subsystem which will ensure the flow of nitrogen dioxide/nitrogen tetroxide is limited to the oxidation column. In regard to the facility worker, the applicant stated that the same PSSCs that protect the worker from radioactive releases will also protect the facility worker from any radiochemical releases. However, a design basis and

PSSCs are needed for potentially toxic or reactive gases in the offgas unit as discussed in revised DSER Section 11.2.1.3.10 (Open Item AP-10).

A fire inside the secured warehouse could also result in unacceptable consequences to the facility worker and site worker through the release of depleted uranium dioxide. The applicant has opted to meet the performance objectives using a strategy of mitigation. The PSSCs identified to protect the facility worker and the site worker are facility worker actions and combustible loading controls. The safety function of the combustible loading controls is to limit the quantity of combustibles in the secured warehouse to ensure that any fire that may occur will not encompass a large fraction of the stored depleted uranium dioxide. The function of the facility worker action is to ensure that facility workers take proper actions to limit chemical consequences as a result of a fire. Based on the applicant's deterministic criteria and the NUREG-1718 Table A-5 descriptions (administrative control and an enhanced administrative control), the staff considers this to be an acceptable strategy for meeting the 10 CFR §70.61 performance requirements.

5.1.6.4 Consequence Assessment

The applicant has performed an analysis of the bounding mitigated consequences of each event type. These analyses are derived from the hazard assessment performed to establish the PSSCs and represent the bounding accident from each event type. The event types considered are the same as those discussed earlier and consist of loss of confinement, internal fire, load handling, explosion, and criticality. The calculated mitigated consequences from each event type were found to be below 10 CFR §70.61(c) threshold levels. A consequence analysis was not provided for chemical events because the unmitigated consequences were determined by the applicant to be below the 10 CFR §70.61(c) threshold limits to the public and site worker. As noted above, however, the staff has an open item in regard to this determination.

The bounding loss of confinement event is an event caused by a load handling accident involving a glovebox in the jar storage and handling unit.

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The bounding internal fire event is a fire in the fire area containing the final dosing unit. This unit contains polished plutonium powder for the purpose of down blending the mixed oxide powder to the desired blend for fuel rod fabrication. ***Text removed under 10 CFR 2.390.**

The bounding explosion event is an event that involves the entire material at risk within a process cell. The cause of the explosion was not postulated.

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***Text removed under 10 CFR 2.390.**

The staff's independent evaluation of the applicant's bounding consequence determinations are provided in revised DSER Sections 9.1.1.4 and 10.1.3. Presently, the staff has a concern with leak path factor used by the applicant particularly when fire or explosion events are being considered. The applicant used a value of 99.99 percent efficiency for HEPA filters for all cases. Absent further sufficient justification from DCS, the staff's present position is that it would not approve facility construction on a total assumed particulate release factor greater than 10^{-2} for accident analyses where severe environmental conditions are present. This is further discussed in Section 11.4.5.2 of the revised DSER. Although this open item does not change the acceptability of the facility performance in terms of dose to workers and the public, it does have an adverse effect on the acceptability of the environmental releases (Open Item VS-1).

5.1.7 Description of PSSCs

The acceptability of the various strategies for preventing and/or mitigating identified hazards is also dependent on the design bases of the PSSCs. The specific designs or "design bases" of the PSSCs as determined through the DCS safety assessment and are discussed in the appropriate sections of this revised DSER. The revised DSER sections were the design bases of each of the PSSCs are discussed is identified in Table 5-2.

5.2 EVALUATION FINDINGS

In Section 5 of the revised CAR, DCS provided a description of the safety analysis that it performed and the identified PSSCs for the proposed facility. Based on the staff's review of the revised CAR and supporting information provided by the applicant relevant to the safety analysis and the identified PSSCs, 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.

A summary of the staff's evaluation findings in regards to the safety assessment portion of the review is as follows:

- The plant site description relating to safety assessment was found to be adequate.
- The Safety Assessment Team description was found to be adequate.

The purpose of the safety assessment methodology review, as discussed in revised DSER Section 5.1.5, was to determine if the safety assessment was complete by assuring that all appropriate natural phenomena, external man-made hazards, and internal process hazards were considered. The methodology for the safety assessment of the design basis was found to be adequate.

The purpose of the safety assessment results review, as discussed in revised DSER Section 5.1.6 was to evaluate the appropriateness of natural phenomena and external man-made hazards selected for design, the adequacy of the PSSCs selected to protect against these events, and the adequacy of the strategy and identified PSSCs at a conceptual level for the internal process hazards. The results of the safety assessment of the design basis was found to have the open items shown below. These open items are discussed under the event category that they are associated with. It should be noted that some open items affect more than one event category.

<u>Leaks in AP Vessels or Pipes Within Process Cells (Confinement)</u>

- The applicant needs to evaluate the effects of toxic chemicals (evolved from licensed materials) released through the process cell ventilation system using an acceptable chemical consequence level standard. Also, information on indoor airspeed values and evaporation models needs to be provided (CS-5b).

<u>AP/MP C3 Glovebox Area (Fire)</u>

- The applicant needs to provide sufficient justification that the C3 and C4 final HEPA filter could perform their safety function under fire/soot conditions (FS-1).

- The applicant needs to address the pyrophoric nature of some UO_2 powders which is associated with fire and soot conditions on filters (MP-1).

<u>Facility (Fire)</u>

- The applicant needs to demonstrate that an adequate margin of safety has been provided for the fire barriers (FS-2).

<u>Hydrogen (Explosion)</u>

- The applicant needs to consider in its hazard analysis with respect to the electrolyzer, fires and/or explosions caused by ignition of flammable gases generated by chemical reactions and/or electrolysis, such as from an overvoltage condition (AP-2).

<u>Radiolysis (Explosion)</u>

- The applicant needs to provide PSSCs and their design bases for flammable gases and vapors in the offgas unit (AP-8).

- The applicant needs to consider in its hazard analysis with respect to the electrolyzer, fires and/or explosions caused by ignition of flammable gases generated by chemical reactions and/or electrolysis, such as from an overvoltage condition (AP-2).

<u>HAN (Explosion)</u>

- The staff concludes that the HAN/hydrazine analysis is not complete and that PSSCs and their design bases for preventing HAN/hydrazine explosions are not adequate for all potentially affected units and components (CS-2).

Solvent (Explosion)

- The staff concludes that the applicant's analysis of solvent flammability is not complete and that the design basis for solvent temperature and flammable vapor concentrations in the offgas treatment unit is not adequate(CS-9, AP-8, and AP-9).

TBP-Nitrate (Red Oils) (Explosion)

- The staff concludes that the red oil phenomena analysis is not complete and that PSSCs and their design bases for preventing red oil explosions are not adequate for all potentially affected components (CS-1).

Hydrazoic Acid (Explosion)

- The staff concludes that the HAN/Hydrazine analysis of the revised CAR is not complete and that PSSCs and their design bases for preventing hydrazoic acid explosions are not adequate for all potentially affected units and components (CS-2).

- The staff concludes that the HAN/Hydrazine analysis of the revised CAR is not complete and that PSSCs and their design basis for preventing azide formation and potential explosions are not adequate for all potentially affected units and components (CS-3).

Electrolysis Related Explosion

- The staff concludes that the applicant's hazard and accident analysis did not include events involving titanium, such as titanium fires (AP-3).

- The staff concludes that with respect to the electrolyzer, the applicant's hazard and accident analysis did not consider fires and/or explosions caused by flammable gases generated by chemical reactions and/or electrolysis, such as from an overvoltage condition (AP-2).

Chemical Hazards

- The applicant needs to identify a suitable design basis for habitability in the Emergency Control Room (CS-10).

- The applicant has not provided parameters for the plutonium feed for the facility. PSSCs and design bases should be identified for this feed material or a justification provided that it is not necessary (AP-7).

Radiochemical Hazards

- The applicant needs to provide a design basis and PSSCs for potentially toxic or reactive gases in the offgas unit (AP-10).

Consequence Assessment

- The bounding consequence analyses were found to be unacceptable regarding the assumed release factor for the HEPA filters in the fire and explosion consequence assessments (VS-1).

The applicant's discussion of the role of the safety assessment in the ISA process and its programmatic commitments for performance and continuation of the ISA process were found to be acceptable.

5.3 REFERENCES

5.3.1 American National Standards Institute/American Nuclear Society (ANSI/ANS) 8.1-1983

5.3.2 Brown, David, U.S. Nuclear Regulatory Commission, Memorandum to Eric Leeds, "February 21-22, 2002 In-Office Review Summary: Review of Duke Cogema Stone and Webster Construction Authorization Request Supporting Documents for the Mixed Oxide Fuel Fabrication Facility," March 11, 2002

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5.3.4 Code of Federal Regulations, Title 10, Energy, Part 20, "Standards for Protection Against Radiation."

5.3.5 Code of Federal Regulations, Title 10,Energy, Part 70, "Domestic Licensing of Special Nuclear Material."

5.3.6 Department of Energy (U.S.)(DOE). Standard-1020-94, "Change Notice #1. Natural Phenomena Hazards Design and Evaluation Criteria for Departments of Energy Facilities." DOE: Washington D.C.

5.3.7 Hastings, P., Duke Cogema Stone & Webster, letter to U.S. Nuclear Regulatory Commission, RE; Clarification of response to "Request for Additional Information" March 8, 2002

5.3.8 Ihde, R. Duke, Cogema Stone & Webster, letter to Document Control Desk, U.S. Nuclear Regulatory Commission, Docket NUMBER 070-03098 Duke Cogema Stone & Webster Mixed Oxide (MOX) Fuel fabrication Facility Construction Authorization Request, DCS-NRC-000114, October 31, 2002.

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

5.3.10 _____. Regulatory Guide 1.165, "Identification and Characterization of Seismic Sources and Determination of Safe Shutdown Earthquake Ground Motion." NRC: Washington, D.C. 1997

5.3.11 Ihde, R. Duke, Cogema Stone & Webster, letter to Document Control Desk, U.S. Nuclear Regulatory Commission, Docket NUMBER 070-03098 Duke Cogema Stone & Webster Mixed Oxide (MOX) Fuel fabrication Facility Construction Authorization Request, DCS-NRC-000120, November 22, 2002.

TABLE 5-1a. SAFETY ASSESSMENT SUMMARY (CRITICALITY, NATURAL PHENOMENA HAZARDS, EXTERNAL MAN-MADE HAZARDS, AND CHEMICAL HAZARDS)

Event	Event Type	PSSC	Safety Function
Criticality	Criticality	Criticality Controls - Features required to ensure that design bases are Fulfilled	Maintain sub-critical conditions in the process.
Natural Phenomena Hazards (NPHs)	Extreme Wind	MOX Fuel Fabrication Building	Withstand design basis wind loads and wind-driven missiles. Provide protection for internal SSCs.
		Emergency Generator Building	Withstand design basis wind loads and wind-driven missiles. Provide protection for internal SSCs.
		Missile Barriers	Withstand design basis wind loads and wind-driven missiles. Provide protection for internal SSCs.
		Waste Transfer Line	Withstand design basis wind loads and wind-driven missiles.
	Earthquake	MOX Fuel Fabrication Building	Withstand the effects of design basis earthquake.
		Emergency Generator Building	Withstand the effects of design basis earthquake.
		Waste Transfer Line	Withstand the effects of design basis earthquake.
		Fluid Transport Systems	Withstand the effects of design basis earthquake.
		Seismic Monitoring and Associated Seismic Isolation Valves	Prevent fire and criticality as a result of an uncontrolled release of chemicals and water within the MFFF building.
	Tornado	MOX Fuel Fabrication Building	Withstand design basis tornado wind loads and tornado-generated missiles. Provide protection to internal PSSCs.
		Emergency Generator Building	Withstand design basis tornado wind loads and tornado-generated missiles. Provide protection for internal PSSCs.
		Missile Barriers	Withstand design basis tornado wind loads and tornado-generated missiles. Provide protection for internal PSSCs.
		Waste Transfer Line	Withstand design basis tornado wind loads and tornado-driven missiles.
		Tornado Dampers	Protect MFFF ventilation systems from differential pressure effects of the tornado.

TABLE 5-1a. SAFETY ASSESSMENT SUMMARY (CRITICALITY, NATURAL PHENOMENA HAZARDS, EXTERNAL MAN-MADE HAZARDS, AND CHEMICAL HAZARDS)

Event	Event Type	PSSC	Safety Function
Natural Phenomena Hazards (NPHs)	External Fire	MOX Fuel Fabrication Building	Withstand the effects of the design basis external fire. Provide protection for internal SSCs from the effects of heat, fire, and smoke.
		Emergency Generator Building	Withstand the effects of the design basis external fire. Provide protection for internal SSCs from the effects of heat, fire, and smoke.
		Emergency Control Room Air-Conditioning System	Ensure habitable conditions for operators.
		Waste Transfer Line	Withstand the effects of external fires.
	Rain, Snow, and Ice	MOX Fuel Fabrication Building	Withstand the effects of the design basis rain, snow, ice loads. Provide protection for internal SSCs.
		Emergency Generator Building	Withstand the effects of the design basis rain, snow, ice loads. Provide protection for internal SSCs.
		Waste Transfer Line	Withstand the effects of design basis rain, snow, ice loads.
	Lighting	None	N/A
	Temperatures Extremes	None	N/A
External Man-Made	Release of Radioactive Material or Hazardous Chemicals	Emergency Control Room Air-Conditioning System	Ensure that the emergency control rooms are habitable.
	Direct Damage to Principal SSCs	MOX Fuel Fabrication Building (To be described in the ISA)	Withstand overpressure of explosions external to the MFFF area.
		Emergency Generator Building (To be described in the ISA)	Withstand overpressure of explosions external to the MFFF area.
	Loss of Offsite Power	Section 5.5.2.9, Section 5.4, Support Systems-Table 5.5-22 (Revised CAR)	Supply emergency power upon loss of offsite power.
	Fire	MOX Fuel Fabrication Building	Withstand the effects of the design basis external fire. Provide protection for internal SSCs from the effects of heat, fire, and smoke.

TABLE 5-1a. SAFETY ASSESSMENT SUMMARY (CRITICALITY, NATURAL PHENOMENA HAZARDS, EXTERNAL MAN-MADE HAZARDS, AND CHEMICAL HAZARDS)

Event	Event Type	PSSC	Safety Function
External Man-Made (Cont.)	Fire	Emergency Generator Building	Withstand the effects of the design basis external fire. Provide protection for internal SSCs from the effects of heat, fire, and smoke.
		Emergency Control Room Air-Conditioning	Ensure habitable conditions for operators.
		Waste Transfer Line	Withstand the effects of external fires.
External Exposure	Operator is inadvertently exposed to excessive direct radiation	Not Required	N/A
Chemical Mechanical failure Corrosion failure Ventilation system failure Incorrect Chemical Addition Drop of Container Impact of NPHs	A release of hazardous chemicals not produced from licensed materials	Emergency Control Room Air-Conditioning System	Ensure habitable conditions for operators in the control room.
	A release of hazardous chemicals produced from licensed materials	Process Cell Entry Controls	Prevent the entry of personnel into process cells during normal operations. Ensure that workers do not receive a chemical consequence in excess of limits while performing maintenance in the AP process cells.
		C4 Confinement Systems	Contain a chemical release within a glovebox and provide an exhaust path for removal of chemical vapors.
		Facility Worker Action	Ensure that facility workers take proper actions to limit chemical consequences for leaks occurring in C3
	A release of hazardous chemicals and radioactive materials.	Process Safety Control Subsystem (NO_2/N_2O_4)	Ensure that the flow rate of nitrogen dioxide/dinitrogen tetroxide is limited to the oxidation column of the purification cycle.
		Combustible Loading Controls (UO_2)	Limit the quantity of combustibles in the secured warehouse to ensure that any fire that may occur will not encompass a large fraction of the stored depleted uranium.
		Facility Worker Actions (UO_2)	Ensure that facility workers take proper actions to limit chemical consequences in the secured warehouse.

TABLE 5-1b SAFETY ASSESSMENT SUMMARY (PROCESS HAZARDS)

Event Type	Event Group	Bounding Event	PSSC (public)	Safety Function	PSSC (site worker)	Safety Function	PSSC (facility	Safety Function	PSSC (environment)	Safety Function
Loss of Confinement/ Dispersal of Nuclear Material	Over Temperature	Excessive Temperature of the AP Electrolyzer in a Glovebox	C3 Confinement	Provide filtration to mitigate dispersions from C3 areas.	C3 Confinement	Provide filtration to mitigate dispersions from C3 areas.	Process Safety Control Subsystem	Shutdown process equipment prior to exceeding a temperature safety limit.	Process Safety Control Subsystem	Shutdown process equipment prior to exceeding a temperature safety limit.
	Corrosion	Corrosion Involving Pneumatic Transfer of Corrosive Chemicals	None	N/A	None	N/A	Material Maintenance and Surveillance Program	Detect and limit damage resulting from corrosion.	Material Maintenance and Surveillance Program	Detect and limit damage resulting from corrosion.
	Small Breaches in a Glovebox Confinement Boundary or Backflow from a Glovebox through Utility Lines	Backflow Through the Interfacing Gas Line to the Interfacing System Followed by the Opening of this Interfacing System During a Maintenance Operation	None	N/A	None	N/A	C4 Confinement System	Maintain a negative glovebox differential pressure between glovebox and interfacing systems. Maintain a minimum inward flow through small glovebox breaches.	C4 Confinement System	Maintain a negative glovebox differential pressure between glovebox and interfacing systems. Maintain a minimum inward flow through small glovebox breaches.
	Leaks of AP Process Vessels or Pipes Within Process Cells	Leak of Tanks/Vessels Inside the Process Cell Containing a Portion of the Purification Cycle	None	N/A	None	N/A	Process Cells	Contain leaks within the process cells.	Process Cell Ventilation Systems Passive	Provide filtration to limit the dispersion of radioactive
							Process Cell Entry Controls	Prevent the entry of personnel into process cell during normal operation.		

TABLE 5-1b SAFETY ASSESSMENT SUMMARY (PROCESS HAZARDS)

Event Type	Event Group	Bounding Event	PSSC (public)	Safety Function	PSSC (site worker)	Safety Function	PSSC (facility worker)	Safety Function	PSSC (environment)	Safety Function
Loss of Confinement/ Dispersal of Nuclear Material	Backflow from a Process Vessel Through Utility Lines	Backflow of Radioactive Material from a Waste Tank Containing Americium through an Interfacing Supply Line that is Subsequently Breached or Opened during a Maintenance Operation	None	N/A	Backfllow Prevention Features	Prevent process fluids from backflowing into interfacing systems.	Backflow Prevention Features	Prevent process fluids from backflowing into interfacing systems.	Backflow Prevention Features	Prevent process fluids from backflowing into interfacing systems.
	Rod-Handling Operations	Fracture of One or More Fuel Rods While Utilizing Fuel Handling Equipment Resulting in a Breach of Confinement.	None	N/A	None	N/A	Facility Worker Action	Ensure that facility workers take proper actions to limit radiological exposure.	None	N/A
							Material Handling Controls	Ensure proper handling of primary confinements outside of gloveboxes.		
							Material Handling Equipment	Limit damage to fuel rods/ assemblies during handling operations.		

TABLE 5-1b SAFETY ASSESSMENT SUMMARY (PROCESS HAZARDS)

Event Type	Event Group	Bounding Event	PSSC (public)	Safety Function	PSSC (site worker)	Safety Function	PSSC (facility worker)	Safety Function	PSSC (environment)	Safety Function
Loss of Confinement/ Dispersal of Nuclear Material	Breaches in Containers Outside the Gloveboxes Due to Handling Operations in C2 and C3 Areas	Container Containing Filters is Breached While in C2 Area	Materials Handling and Control (C2 Areas)	Ensure proper handling of primary confinement types outside of gloveboxes.	Materials Handling and Control (C2 Areas)	Ensure proper handling of primary confinement types outside of gloveboxes	Material Handling Controls	Ensure proper handling of primary confinement types outside the gloveboxes	Materials Handling and Control (C2 Areas)	Ensure proper handling of primary confinement types outside
			3013 Canister (C2 Areas)	Withstand the effects of design basis drops without breaching.	3013 Canister (C2 Areas)	Withstand the effects of design basis drops without breaching.	3013 Canister	Withstand the effects of design basis drops without breaching.	3013 Canister (C2 Areas)	Withstand the effects of design basis drops without breaching.
			Transfer Container (C2 Areas)	Withstand the effect of design basis drops without breaching.	Transfer Container (C2 Areas)	Withstand the effect of design basis drops without breaching.	Transfer Container	Withstand the effects of design basis drops without breaching.	Transfer Container (C2 Areas)	Prevention: Withstand the effect of design basis drops without breaching.
			C3 Confinement System (C3 Areas)	Provide filtration to mitigate dispersion from the C3 areas.	C3 Confinement System (C3 Areas)	Provide filtration to mitigate dispersion from the C3 areas.	Facility Worker Controls (C3 Areas)	Ensure that facility workers take proper actions prior to bag-out operations to limit radiological exposure.	C3 Confinement System (C3 Areas)	Provide filtration to mitigate dispersion from the C3 areas.

TABLE 5-1b SAFETY ASSESSMENT SUMMARY (PROCESS HAZARDS)

		Event	PSSC (public)	Safety Function	PSSC (site worker)	Safety Function	PSSC (facility worker)	Safety Function	PSSC (environment)	Safety Function
Loss of Confinement/ Dispersal of Nuclear Material	Over or Under Pressurization of Glovebox	Rapid Over-Pressurization of the Calcining Furnace	None	N/A	None	N/A	Facility Worker Action (slow pressurization)	Ensure that facility workers take proper actions to limit radiological exposure.	C3/C4 Confinement System	Provide filtration to mitigate dispersion from C3/C4 areas.
							Process Safety Control Subsystem (slow pressurization)	Warn operators of glovebox pressure discrepancies prior to exceeding differential pressure limits.		
							Glovebox Pressure Controls (rapid or slow pressurization)	Maintain glovebox pressure within design limits.		
	Excessive Temperature Due to decay Heat from Radioactive Materials	Excessive Temperature (Due to decay Heat) of C2 Storage Area (PuO_2 Powder 3013 Storage Unit)	High Depressurization Exhaust System (C3 Confinement System)	Provide exhaust to ensure that temperatures in the 3013 canister storage structure are maintained within design limits.	High Depressurization Exhaust System (C3 Confinement System)	Provide exhaust to ensure that temperatures in the 3013 canister storage structure are maintained within design limits.	High Depressurization Exhaust System (C3 Confinement System)	Provide exhaust to ensure that temperatures in the 3013 canister storage structure are maintained within design limits.	High Depressurization Exhaust System (C3 Confinement System)	Provide exhaust to ensure that temperature s in the 3013 canister storage structure are maintained within design limits.

TABLE 5-1b SAFETY ASSESSMENT SUMMARY (PROCESS HAZARDS)

Event Type	Event Group	Bounding Event	PSSC (public)	Safety Function	PSSC (site worker)	Safety Function	PSSC (facility worker)	Safety Function	PSSC (environment)	Safety Function
Loss of Confinement/ Dispersal of Nuclear Material	Glovebox Dynamic Exhaust Failure	Loss of Negative Pressure or a Flow Perturbation Involving the C4 Dynamic Confinement System Resulting in a Ventilation Air Flow Reversal into a C3 Area	None	N/A	C4 Confinement System	Operate to ensure that a negative pressure differential exists between the C4 glovebox. Ensure that the C4 exhaust is effectively filtered.	C4 Confinement System	Operate to ensure that a negative pressure differential exists between the C4 glovebox. Ensure that the C4 exhaust is effectively filtered.	C4 Confinement System	Operate to ensure that a negative pressure differential exists between the C4 glovebox. Ensure that the C4 exhaust is effectively filtered.
	Process Fluid Line Leak in a C3 Area Outside the Glovebox	A Leak from a Line Carrying a Process Fluid in a C3 Area Outside of a Glovebox or Process Cell Caused by Corrosive Chemicals or Mechanical Failure of AP Piping	None	N/A	None	N/A	Double-Walled Pipe	Prevent leaks from pipes containing process fluids from leaking into C3 areas.	Double-Walled Pipe	Prevent leaks from pipe containing process fluids from leaking into C3 areas.
	Sintering Furnace Confinement Boundary Failure	Slow leakage through seals	None	N/A	None	N/A	Sintering Furnace	Provide primary confinement boundary against leaks into C3 areas.	Sintering Furnace	Provide primary confinement boundary against leaks into C3 areas
		Rapid Over-Pressurization of the Sintering Furnace					Sintering Furnace Pressure Controls	Maintain sintering furnace pressure within design limits.	Sintering Furnace Pressure Controls	Maintain sintering furnace pressure within design limits.

TABLE 5-1b SAFETY ASSESSMENT SUMMARY (PROCESS HAZARDS)

Event Type	Event Group	Bounding Event	PSSC (public)	Safety Function	PSSC (site worker)	Safety Function	PSSC (facility worker)	Safety Function	PSSC (environment)	Safety Function
Loss of Confinement/ Dispersal of Nuclear Material	Sintering Furnace Confinement Boundary Failure	Rapid Over-Pressurization of the Sintering Furnace	None	N/A	None	N/A	Sintering Furnace Pressure Controls	Minimize consequence s of leak from seal failure.	Sintering Furnace Pressure Controls	Minimize consequence s of leak from seal failure.
Fire	AP Process Cells	Fire in the AP Process Cells Containing the Dissolution Tanks	Process Cell Fire Prevention Features	Ensure that fires in the process cells are highly unlikely.	Process Cell Fire Prevention Features	Ensure that fires in the process cells are highly unlikely.	Process Cell Fire Prevention Features	Ensure that fires in the process cells are highly unlikely.	Process Cell Fire Prevention Features	Ensure that fires in the process cells are unlikely.
	AP/MP C3 Glovebox Areas	Fire Inside or Outside the Glovebox (Fire Areas Containing Process Gloveboxes) Fire within the PuO_2 Buffer Storage Area (Gloveboxes that Store Radiological Materials)	C3/C4 Confinement Systems	Remain operable during design basis fire and effectively filter any release.	C3/C4 Confinement Systems	Remain operable during design basis fire and effectively filter any release.	Facility Worker Action	Ensure that facility workers take proper actions to limit radiological exposure.	C3/C4 Confinement Systems	Remain operable during design basis fire and effectively filter any release.

TABLE 5-1b SAFETY ASSESSMENT SUMMARY (PROCESS HAZARDS)

Event Type	Event Group	Bounding Event	PSSC (public)	Safety Function	PSSC (site worker)	Safety Function	PSSC (facility worker)	Safety Function	PSSC (environment)	Safety Function
Fire	AP/MP C3 Glovebox Areas (Cont.)	Fire Inside or Outside the Glovebox (Fire Areas Containing Process Gloveboxes) Fire within the PuO_2 Buffer Storage Area (Gloveboxes that Store Radiological Materials)	Combustible Loading (For storage gloveboxes only)	Limit the quantity of combustibles in fire areas containing a storage glovebox such that any fire that may occur will not encompass a large fraction of the stored radiological material.	Combustible Loading (For storage gloveboxes only)	Limit the quantity of combustibles in fire areas containing a storage glovebox such that any fire that may occur will not encompass a large fraction of the stored radiological material.	Facility Worker Action	Ensure that facility workers take proper actions to limit radiological exposure.	Combustible Loading (For storage gloveboxes only)	Limit the quantity of combustibles in fire areas containing a storage glovebox such that any fire that may occur will not encompass a large fraction of the stored radiological material.
	C1 and/or C2-3013 Canister	Fire Affecting 3013 Canister	Combustible Loading Controls	Limit the quantity of combustibles in a fire area containing 3013 canisters to ensure that the canisters are not adversely impacted by a fire.	Combustible Loading Controls	Limit the quantity of combustibles in a fire area containing 3013 canisters to ensure that the canisters are not adversely impacted by a fire.	Combustible Loading Controls	Limit the quantity of combustibles in a fire area containing 3013 canisters to ensure that the canisters are not adversely impacted by a fire.	Combustible Loading Controls	Limit the quantity of combustibles in a fire area containing 3013 canisters to ensure that the canisters are not adversely impacted by a fire.
	C1 and/or C2-3013 Transport Cask	Fire in the Truck Bay Involving Transport Packages	3013 Transport Cask	Withstand the design basis fire without breaching.	3013 Transport Cask	Withstand the design basis fire without breaching.	3013 Transport Cask	Withstand the design basis fire without breaching.	3013 Transport Cask	Withstand the design basis fire without breaching.

TABLE 5-1b SAFETY ASSESSMENT SUMMARY (PROCESS HAZARDS)

Event Type	Event Group	Bounding Event	PSSC (public)	Safety Function	PSSC (site worker)	Safety Function	PSSC (facility worker)	Safety Function	PSSC (environment)	Safety Function
Fire	C1 and/or C2-3013 Transport Cask (Cont.)	Fire in the Truck Bay Involving Transport Packages	Combustible Loading Controls	Limit the quantity of combustibles in a fire area containing 3013 transport casks to ensure that the cask design basis fire is not exceeded.	Combustible Loading Controls	Limit the quantity of combustibles in a fire area containing 3013 transport casks to ensure that the cask design basis fire is not exceeded.	Combustible Loading Controls	Limit the quantity of combustibles in a fire area containing 3013 transport casks to ensure that the cask design basis fire is not exceeded.	Combustible Loading Controls	Limit the quantity of combustible s in a fire area containing 3013 transport casks to ensure that the cask design basis fire is not exceeded
	C1 and/or C2 Areas-Fuel Rod	Fire in the Fuel Assembly Storage Area	Combustible Loading Controls	Limit the quantity of combustibles in a fire area containing fuel rods to ensure that the fuel rods are not adversely impacted by a fire.	Combustible Loading Controls	Limit the quantity of combustibles in a fire area containing fuel rods to ensure that the fuel rods are not adversely impacted by a fire.	Combustible Loading Controls	Limit the quantity of combustibles in a fire area containing fuel rods to ensure that the fuel rods are not adversely impacted by a fire.	Combustible Loading Controls	Limit the quantity of combustible s in a fire area containing fuel rods to ensure that the fuel rods are not adversely impacted by a fire.
	C1 and/or C2 Areas-MOX Fuel Transport Cask	Fire Affecting the MOX Fuel Transport Cask	None	N/A	MOX Fuel Transport Cask	Withstand the design basis fire without breaching.	MOX Fuel Transport Cask	Withstand the design basis fire without breaching.	MOX Fuel Transport Cask	Withstand the design basis fire without breaching.

TABLE 5-1b SAFETY ASSESSMENT SUMMARY (PROCESS HAZARDS)

Event Type	Event Group	Bounding Event	PSSC (public)	Safety Function	PSSC (site worker)	Safety Function	PSSC (facility worker)	Safety Function	PSSC (environment)	Safety Function
Fire	C1 and/or C2 Areas-MOX Fuel Transport Cask (Cont.)	Fire Affecting the MOX Fuel Transport Cask	None	N/A	Combustible Loading Controls	Limit the quantity of combustibles in a fire area containing MOX fuel transport casks to ensure that the cask design basis fire is not exceeded.	Combustible Loading Controls	Limit the quantity of combustibles in a fire area containing MOX fuel transport casks to ensure that the cask design basis fire is not exceeded.	Combustible Loading Controls	Limit the quantity of combustible s in a fire area containing MOX fuel transport casks to ensure that the cask design basis fire is not exceeded.
	C1, C2, and/or C3 Areas-Waste Container	Fire in the Assembly Packaging Area	None	N/A	None	N/A	Facility Worker Action	Ensure that facility workers take proper actions to limit radiological exposure.	None	N/A
	C1, C2, and/or C3 Areas - Transfer Container	Fire in Either the Airlocks, Corridors, Stairways, Safe Areas, or Liquid Waste Reception Areas	None	N/A	None	N/A	Combustible Loading Controls	Limit the quantity of combustibles in a fire area containing transfer containers to ensure that the containers are not adversely impacted by a fire.	Combustible Loading Controls	Limit the quantity of combustible s in a fire area containing transfer containers to ensure that the containers are not adversely impacted by fire.

TABLE 5-1b SAFETY ASSESSMENT SUMMARY (PROCESS HAZARDS)

Event Type	Event Group	Bounding Event	PSSC (public)	Safety Function	PSSC (site worker)	Safety Function	PSSC (facility worker)	Safety Function	PSSC (environment)	Safety Function
Fire	C1 and/or C2 Areas-Final C4 HEPA Filter	Fire Impacting Final C4 HEPA Filters Breaches the HEPA Filter House Allowing the Material to Pass Directly to the Stack.	None	N/A	Combustible Loading Controls	Limit the quantity of combustibles in the filter area to ensure that the final C4 HEPA filters are not impacted by a fire in the filter room.	Combustible Loading Controls	Limit the quantity of combustibles in the filter area to ensure that the final C4 HEPA filters are not adversely impacted by a fire in the filter room.	Combustible Loading Controls	Limit the quantity of combustibles in the filter area to ensure that the final C4 HEPA filters are not impacted by a fire in the filter room.
	Outside the MOX Fabrication Building	Fire Involving Diesel Fuel Storage, Gasoline Storage, or the Reagents Processing Building such that the MFFF Building Structure is Damaged and Radioactive Material is Released.	MOX Fuel Fabrication Building Structure	Maintain structural integrity and prevent damage to internal PSSCs from external fires.	MOX Fuel Fabrication Building Structure	Maintain structural integrity and prevent damage to internal PSSCs from external fires.	MOX Fuel Fabrication Building Structure	Maintain structural integrity and prevent damage to internal PSSCs from external fires.	MOX Fuel Fabrication Building Structure	Maintain structural integrity and prevent damage to internal PSSCs from external fires.
			Emergency Generator Building Structure	Maintain structural integrity and prevent damage to internal PSSCs from fires external to the structure.	Emergency Generator Building Structure	Maintain structural integrity and prevent damage to internal PSSCs from fires external to the structure.	Emergency Generator Building Structure	Maintain structural integrity and prevent damage to internal PSSCs from fires external to the structure.	Emergency Generator Building Structure	Maintain structural integrity and prevent damage to internal PSSCs from fires external to the structure.

TABLE 5-1b SAFETY ASSESSMENT SUMMARY (PROCESS HAZARDS)

Event Type	Event Group	Bounding Event	PSSC (public)	Safety Function	PSSC (site worker)	Safety Function	PSSC (facility worker)	Safety Function	PSSC (environment)	Safety Function
Fire	Outside the MOX Fabrication Building (Cont.)	Fire Involving Diesel Fuel Storage, Gasoline Storage, or the Reagents Processing Building such that the MFFF Building Structure is Damaged and radioactive material is released.	Emergency Control Room Air Conditioning System	Ensure habitable conditions for operators.	Emergency Control Room Air Conditioning System	Ensure habitable conditions for operators.	Emergency Control Room Air Conditioning System	Ensure habitable conditions for operators.	Emergency Control Room Air Conditioning System	Ensure habitable conditions for operators.
			Waste Transfer Line	Prevent damage to line from external fires.	Waste Transfer Line	Prevent damage to line from external fires.	Waste Transfer Line	Prevent damage to line from external fires.	Waste Transfer Line	Prevent damage to line from external fires.
	Facility Wide Systems	Fire Involving the Pneumatic Pipe Automatic Transfer System	None	N/A	None	N/A	Facility Worker Action	Ensure that facility workers take proper actions to limit radiological exposure.	Combustible Loading Controls	Limit the quantity of combustibles in areas containing the pneumatic transfer system to ensure this system is not adversely impacted.
							Combustible Loading Controls	Limit the quality of combustibles in a fire area containing a pneumatic system to ensure that this system is not adversely impacted by a fire		

TABLE 5-1b SAFETY ASSESSMENT SUMMARY (PROCESS HAZARDS)

Event Type	Event Group	Bounding Event	PSSC (public)	Safety Function	PSSC (site worker)	Safety Function	PSSC (facility worker)	Safety Function	PSSC (environment)	Safety Function
Fire	Facility	Fire in All Process Cells Units and Support Units with Radioactive Material Present	Fire Barriers	Contain fires within a single fire area.	Fire Barriers	Contain fires within a single fire area.	Fire Barriers	Contain fires within a single fire area.	Fire Barriers	Contain fires within a single fire area.
							Facility Worker Action	Ensure that facility workers take proper actions to limit radiological exposure.		
Load Handling	AP Process Cells	AP process Cell Containing the Dissolution Tanks Event Results in a Breach of the AP Dissolution Tanks and Subsequent Release of Unpolished PuO_2 Solution	None	N/A	None	N/A	Process Cells	Contain fluid leaks within the process cells.	Process Cell Ventilation System Passive Boundary	Provide filtration to limit the dispersion of radioactive material.
							Process Cell Entry Controls	Prevent the entry of personnel into process cells during normal operations. Ensure that facility workers do not receive a radiological dose in excess of limits while performing maintenance		

TABLE 5-1b SAFETY ASSESSMENT SUMMARY (PROCESS HAZARDS)

Event Type	Event Group	Bounding Event	PSSC (public)	Safety Function	PSSC (site worker)	Safety Function	PSSC (facility worker)	Safety Function	PSSC (environment)	Safety Function
Load Handling	AP/MP C3 Glovebox Areas	Gloveboxes that Contain Jar Storage and Handling of the MOX Powder Workshop Event results in a breach of a Glovebox and Subsequent Release of Radiological Material	C3 Confinement System	Provide filtration to mitigate dispersion from the C3 AreasC3	C3 Confinement System	Provide filtration to mitigate dispersion from the C3 Areas.	Material Handling Controls	Prevent impacts to the glovebox during normal operations from loads handled either outside or inside the glovebox that could exceed the glovebox design basis. loads handled either outside or inside the glovebox that could exceed the glovebox design basis. Confinement System	Material Handling Controls	Prevent impacts to the glovebox during normal operations from loads handled either outside or inside the glovebox that could exceed the glovebox design basis. loads handled either outside or inside the glovebox that could exceed the glovebox design basis. Confinement System
							Glovebox	Maintain confinement integrity for design basis impacts.	Glovebox	Maintain confinement integrity for design basis impacts.

TABLE 5-1b SAFETY ASSESSMENT SUMMARY (PROCESS HAZARDS)

Event Type	Event Group	Bounding Event	PSSC (public)	Safety Function	PSSC (site worker)	Safety Function	PSSC (facility worker)	Safety Function	PSSC (environment)	Safety Function
Load Handling	AP/MP C3 Glovebox Areas (Cont.)	Gloveboxes that Contain Jar Storage and Handling of the MOX Powder Workshop. Event results in a Breach of a Glovebox and Subsequent Release of Radiological Material	(See previous page)	(See previous page)	(See previous page)	(See previous page)	Material Handling Equipment	Prevent impacts to the glovebox through the use of engineered equipment.	Material Handling Equipment	Prevent impacts to the glovebox through the use of engineered equipment.
							Facility Worker Controls	Ensure that facility workers take proper actions prior to maintenance activities to limit radiological exposure.		
	C1 and/or C2 Areas-3013 Canister	Drop of One 31013 Canister Onto Another 3013 canister Each Containing Unpolished PuO2 in Powder Form	None	N/A	3013 Canister	Withstand the effects of the design basis drop without breaching.	3013 Canister	Withstand the effects of the design basis drop without breaching.	3013 Canister	Withstand the effects of the design basis drop without breaching.
					Material Handling Controls	Ensure that design basis lift height of the 3013 canister is not exceeded.	Material Handling Controls	Ensure that design basis lift height of the 3013 canister is not exceeded.	Material Handling Controls	Ensure that design basis lift height of the 3013 canister is not exceeded.
	C1 and/or C2 Areas-3013 Transport Cask	Drop of a 3013 Transport Cask Containing Unpolished PuO_2 in Powder Form onto Another Transport Cask	None	N/A	3013 Transport Cask	Withstand the effects of design basis drops without release of radioactive materials.	3013 Transport Cask	Withstand the effects of design basis drops without release of radioactive materials.	3013 Transport Cask	Withstand the effects of design basis drops without release of radioactive materials.

TABLE 5-1b SAFETY ASSESSMENT SUMMARY (PROCESS HAZARDS)

Event Type	Event Group	Bounding Event	PSSC (public)	Safety Function	PSSC (site worker)	Safety Function	PSSC (facility worker)	Safety Function	PSSC (environment)	Safety Function
Load Handling	C1 and/or C2 Areas-3013 Transport Cask (Cont.)	Drop of a 3013 Transport Cask Containing Unpolished PuO_2 in Powder Form	None	N/A	Material Handling Controls	Ensure that design basis lift height of the 3013 transport cask is not exceeded.	Material Handling Controls	Ensure that design basis lift height of the 3013 transport cask is not exceeded.	Material Handling Controls	Ensure that design basis lift height of the 3013 transport cask is not exceeded.
	C1 and/or C2 Areas-Fuel Rod	Drop of a Fuel Assembly onto Another Fuel Assembly Each Containing MOX (6%)	None	N/A	None	N/A	Facility Worker Action	Ensure that facility workers take proper actions to limit radiological exposure.	None	N/A
	C1 and/or C2 Areas- MOX Fuel Transport Cask	Drop of One MOX Fuel Transport Cask Containing up to three MOX Fuel Assemblies	None	N/A	None	N/A	MOX Fuel Transport Cask	Withstand the effects of design basis drops without release of radioactive material.	MOX Fuel Transport Cask	Withstand the effects of design basis drops without release of radioactive material.
							Material Handling Design Controls	Ensure that design basis lift height of MOX fuel transport cask is not exceeded.	Material Handling Design Controls	Ensure that design basis lift height of MOX fuel transport cask is not exceeded.
	C1, C2, and/or C3 Areas- Waste Container	A Damage Waste Drum in the Assembly Packaging (Truck Bay) Area	None	N/A	None	N/A	Facility Worker Action	Ensure that facility workers take proper actions to limit radiological exposure.	None	N/A

TABLE 5-1b SAFETY ASSESSMENT SUMMARY (PROCESS HAZARDS)

Event Type	Event Group	Bounding Event	PSSC (public)	Safety Function	PSSC (site worker)	Safety Function	PSSC (facility worker)	Safety Function	PSSC (environment)	Safety Function
Load Handling	C1 and/or C2 Areas- Transfer Container (Cont.)	Drop of a Transfer Container Containing a HEPA Filter with PuO_2 in Powder Form	None	N/A	Transfer Container Material Handling Controls	Withstand the effects of design basis drops without breaching. Ensure that the design basis lift height of the transfer container is not exceeded.	Transfer Container Material Handling Controls	Withstand the effects of design basis drops without breaching. Ensure that the design basis lift height of the transfer container is not exceeded.	Transfer Container Material Handling Controls	Withstand the effects of design basis drops without breaching. Ensure that the design basis lift height of the transfer container is not exceeded.
	C1 and/or C2 Areas-Final C4 HEPA Filter	Impact to Final C4 HEPA Filters Breaching the HEPA Filter Housing and Allowing the Material from the HEPA Filters to Pass Directly to the Stack.	None	N/A	Material Handling Controls	Ensure that load handling activities that could potentially lead to a breach in the final C4 HEPA filters do not occur.	Material Handling Controls	Ensure that load handling activities that could potentially lead to a breach in the final C4 HEPA filters do not occur.	Material Handling Controls	Ensure that load handling activities that could potentially lead to a breach in the final C4 HEPA filters do not occur.
	C4 Confinement	Spill of Unpolished Plutonium Powder Inside a Glovebox but does not Result in a Breach of the Glovebox	None	N/A	C4 Confinement System	Maintain a negative glovebox pressure differential between the glovebox and the interfacing systems.	C4 Confinement System	Maintain a negative glove box pressure differential between the glovebox and the interfacing systems.	C4 Confinement System	Maintain a negative glove box pressure differential between the glovebox and the interfacing systems.

TABLE 5-1b SAFETY ASSESSMENT SUMMARY (PROCESS HAZARDS)

Event Type	Event Group	Bounding Event	PSSC (public)	Safety Function	PSSC (site worker)	Safety Function	PSSC (facility worker)	Safety Function	PSSC (environment)	Safety Function
Load Handling	Outside the MOX Fuel Fabrication Building	Load handling Event Involving the Waste Transfer Line	Waste Transfer Line	Ensure that the waste transfer line is protected from activities taking place outside the MOX Fuel Fabrication Building.	Waste Transfer Line	Ensure that the waste transfer line is protected from activities taking place outside the MOX Fuel Fabrication Building.	Waste Transfer Line	Ensure that the waste transfer line is protected from activities taking place outside the MOX Fuel Fabrication Building.	Waste Transfer Line	Ensure that the waste transfer line is protected from activities taking place outside the MOX Fuel Fabrication Building.
	Facility wide	Breach of the MFFF Structure from a Heavy Load Resulting in a Breach of Confinement or in a Breach of Container Holding Nuclear Materials	MOX Fuel Fabrication Building Structure	Withstand the effects of load drops that could potentially impact radiological material.	MOX Fuel Fabrication Building Structure	Withstand the effects of load drops that could potentially impact radiological material.	MOX Fuel Fabrication Building Structure	Withstand the effects of load drops that could potentially impact radiological material.	MOX Fuel Fabrication Building Structure	Withstand the effects of load drops that could potentially impact radiological material.
			Material Handling Controls	Prevent load handling events that could breach primary confinements.	Material Handling Controls	Prevent load handling events that could breach primary confinements.	Material Handling Controls	Prevent load handling events that could breach primary confinements.	Material Handling Controls	Prevent load handling events that could breach primary confinements.

TABLE 5-1b SAFETY ASSESSMENT SUMMARY (PROCESS HAZARDS)

Event Type	Event Group	Bounding Event	PSSC (public)	Safety Function	PSSC (site worker)	Safety Function	PSSC (facility worker)	Safety Function	PSSC (environment)	Safety Function
Explosion	Hydrogen Explosion	Explosion of Hydrogen and Oxygen in a Sintering Furnace or Sintering Furnace Room	Process Safety Control Subsystem	Prevent formation of an explosive mixture of hydrogen within the MFFF associated with the use of the hydrogen-argon gas.	Process Safety Control Subsystem	Prevent formation of an explosive mixture of hydrogen within the MFFF associated with the use of the hydrogen-argon gas.	Process Safety Control Subsystem	Prevent formation of an explosive mixture of hydrogen within the MFFF associated with the use of the hydrogen-argon gas.	Process Safety Control Subsystem	Prevent formation of an explosive mixture of hydrogen within the MFFF associated with the use of the hydrogen-argon gas.
	Steam Over-Pressurization Explosion	Water Entry into the Sintering Furnace Due to Failure of the Water Level Controller in the Humidifier, from the Sintering Furnace, Results in a Steam Explosion	Process Safety Control Subsystem	Ensure isolation of the sintering humidifier water flow on high water level.	Process Safety Control Subsystem	Ensure isolation of the sintering humidifier water flow on high water level.	Process Safety Control Subsystem	Ensure isolation of the sintering humidifier water flow on high water level.	Process Safety Control Subsystem	Ensure isolation of the sintering humidifier water flow on high water level.
	Radiolysis Induced Explosion	Buildup in the Vapor Space of an AP Vessel Tank or Piping Hydrogen Buildup in the Vapor Space of a Raffinates Tank	Offgas Treatment System	Provide an exhaust path for the removal of the diluted hydrogen gas in process vessels.	Offgas Treatment System	Provide an exhaust path for the removal of the diluted hydrogen gas in process vessels.	Offgas Treatment System	Provide an exhaust path for the removal of the diluted hydrogen gas in process vessels.	Offgas Treatment System	Provide an exhaust path for the removal of the diluted hydrogen gas in process vessels.

TABLE 5-1b SAFETY ASSESSMENT SUMMARY (PROCESS HAZARDS)

Event Type	Event Group	Bounding Event	PSSC (public)	Safety Function	PSSC (site worker)	Safety Function	PSSC (facility worker)	Safety Function	PSSC (environment)	Safety Function
Explosion	Radiolysis Induced Explosion (Cont.)	Buildup in the Vapor Space of an AP Vessel Tank or Piping Hydrogen Buildup in the Vapor Space of a Raffinates Tank	Instrument Air System (Emergency Scavenging Air)	Provide sufficient scavenging air to dilute the hydrogen generated during radiolysis.	Instrument Air System (Emergency Scavenging Air)	Provide sufficient scavenging air to dilute the hydrogen generated during radiolysis.	Instrument Air System (Emergency Scavenging Air)	Provide sufficient scavenging air to dilute the hydrogen generated during radiolysis.	Instrument Air System (Emergency Scavenging Air)	Provide sufficient scavenging air to dilute the hydrogen generated during radiolysis.
					Waste Containers Bounding Event: Hydrogen Accumulation in Waste Container Containing Hydrocarbons	Ensure that hydrogen buildup in excess of explosive limits does not occur while providing appropriate confinement of radioactive material.	Waste Containers Bounding Event: Hydrogen Accumulation in Waste Container Containing Hydrocarbons	Ensure that hydrogen buildup in excess of explosive limits does not occur while providing appropriate confinement of radioactive material.	Waste Containers Bounding Event: Hydrogen Accumulation in Waste Container Containing Hydrocarbons	Ensure that hydrogen buildup in excess of explosive limits does not occur while providing appropriate confinement of radioactive material.
	Hydroxylamine Nitrate (HAN) Explosion- Process Vessels containing HAN and Hydrazine Nitrate without NO_x Addition	Explosion in AP Process Vessels Containing HAN	Process Safety Control Subsystem	Ensure that the temperature of the solution containing HAN is limited to temperatures that are within safety limits.	Process Safety Control Subsystem	Ensure that the temperature of the solution containing HAN is limited to temperatures that are within safety limits.	Process Safety Control Subsystem	Ensure that the temperature of the solution containing HAN is limited to temperatures that are within safety limits.	Process Safety Control Subsystem	Ensure that the temperature of the solution containing HAN is limited to temperatures that are within safety limits.

TABLE 5-1b SAFETY ASSESSMENT SUMMARY (PROCESS HAZARDS)

Event Type	Event Group	Bounding Event	PSSC (public)	Safety Function	PSSC (site worker)	Safety Function	PSSC (facility worker)	Safety Function	PSSC (environment)	Safety Function
Explosion	Hydroxylamine Nitrate (HAN) Explosion-Process Vessels Containing HAN and Hydrazine Nitrate without NO_x Addition	Explosion in AP Process Vessels Containing HAN	Chemical Safety Control	Ensure that concentration of nitric acid, metal impurities, and HAN introduced in the process are within safety limits.	Chemical Safety Control	Ensure that concentration of nitric acid, metal impurities, and HAN introduced in the process are within safety limits.	Chemical Safety Control	Ensure that concentration of nitric acid, metal impurities, and HAN introduced in the process are within safety limits.	Chemical Safety Control	Ensure that concentration of nitric acid, metal impurities, and HAN introduced in the process are within safety limits.
	Hydroxylamine Nitrate Explosion-Vessels Containing HAN and No Hydrazine Hydrate	Explosion in AP Process Vessels Containing Radiological Materials	Process Safety Control Subsystem	Ensure that the temperature of the solution containing HAN is limited to temperatures that are within the safety limits.	Process Safety Control Subsystem	Ensure that the temperature of the solution containing HAN is limited to temperatures that are within the safety limits.	Process Safety Control Subsystem	Ensure that the temperature of the solution containing HAN is limited to temperatures that are within the safety limits.	Process Safety Control Subsystem	Ensure that the temperature of the solution containing HAN is limited to temperatures that are within the safety limits.
			Chemical Safety Control	Ensure that concentration of nitric acid, metal impurities, and HAN introduced in the process are below their respective safety limits.	Chemical Safety Control	Ensure that concentration of nitric acid, metal impurities, and HAN introduced in the process are below their respective safety limits.	Chemical Safety Control	Ensure that concentration of nitric acid, metal impurities, and HAN introduced in the process are below their respective safety limits.	Chemical Safety Control	Ensure that concentration of nitric acid, metal impurities, and HAN introduced in the process are below their respective safety limits.

TABLE 5-1b SAFETY ASSESSMENT SUMMARY (PROCESS HAZARDS)

Event Type	Event Group	Bounding Event	PSSC (public)	Safety Function	PSSC (site worker)	Safety Function	PSSC (facility worker)	Safety Function	PSSC (environment)	Safety Function
Explosion	Hydroxylamine Nitrate Explosion-Process Vessels Containing HAN and Hydrazine Nitrate with NO_x Addition	Explosion in AP Process Vessels Containing HAN	Chemical Safety Control	Ensure that concentrations of the HAN, hydrazine nitrate, and hydrazoic acid are within the safety limits.	Chemical Safety Control	Ensure that concentrations of the HAN, hydrazine nitrate, and hydrazoic acid are within the safety limits.	Chemical Safety Control	Ensure that concentrations of the HAN, hydrazine nitrate, and hydrazoic acid are within the safety limits.	Chemical Safety Control	Ensure that concentrations of the HAN, hydrazine nitrate, and hydrazoic acid are within the safety limits.
			Offgas Treatment System	Provide an exhaust path for the removal of off-gases generated during the decomposition of HAN, hydrazine nitrate, and hydrazoic acid. Provide heat transfer/ pressure relief for affected process vessels.	Offgas Treatment System	Provide an exhaust path for the removal of off-gases generated during the decomposition of HAN, hydrazine nitrate, and hydrazoic acid. Provide heat transfer/ pressure relief for affected process vessels.	Offgas Treatment System	Provide an exhaust path for the removal of off-gases generated during the decomposition of HAN, hydrazine nitrate, and hydrazoic acid. Provide heat transfer/ pressure relief for affected process vessels.	Offgas Treatment System	Provide an exhaust path for the removal of off-gases generated during the decomposition of HAN, hydrazine nitrate, and hydrazoic acid. Provide heat transfer/ pressure relief for affected process vessels.
			Process Safety Control Subsystem	Control the liquid flow rate into the oxidation column ensuring that the potential heat evolution and pressure increase do not exceed the design capabilities of the process vessels	Process Safety Control Subsystem	Control the liquid flow rate into the oxidation column ensuring that the potential heat evolution and pressure increase do not exceed the design capabilities of the process vessels.	Process Safety Control Subsystem	Control the liquid flow rate into the oxidation column ensuring that the potential heat evolution and pressure increase do not exceed the design capabilities of the process vessels.	Process Safety Control Subsystem	Control the liquid flow rate into the oxidation column ensuring that the potential heat evolution and pressure increase do not exceed the design capabilities of the process vessels.

TABLE 5-1b SAFETY ASSESSMENT SUMMARY (PROCESS HAZARDS)

Event Type	Event Group	Bounding Event	PSSC (public)	Safety Function	PSSC (site worker)	Safety Function	PSSC (facility worker)	Safety Function	PSSC (environment)	Safety Function
Explosion	Hydrogen Peroxide Explosion	Hydrogen Peroxide Explosion in AP Vessels, Tanks, and Piping Which Results in an Energetic Breach of the Vessels, Tanks, and Piping and in a Loss of Confinement and Dispersal of Nuclear Materials	Chemical Safety Control	Ensure that explosive concentrations of hydrogen peroxide do not occur.	Chemical Safety Control	Ensure that explosive concentrations of hydrogen peroxide do not occur.	Chemical Safety Control	Ensure that explosive concentrations of hydrogen peroxide do not occur.	Chemical Safety Control	Ensure that explosive concentrations of hydrogen peroxide do not occur.
	Solvent Explosion	Solvents in AP Vessels, Tanks, and Piping Which Results in an Energetic Breach of the Vessels, Tanks, and Piping and in a Loss of Confinement and Dispersal of Nuclear Materials	None	N/A	Process Safety Control Subsystem	Ensure the temperature of the solution containing solvents is limited within the safety limits.	Process Safety Control Subsystem	Ensure the temperature of the solution containing solvents is limited within the safety limits.	Process Safety Control Subsystem	Ensure the temperature of the solution containing solvents is limited within the safety limits.
					Process Cell Fire Prevention Features	Ensure that fires in process cells are highly unlikely.	Process Cell Fire Prevention Features	Ensure that fires in process cells are highly unlikely.	Process Cell Fire Prevention Features	Ensure that fires in process cells are highly unlikely.
					Offgas Treatment System	Provide an exhaust path for removal of gases in process vessels.	Offgas Treatment System	Provide an exhaust path for removal of gases in process vessels.	Offgas Treatment System	Provide an exhaust path for removal of gases in process vessels.

TABLE 5-1b SAFETY ASSESSMENT SUMMARY (PROCESS HAZARDS)

Event Type	Event Group	Bounding Event	PSSC (public)	Safety Function	PSSC (site worker)	Safety Function	PSSC (facility worker)	Safety Function	PSSC (environment)	Safety Function
Explosion	TBP-Nitrate Explosion (Red Oil)	Process related Chemical Explosion Involving red Oil Formation in the AP Boiler, Vessel, or Tank Results in Loss of Confinement and Dispersal of Nuclear Materials	Offgas Treatment System	Provide an exhaust path for removal of gases in process vessels.	Offgas Treatment System	Provide an exhaust path for removal of gases in process vessels.	Offgas Treatment System	Provide an exhaust path for removal of gases in process vessels.	Offgas Treatment System	Provide an exhaust path for removal of gases in process vessels.
			Process Safety Control Subsystem	Ensure the temperatures in process vessels containing organics are within the safety limits. Control the residence time and of organics in process vessels in the presence of oxidizers and radiation fields and high temperatures.	Process Safety Control Subsystem	Ensure the temperatures in process vessels containing organics are within the safety limits. Control the residence time and of organics in process vessels in the presence of oxidizers and radiation fields and high temperatures.	Process Safety Control Subsystem	Ensure the temperatures in process vessels containing organics are within the safety limits. Control the residence time and of organics in process vessels in the presence of oxidizers and radiation fields and high temperatures.	Process Safety Control Subsystem	Ensure the temperatures in process vessels containing organics are within the safety limits. Control the residence time and of organics in process vessels in the presence of oxidizers and radiation fields and high temperatures.
			Chemical Safety Control	Limit the quantity of organics entering to vessels containing oxidizing agents at high temperatures.	Chemical Safety Control	Limit the quantity of organics entering to vessels containing oxidizing agents at high temperatures.	Chemical Safety Control	Limit the quantity of organics entering to vessels containing oxidizing agents at high temperatures.	Chemical Safety Control	Limit the quantity of organics entering to vessels containing oxidizing agents at high temperatures.

TABLE 5-1b SAFETY ASSESSMENT SUMMARY (PROCESS HAZARDS)

Event Type	Event Group	Bounding Event	PSSC (public)	Safety Function	PSSC (site worker)	Safety Function	PSSC (facility worker)	Safety Function	PSSC (environment)	Safety Function
Explosion	TBP-Nitrate Explosion (Red Oil) (Cont.)	Process related Chemical Explosion Involving red Oil Formation in the AP Boiler, Vessel, or Tank Results in Loss of Confinement and Dispersal of Nuclear Materials	Chemical Safety Control	Ensure that a diluent is not very susceptible to either nitration or radiolysis.	Chemical Safety Control	Ensure that a diluent is not very susceptible to either nitration or radiolysis.	Chemical Safety Control	Ensure that a diluent is not very susceptible to either nitration or radiolysis.	Chemical Safety Control	Ensure that a diluent is not very susceptible to either nitration or radiolysis.
	AP Vessel Over-Pressurization Explosion	Over Pressurization of AP Tanks, Vessels, and Piping as a Result of an Increase of Exothermic Chemical Reactions of Solutions	Fluid Transport Systems	Ensure that process vessels, tanks, and piping are design to prevent process deviations from creating over-pressurization events.	Fluid Transport Systems	Ensure that process vessels, tanks, and piping are design to prevent process deviations from creating over-pressurization events.	Fluid Transport Systems	Ensure that process vessels, tanks, and piping are design to prevent process deviations from creating over-pressurization events.	Fluid Transport Systems	Ensure that process vessels, tanks, and piping are design to prevent process deviations from creating over-pressurization events.
			Offgas Treatment Systems	Provide an exhaust path for removal of gases in process vessels.	Offgas Treatment Systems	Provide an exhaust path for removal of gases in process vessels.	Offgas Treatment Systems	Provide an exhaust path for removal of gases in process vessels.	Offgas Treatment Systems	Provide an exhaust path for removal of gases in process vessels.

TABLE 5-1b SAFETY ASSESSMENT SUMMARY (PROCESS HAZARDS)

Event Type	Event Group	Bounding Event	PSSC (public)	Safety Function	PSSC (site worker)	Safety Function	PSSC (facility worker)	Safety Function	PSSC (environment)	Safety Function
Explosion	AP Vessel Over-Pressurization Explosion	Over Pressurization of AP Tanks, Vessels, and Piping as a Result of an Increase of Exothermic Chemical Reactions of Solutions	Chemical Safety Controls	Ensure control of chemical make up of the reagents. Ensure segregation/ separation of vessels/ components from incompatible chemicals.	Chemical Safety Controls	Ensure control of chemical make up of the reagents. Ensure segregation/ separation of vessels/ components from incompatible chemicals.	Chemical Safety Controls	Ensure control of chemical make up of the reagents. Ensure segregation/ separation of vessels/ components from incompatible chemicals.	Chemical Safety Controls	Ensure control of chemical make up of the reagents. Ensure segregation/ separation of vessels/ components from incompatible chemicals.
	Pressure Vessel Over-Pressurization Explosion	Over-Pressurization of Gas Bottles, Tanks, or Receivers Which Could Impact Primary Confinement and Result in a Release of Radioactive Material	Pressure Vessels Controls	Ensure that primary confinements are protected from the impact of pressure vessels failures.	Pressure Vessels Controls	Ensure that primary confinements are protected from the impact of pressure vessels failures.	Pressure Vessels Controls	Ensure that primary confinements are protected from the impact of pressure vessels failures.	Pressure Vessels Controls	Ensure that primary confinements are protected from the impact of pressure vessels failures.

TABLE 5-1b SAFETY ASSESSMENT SUMMARY (PROCESS HAZARDS)

Event Type	Event Group	Bounding Event	PSSC (public)	Safety Function	PSSC (site worker)	Safety Function	PSSC (facility worker)	Safety Function	PSSC (environment)	Safety Function
Explosion	Hydrazoic Acid (HN_3) Explosion	Process Related Chemical Explosion Involving HAN/Nitric Acid Vessels, Tanks, and Piping Which Results in the Breach of AP Vessels, Tanks, and Piping	Chemical Safety Control	Assure the proper concentration of hydrazine nitrate is introduced into the system.	Chemical Safety Control	Assure the proper concentration of hydrazine nitrate is introduced into the system.	Chemical Safety Control	Assure the proper concentration of hydrazine nitrate is introduced into the system.	Chemical Safety Control	Assure the proper concentration of hydrazine nitrate is introduced into the system.
			Chemical Safety Control	Ensure that hydrazoic acid is not accumulated in the process or propagated into the acid recovery and oxalic mother liquors recovery units.	Chemical Safety Control	Ensure that hydrazoic acid is not accumulated in the process or propagated into the acid recovery and oxalic mother liquors recovery units.	Chemical Safety Control	Ensure that hydrazoic acid is not accumulated in the process or propagated into the acid recovery and oxalic mother liquors recovery units.	Chemical Safety Control	Ensure that hydrazoic acid is not accumulated in the process or propagated into the acid recovery and oxalic mother liquors recovery units.
			Process Safety Control Subsystem	Ensure that the temperature solutions potentially containing hydrazoic acid is limited to prevent an explosive concentration of hydrazoic acid	Process Safety Control Subsystem	Ensure that the temperature solutions potentially containing hydrazoic acid is limited to prevent an explosive concentration of hydrazoic acid	Process Safety Control Subsystem	Ensure that the temperature solutions potentially containing hydrazoic acid is limited to prevent an explosive concentration of hydrazoic acid	Process Safety Control Subsystem	Ensure that the temperature solutions potentially containing hydrazoic acid is limited to prevent an explosive concentration of hydrazoic acid

TABLE 5-1b SAFETY ASSESSMENT SUMMARY (PROCESS HAZARDS)

Event Type	Event Group	Bounding Event	PSSC (public)	Safety Function	PSSC (site worker)	Safety Function	PSSC (facility worker)	Safety Function	PSSC (environment)	Safety Function
Explosion	Metal Azide Explosions	Chemical Explosion involving an Azide (Other than Hydrazoic Acid in an AP Boiler, Vessel, or Tank that Results in an Energetic Breach of the AP Boiler, Vessel, or Tank	Chemical Safety Control	Ensure that metal azides are not added to high temperature process equipment. Ensure that the sodium azide has been destroyed prior to transfer of the alkaline waste into the high alpha waste of the waste recovery unit.	Chemical Safety Control	Ensure that metal azides are not added to high temperature process equipment. Ensure that the sodium azide has been destroyed prior to transfer of the alkaline waste into the high alpha waste of the waste recovery unit.	Chemical Safety Control	Ensure that metal azides are not added to high temperature process equipment. Ensure that the sodium azide has been destroyed prior to transfer of the alkaline waste into the high alpha waste of the waste recovery unit.	Chemical Safety Control	Ensure that metal azides are not added to high temperature process equipment. Ensure that the sodium azide has been destroyed prior to transfer of the alkaline waste into the high alpha waste of the waste recovery unit.
			Process Safety Control Subsystem	Ensure that metal azides are not exposed to temperatures that can allow the energetic decomposition of azides. Limit and control conditions in which dry-out can occur.	Process Safety Control Subsystem	Ensure that metal azides are not exposed to temperatures that can allow the energetic decompositio n of azides. Limit and control conditions in which dry-out can occur.	Process Safety Control Subsystem	Ensure that metal azides are not exposed to temperatures that can allow the energetic decomposition of azides. Limit and control conditions in which dry-out can occur.	Process Safety Control Subsystem	Ensure that metal azides are not exposed to temperatures that can allow the energetic decomposition of azides. Limit and control conditions in which dry-out can occur.

TABLE 5-1b SAFETY ASSESSMENT SUMMARY (PROCESS HAZARDS)

Event Type	Event Group	Bounding Event	PSSC (public)	Safety Function	PSSC (site worker)	Safety Function	PSSC (facility worker)	Safety Function	PSSC (environment)	Safety Function
Explosion	Pu (IV) Oxalate Explosion	Chemical Explosion Involving Pu (IV) Oxalate in the Calcining Furnace Results in an Energetic Breach of the Furnace and Glovebox and the Dispersal of Radioactive Material	Chemical Safety Control	Measure the valence of plutonium prior to adding oxalic acid to the oxalic precipitation and oxidation unit to ensure that plutonium IV cannot be formed.	Chemical Safety Control	Measure the valence of plutonium prior to adding oxalic acid to the oxalic precipitation and oxidation unit to ensure that plutonium IV cannot be formed.	Chemical Safety Control	Measure the valence of plutonium prior to adding oxalic acid to the oxalic precipitation and oxidation unit to ensure that plutonium IV cannot be formed.	Chemical Safety Control	Measure the valence of plutonium prior to adding oxalic acid to the oxalic precipitation and oxidation unit to ensure that plutonium IV cannot be formed.
	Electrolysis Related Explosion	Explosion of Hydrogen in the Vapor Space on the Electrolyzer	Process Safety Control Subsystem	Limit the generation of hydrogen Ensures that the normality of the acid is sufficiently high to ensure that the off-gas is not flammable.	Process Safety Control Subsystem	Limit the generation of hydrogen Ensures that the normality of the acid is sufficiently high to ensure that the off-gas is not flammable.	Process Safety Control Subsystem	Limit the generation of hydrogen Ensures that the normality of the acid is sufficiently high to ensure that the off-gas is not flammable.	Process Safety Control Subsystem	Limit the generation of hydrogen Ensures that the normality of the acid is sufficiently high to ensure that the off-gas is not flammable.
	Laboratory Explosion	Explosion Within the MFFF laboratory Involving Flammable, Explosive, or Reactive Chemicals Which results in a Dispersal of Radiological Material	C3 Confinement	Provide filtration to mitigate dispersions from the C3 areas.	C3 Confinement	Provide filtration to mitigate dispersions from the C3 areas.	Chemical Safety Control	Ensure control of the chemical make up of the laboratory reagents Ensure segregation/ separation of vessels/ components from incompatible chemicals.	C3 Confinement	Provide filtration to mitigate dispersions from the C3 areas.

TABLE 5-1b SAFETY ASSESSMENT SUMMARY (PROCESS HAZARDS)

Event Type	Event Group	Bounding Event	PSSC (public)	Safety Function	PSSC (site worker)	Safety Function	PSSC (facility worker)	Safety Function	PSSC (environment)	Safety Function
Explosion	Laboratory Explosion (Cont.)	Explosion Within the MFFF laboratory Involving Flammable, Explosive, or Reactive Chemicals Which results in a Dispersal of Radiological Material	C3 Confinement	Provide filtration to mitigate dispersions from the C3 areas.	C3 Confinement	Provide filtration to mitigate dispersions from the C3 areas.	Laboratory Materials Controls	Minimize the quantities of hazardous chemical/ radiological materials in the laboratory	C3 Confinement	Provide filtration to mitigate dispersions from the C3 areas.
							Facility Worker Actions	Ensure that facility workers take proper actions to limit radiological/ chemical exposures.		
	Outside Explosion	Explosions in the Reagent Processing Building, Gas Storage Area, Emergency Diesel Generator Building, and the Access Building	MOX Fuel Fabrication Building Structure	Maintain structural integrity and prevent damage to internal SSCs.	MOX Fuel Fabrication Building Structure	Maintain structural integrity and prevent damage to internal SSCs.	MOX Fuel Fabrication Building Structure	Maintain structural integrity and prevent damage to internal SSCs.	MOX Fuel Fabrication Building Structure	Maintain structural integrity and prevent damage to internal SSCs.
			Emergency Generator Building Structure	Maintain structural integrity and prevent damage to internal SSCs from external explosions.	Emergency Generator Building Structure	Maintain structural integrity and prevent damage to internal SSCs from external explosions.	Emergency Generator Building Structure	Maintain structural integrity and prevent damage to internal SSCs from external explosions.	Emergency Generator Building Structure	Maintain structural integrity and prevent damage to internal SSCs from external explosions.
			Waste Transfer Line	Prevent damage to the line from outside explosions.	Waste Transfer Line	Prevent damage to the line from outside explosions.	Waste Transfer Line	Prevent damage to the line from outside explosions.	Waste Transfer Line	Prevent damage to the line from outside explosions.

TABLE 5-1b SAFETY ASSESSMENT SUMMARY (PROCESS HAZARDS)

Event Type	Event Group	Bounding Event	PSSC (public)	Safety Function	PSSC (site worker)	Safety Function	PSSC (facility worker)	Safety Function	PSSC (environment)	Safety Function
Explosion	Outside Explosion (Cont.)	Explosions in the Reagent Processing Building, Gas Storage Area, Emergency Diesel Generator Building, and the Access Building	Hazardous Materials Delivery Controls	Ensure that the quantity of delivered hazardous material and its proximity to the outside explosion's PSSCs are controlled within the bounds of the values used to demonstrate that the consequences of outside explosions are acceptable.	Hazardous Materials Delivery Controls	Ensure that the quantity of delivered hazardous material and its proximity to the outside explosion's PSSCs are controlled within the bounds of the values used to demonstrate that the consequences of outside explosions are acceptable.	Hazardous Materials Delivery Controls	Ensure that the quantity of delivered hazardous material and its proximity to the outside explosion's PSSCs are controlled within the bounds of the values used to demonstrate that the consequences of outside explosions are acceptable.	Hazardous Materials Delivery Controls	Ensure that the quantity of delivered hazardous material and its proximity to the outside explosion's PSSCs are controlled within the bounds of the values used to demonstrate that the consequences of outside explosions are acceptable.

TABLE 5-2, PRINCIPAL SSCs AND DESIGN BASES FUNCTIONS AND VALUES DEVELOPED FROM THE SAFETY ASSESSMENT

PSSC	Design Bases Safety Function	Design Bases Values	DSER Section
3013 Canister	Withstand the effects of design basis drops without breaching	DOE-STD-3010-1996 Outer canister designed to withstand 30 ft. drop while remaining leak tight. Inner container designed to withstand 4 ft. drop while remaining leak tight. Outer container designed to withstand 699 psig, inner container withstands 100 psig. Qualified 50 year life.	11.7.1.2
3013 Transport Cask	Withstand design basis fire	Thermal design per 10 CFR 71.73, 800EC for 30 minutes.	7.1.5.2
	Withstand design basis drop	Designed for free drop, crushing, and puncture per 10 CFR 71.73	11.7.1.2
Backflow Prevention features	Prevent process fluids from back-flowing into interfacing systems	ASME B31.3	11.8
C2 Confinement System Passive Barrier	Limit the dispersion of radioactive material	Two HEPA filter banks prior to discharge; Spark arrestors and prefilters in each filtration assembly; HEPA filter design temperature of 450 F; Fire-rated dampers between designated fire areas; In-place HEPA filter testing for final discharge filtration assemblies; System design in accordance with Regulatory Guide 3.12 except heat removal is by airflow dilution; HEPA filter design; HEPA filter housing design, construction and testing; and HEPA filter housing isolation dampers in accordance with ASME N509; HEPA filter design and testing; HEPA filter housing design and testing; ductwork and pipe flexible connections; and fan design, construction, and testing in accordance with ASME AG-1; Sheet metal ductwork design, construction, and testing; "bubble tight" isolation damper construction and testing; HEPA filter housing testing; and HEPA filter testing in accordance with ERDA 76-21; Filter testing in accordance with ASME N510 with each HEPA stage having a leakage efficiency of 99.95 percent; Tornado dampers; Final filters and downstream ductwork remain structurally intact during and after tornadoes and and design basis earthquakes;	11.4.1.3

TABLE 5-2, PRINCIPAL SSCs AND DESIGN BASES FUNCTIONS AND VALUES DEVELOPED FROM THE SAFETY ASSESSMENT

PSSC	Design Bases Safety Function	Design Bases Values	DSER Section
C3 Confinement System	Provide filtration to mitigate dispersions from the C3 areas	C3 zone pressure maintained at negative pressure with respect to atmoshere during normal operation and transients; Two 100 percent capacity fans in C3 confinement system; System design in accordance with Regulatory Guide 3.12, except heat removal is by airflow dilution; HEPA filter design; HEPA filter housing design, construction and testing; and HEPA filter housing isolation dampers in accordance with ASME N509; HEPA filter design and testing; HEPA filter housing design and testing; ductwork and pipe flexible connections; and fan design, construction, and testing in accordance with ASME AG-1; Sheet metal ductwork design, construction, and testing; "bubble tight" isolation damper construction and testing; HEPA filter housing testing; and HEPA filter testing in accordance with ERDA 76-21; Filter testing in accordance with ASME N510 with each HEPA stage having a leakage efficiency of 99.95 percent; Tornado dampers; Fan power from normal (non-PSSC), standby (non-PSSC), and emergency (PSSC) supplies; Remains operational after facility fires, tornadoes, and design basis earthquakes;	11.4.1.3
	Remain operable during design basis fire and effectively filter any release	Spark arresters and prefilters in each filtration assembly upstream of HEPA filters; Fire-rated dampers between designated fire areas; In-place HEPA filter testing for final discharge filtration assemblies; HEPA filter design temperature of 450 F;	Open item: 7.1.5.5 Open Item 11.4.1.3
	Limit the dispersion of radioactive material	Designed to maintain exhaust safety function assuming single active component failure; HEPA filter assembly release fraction: 1E-4 Two 100 percent capacity redundant assemblies of two HEPA filter banks prior to discharge;	11.4.1.3
	Provide exhaust to ensure that temperature in the 3013 canister storage structure is maintained within design limits.	Maintain ambient temperatures with sufficient air flow in the canister storage structure. Reliability design bases are as described above.	11.4.1.3
	Provide cooling air exhaust from designated electrical rooms	Maintain ambient temperatures with sufficient air flow in the designated electrical rooms. Reliability design bases are as described above	11.4.1.3

TABLE 5-2, PRINCIPAL SSCs AND DESIGN BASES FUNCTIONS AND VALUES DEVELOPED FROM THE SAFETY ASSESSMENT

PSSC	Design Bases Safety Function	Design Bases Values	DSER Section
C4 Confinement System	Remain operable operable during design basis fire and effectively filter any release	Spark arresters and prefilters in each filtration assembly upstream of HEPA filters; Fire-rated dampers between designated fire areas; In-place HEPA filter testing for final discharge filtration assemblies; HEPA filter design temperature of 450 F;	Open Item: 7.1.5.5 Open Item: 11.4.1.3
	Maintain negative glovebox pressure between glovebox and interfacing systems	Same as above as appropriate C4 zone pressure maintained at negative pressure with respect to C3 zone during normal operation and transients; Redundant pressure sensors to maintain C4 pressures;	11.4.1.3
	Maintain minimum inward flow through small glovebox releases	same as above as appropriate High-capacity flow system (125 ft/min) in the event of glovebox breach to maintain negative pressure;	11.4.1.3
	Ensure that C4 exhaust is effectively filtered	same as above as appropriate In-place HEPA filter testing for final discharge filtration assemblies; System design in accordance with Regulatory Guide 3.12, except heat removal is by airflow dilution; HEPA filter design; HEPA filter housing design, construction and testing; and HEPA filter housing isolation dampers in accordance with ASME N509; HEPA filter design and testing; HEPA filter housing design and testing, ductwork and pipe flexible connections; and fan design, construction, and testing in accordance with ASME AG-1 Filter testing in accordance with ASME N510 with each HEPA stage having a leakage efficiency of 99.95 percent;	11.4.1.3
	Operate to ensure that a negative pressure differential exists between the C4 glovebox and the C3 area.	Fan power from normal (non-PSSC), standby (non-PSSC), emergency (PSSC), and uninterruptible (PSSC) supplies; Remains operational during facility fires and tornadoes and design basis earthquakes; Four 100 percent capacity fans in C4 discharge system; Piping, valves, and fittlings associated with gloveboxes in accordance with ASME B31.3;	11.4.1.3
	Contain a chemical release within a glovebox and provide an exhaust path for removal of the chemical vapors	Contain chemicals within C4 and exhaust so that moderate chemical consequence limits are not exceeded outside. Chemical consequence limits with adequate margin need to be identified	8.1.2.4.1 Open item:

TABLE 5-2, PRINCIPAL SSCs AND DESIGN BASES FUNCTIONS AND VALUES DEVELOPED FROM THE SAFETY ASSESSMENT

PSSC	Design Bases Safety Function	Design Bases Values	DSER Section
Chemical Safety Controls	Ensure that explosive concentrations of hydrogen peroxide do not occur.	Limit the received H_2O_2 solution concentrations to 35% or less.	8.1.2.5.2.5
	Ensure a diluent is used that is not very susceptible to either nitration or radiolysis	Diluent does not contain cyclic hydrocarbons.	8.1.2.5.2.5 Open item: red oil
	Ensure that quantities of organics are limited from entering process vessels containing oxidizing agents and at potentially high temperatures.	Design basis value not provided.	8.1.2.5.2.5 Open item : red oil
	Ensure that hydrazoic acid is not accumulated in the process or propagated to units that might lead to explosive conditions.	Maximum hydrazine concentration of 0.14M. Hydrazine yield of 39.3% or less. No hydrazoic acid accumulation into acid recovery and OML recovery units.	8.1.2.5.2.3.2 Open item:
	Ensure metal azides are not introduced into high temperature process equipment	No addition to high temperature equipment. Tanks potentially containing azides not allowed to dryout.	8.1.2.5.2.3.3
	Ensure the sodium azide has been destroyed prior to the transfer of the alkaline waste to the waste recovery unit.	Azides completely destroyed (OM) prior to acidification.	8.1.2.5.3.3
	Ensure the valance of the plutonium prior to oxalic acid addition is not VI.	Pu(VI) concentration will be low - actual value to be derived at ISA stage. Pressure limited to P_{max} plus 10%.	8.1.2.5.2.6

TABLE 5-2, PRINCIPAL SSCs AND DESIGN BASES FUNCTIONS AND VALUES DEVELOPED FROM THE SAFETY ASSESSMENT

PSSC	Design Bases Safety Function	Design Bases Values	DSER Section
Chemical Safety controls (cont.)	Ensure that nitric acid, metal impurities, and HAN concentrations are controlled and maintained to within safety limits.	Design bases not provided	8.1.2.5.2.3.1 Open item:
	Ensure concentrations of HAN, hydrazine nitrate, and hydrazoic acid are controlled to within safety limits.	Maximum hydrazine concentration of 0.14M. Other values not specified.	8.1.2.5.2.3.2
	Ensure the proper concentration of hydrazine nitrate is introduced into the system.	Hydrazine is not added at concentrations exceeding 35% (as N_2H_4).	8.1.2.5.2.3.1
	Ensure control of the chemical makeup of the reagents and ensure segregation/separation of vessels/components from incompatible chemicals.	Separation and prevention of mixing of incompatible reagents.	8.1.2.5

TABLE 5-2, PRINCIPAL SSCs AND DESIGN BASES FUNCTIONS AND VALUES DEVELOPED FROM THE SAFETY ASSESSMENT

PSSC	Design Bases Safety Function	Design Bases Values	DSER Section
Combustible Loading Controls	Limit combustibles in C2 filter area to ensure that the C4 final HEPA filters are not adversely impacted by a filter room fire.	Based on defense-in-depth principles and multiple layers of protection. Includes control of fixed combustibles by design and control of transient combustibles by design and during operations (through worker training, regular surveillance, and postings). Utilize NFPA 801.	7.1.5.1
	Limit the quantity of combustibles in fire areas containing a storage glovebox and the secured warehouse such that any fire that may occur will not encompass a large fraction of the stored radiological material.	Same as above	7.1.5.1
	Limit combustible in areas containing 3013 canisters	Same as above	7.1.5.1
	Limit combustibles in a fire area containing 3013 transport casks	Same as above	7.1.5.1
	Limit combustibles in a fire area containing fuel rods	Same as above	7.1.5.1
	Limit combustibles in areas containing MOX fuel transport casks	Same as above	7.1.5.1
	Limit the quantity of combustibles in areas containing transfer containers.	Same as above	7.1.5.1

TABLE 5-2, PRINCIPAL SSCs AND DESIGN BASES FUNCTIONS AND VALUES DEVELOPED FROM THE SAFETY ASSESSMENT

PSSC	Design Bases Safety Function	Design Bases Values	DSER Section
Criticality controls (continued)	Prevent criticality events	1. Design of facility operations shall comply with the double contingency principle, as stated in ANSI/ANS-8.1. Nuclear criticality shall be made "highly unlikely" and the failure of each leg of double contingency shall be "unlikely." 2. Computer calculations shall not exceed a maximum k_{eff} , taking all uncertainties and biases into account. Description of calculational methods and their validation, or means of establishing subcritical margins if parameter limits are not based on computer calculations. 3. Facility operations shall be designed to be subcritical under both normal and credible abnormal conditions. Normal conditions will be considered to be those when all controlled parameters are at their controlled values and uncontrolled parameters at their worst credible values. Abnormal conditions shall consider the worst case upset for each loss of a control or controlled parameter. 4. Dominant nuclear criticality safety controlled parameters shall be specified, for each major process and in their order of preference. 5. Design approach shall prefer engineered over administrative controls, and passive over active engineered controls.	Open item: 6.1.3.4.1 6.1.4.3
		6. The facility shall have a criticality accident alarm system that complies with the requirements of 10 CFR §70.24. Description of the detection system and its operating characteristics. 7. The management measures and how they are applied to each controlled parameter shall be described, along with the safety grades for criticality IROFS and the criteria used to assign these IROFS to individual safety grades. 8. A description of the organization and administration for NCS, and the key elements of the NCS Program (including those in SRP Section 6.4.3.2). 9. A description of the technical practices used to determine limits and controls on each controlled parameter, in criticality safety evaluations, including what ANSI/ANS standards are being committed to in whole or in part. 10. Where moderation control is required for subcriticality, a description of the approach to designing the facility to meet both fire safety and criticality safety requirements (including presence and type of fire suppression).	
Double-walled Pipe	Prevent leaks from pipes containing process fluids from leaking into C3 areas.	ANSI/ASME B31.3	11.8

TABLE 5-2, PRINCIPAL SSCs AND DESIGN BASES FUNCTIONS AND VALUES DEVELOPED FROM THE SAFETY ASSESSMENT

PSSC	Design Bases Safety Function	Design Bases Values	DSER Section
Emergency AC Power System	Provide AC power to emergency DC system battery charger	Overall design per IEEE Std 308-1991 and RG 1.32 (Rev.2). Environmental and seismic qualification per ANSI/AISC N690-1994, ASCE 4-98, IEEE Std 323-1983, IEEE Std 344-1987, RG 1.61, and RG 1.100 (Rev.2). Designed for single failure per IEEE Std 379-1994. Electrical independent and separation per IEEE 384-1992 and RG 1.75 (Rev. 2). Periodic testing per IEEE Std 338-1987 and RG 1.118 (Rev. 3). Electrical cables in open trays qualified per IEEE Std 383-1974. Equipment protection based on IEEE Std 741-1997. Battery design and installation per IEEE Std 484-1996. Emergency diesel generators with overall design per IEEE Std 387-1995 and RG 1.9 (Rev. 3) and fuel oil per ANSI/ASTM D975-94. Overall design of uninterruptible power supplies per IEEE Std 944-1986.	11.5.1.3.1
	Provide AC power to emergency diesel generator fuel oil system	Same as above	11.5.1.3.1
	Provide AC power to high depressurization exhaust system	Same as above	11.5.1.3.1
	Provide AC power to emergency control room air-conditioning system	Same as above	11.5.1.3.1
	Provide AC power to C4 confinement system	Same as above	11.5.1.3.1
	Provide AC power to emergency diesel ventilation system	Same as above	11.5.1.3.1
	Provide AC power to emergency control system	Same as above	11.5.1.3.1
	Provide AC power to seismic monitoring and trip system and seismic isolation valves.	Same as above	11.5.1.3.1

TABLE 5-2, PRINCIPAL SSCs AND DESIGN BASES FUNCTIONS AND VALUES DEVELOPED FROM THE SAFETY ASSESSMENT

PSSC	Design Bases Safety Function	Design Bases Values	DSER Section
Emergency Control Room Air Conditioning System	Ensure habitable conditions for operators	One 100 percent capacity filtration stage (using prefilter stage, two HEPA filter stages, and chemical filters) for each control room air supply; One 100 percent capacity air handling unit per control room; One 100 percent capacity exhaust fan and one 100 percent capacity booster fan; Designed to maintain protection assuming single component failure; HEPA filter design temperature of 450 F; Tornado dampers prevent pressurization in supply air system; In-place HEPA filter testing for final discharge filtration assemblies; System design in accordance with Regulatory Guide 3.12; HEPA filter design; HEPA filter housing design, construction and testing; and HEPA filter housing isolation dampers in accordance with ASME N509; HEPA filter design and testing; HEPA filter housing design and testing; ductwork and pipe flexible connections; and fan design, construction, and testing in accordance with ASME AG-1; Sheet metal ductwork design, construction, and testing; “bubble tight” isolation damper construction and testing; HEPA filter housing testing; and HEPA filter testing in accordance with ERDA 76-21; Filter testing in accordance with ASME N510 with each HEPA stage having a leakage efficiency of 99.95 percent; Fan power from normal (non-PSSC), standby (non-PSSC), and emergency (PSSC) supplies; Remains operational during and after facility fires and after tornadoes and design basis earthquakes; Fresh air inlets are located so that the presence of contaminants are minimized (NFPA 801). Design basis for chemical consequence levels with adequate conservatism and margin not provided.	11.4.1.3 8.1.2.6 (open item) 7.1.5.4
Emergency Control System	Provide controls for high depressurization exhaust system	Two redundant, separate, and independent trains. Fundamental design as per IEEE 603-1998. Electrical independence and separation as per IEEE 384-1992 and RG 1.75 (Rev. 2). Single failure criteria as per IEEE 379-1994. Instrument setpoints as per ANSI/ISA 67.04.01-2000 and RG 1.105 (Rev. 3). Designed to function during design basis event as per ANSI/AISC N690-1994, ASCE 4-98, IEEE Std 323-1983, IEEE Std 344-1987, and RG 1.100 (Rev.2). Software programmable electronic systems per EPRI Topical Report TR-106439 (with NRC safety evaluation), IEC 61131-3 (1993-03), IEEE Std 7-4.3.2-1993, IEEE Std 730-1998, IEEE Std 828-1998, IEEE Std 830-1998, IEEE Std 1012-1998, IEEE Std 1028-1997, IEEE Guide 1042-1987, IEEE Std 1074-1997, IEEE Std 1228-1994, NUREG/CR-6090, NUREG/CR-6463, RG 1.168, RG 1.169, RG 1.172, and RG 1.173. Human-system interface per IEEE Std 1023-1988 and NUREG-0700. Seismic monitoring per RG 3.17 and periodic testing per IEEE Std 338-1987, NUREG-0800 (Branch Technical Position HICB-17), and RG 1.118 (Rev. 3). Reduction of electromagnetic and radio frequency interference per IEEE Std 518-1982, IEEE St Std 1050-1996, and RG 1.180 with the design of data communications networks per ANSI/IEEE 802.3.	11.6.1.3.1

TABLE 5-2, PRINCIPAL SSCs AND DESIGN BASES FUNCTIONS AND VALUES DEVELOPED FROM THE SAFETY ASSESSMENT

PSSC	Design Bases Safety Function	Design Bases Values	DSER Section
Emergency Control System (continued)	Provide controls for C4 confinement system	same as above	11.6.1.3.1
	Provide controls for emergency control room air-conditioning system	Same as above	11.6.1.3.1
	Provide controls for emergency AC system	Same as above	11.6.1.3.1
	Provide controls for emergency DC system	Same as above	11.6.1.3.1
	Provide controls for emergency generator ventilation system	Same as above	11.6.1.3.1
	Provide controls for emergency diesel generator fuel oil system	Same as above	11.6.1.3.1
	Shut down process on loss of power	Same as above	11.6.1.3.1
	Shut down and isolate process and systems (as necessary) in response to an earthquake	Same as above for Seismic monitoring and trip system	11.6.1.3.1
Emergency DC System	Provide DC power for high depressurization exhaust system	Overall design per IEEE Std 308-1991, IEEE Std 946-1992, and RG 1.32 (Rev.2). Environmental and seismic qualification per ANSI/AISC N690-1994, ASCE 4-98, IEEE Std 323-1983, IEEE Std 344-1987, and RG 1.100 (Rev.2). Designed for single failure per IEEE Std 379-1994. Electrical independent and separation per IEEE 384-1992 and RG 1.75 (Rev. 2). Periodic testing per IEEE Std 338-1987, IEEE Std 450-1995, and RG 1.118 (Rev. 3). Battery design and installation per IEEE Std 484-1996, IEEE Std 485-1997, and NFPA 111.	11.5.1.3.2
	Provide DC power for C4 confinement system	Same as above	11.5.1.3.2

TABLE 5-2, PRINCIPAL SSCs AND DESIGN BASES FUNCTIONS AND VALUES DEVELOPED FROM THE SAFETY ASSESSMENT

PSSC	Design Bases Safety Function	Design Bases Values	DSER Section
Emergency DC System (continued)	Provide DC power for emergency AC power system controls	Same as above	11.5.1.3.2
	Provide DC power for emergency control room air-conditioning system	Same as above	11.5.1.3.2
	Provide DC power for emergency control system	Same as above	11.5.1.3.2
	Provide DC power for emergency generator ventilation system	Same as above	11.5.1.3.2
Emergency Diesel Generator Structure	Maintain structural integrity and prevent damage to internal SSCs from external fires, external explosions, earthquakes, extreme winds, tornadoes, missiles, rain and snow and ice loadings	Designed to withstand loads and load combinations as appropriate for Category I structures including a tornado max. wind speed of 240 mph, a seismic peak horizontal acceleration of 0.2g and external overpressure of 10 psi. Type I construction per NFPA 220. Lightning protection per NFPA 780.	7.1.5.4 11.1.1.3
Emergency Generator Ventilation System	Provide emergency diesel generator ventilation	One 100 percent capacity air conditioning unit for each switchgear room; One 100 percent capacity roof ventilator for engine room cooling during standby (engine fan cools room during engine operation); Fan power from normal (non-PSSC), standby (non-PSSC), and emergency (PSSC) supplies; Remains operational after facility fires, tornadoes, and design basis earthquakes;	11.4.1.3
Emergency Diesel generator Fuel Oil System	Provide emergency diesel generator fuel oil for the emergency diesels	7 days plus margin fuel storage tank, day tanks 660 gal., dual 100% transfer pumps, strainers, dual cartridge filters, isolation and maintenance valves. IEEE 344-1987, RG 1.100 Rev. 2, IEEE 308-1991, ANS 59-51-1997, ASTM D75-94, NFPA-37, NFPA-110	11.9.1.1, 11.9.1.3
Facility Worker Action	Ensure that facility workers take proper action to limit chemical and/or radiological exposure.	Facility worker response to exit the affected area.	9.1.2.4

TABLE 5-2, PRINCIPAL SSCs AND DESIGN BASES FUNCTIONS AND VALUES DEVELOPED FROM THE SAFETY ASSESSMENT

PSSC	Design Bases Safety Function	Design Bases Values	DSER Section
Facility Worker Controls	Ensure that facility workers take proper actions prior to bag-out operations to limit radiological exposure.	Facility worker pre-job preparation to prevent and/or limit dose during tasks involving transient primary confinements or maintenance.	9.1.2.4
	Ensure that facility workers take proper actions prior to maintenance activities to limit radiological exposure.	Same as above.	9.1.2.4
Fire Barriers	Contain fires within fire area	Minimum rating of two hours. Constructed in accordance with NFPA 221-1997. Fire doors are designed in accordance with NFPA 80-1999. Fire damper per UL 555-1995. Barrier selection and penetration seal program per NFPA 801-1998.	Open item: 7.1.5.6
Fire Detection and Suppression	Support fire barriers as necessary	Detection & Alarm per NFPA 72-1996 Suppression per NFPA 2001-1996 (clean agent) where dispersable fissile material is present.	7.1.5.7.
Fluid Transport System	Prevent over pressurization	ASME Section Boiler & pressure vessel Code VIII, ASME B31.3 Effectiveness for reactive chemicals (HAN, Red Oil) not specified	11.8.1.3
	Withstand as necessary the effects of the DBE such that confinement of radionuclides is maintained.	Seismic Category I design as per seismic qualification program	11.8
Glovebox	Maintain confinement integrity for design basis impacts	Leak integrity 2.5E-3 vol/hr @ 500 Pa. Impact resistant windows, Glovebox floor designed to withstand load drops. Internal guides and barriers to prevent fall of containers. Have pressure relief devices. Welding per AWS D9.1-1998. See 11.7.1.1.2	11.7.1.2
Glovebox Pressure controls	Maintain Glovebox Pressure within design limits	Redundant pressure sensors to monitor differential pressures and provide alarm; Remains operational after facility fires in non-affected areas, tornadoes, and design basis earthquakes;	11.4.1.3

TABLE 5-2, PRINCIPAL SSCs AND DESIGN BASES FUNCTIONS AND VALUES DEVELOPED FROM THE SAFETY ASSESSMENT

PSSC	Design Bases Safety Function	Design Bases Values	DSER Section
Hazardous Material Delivery Controls	Ensure that the quanty of delivered hazardous material and its proximity to the MOX FF building structure, EDG building structure, and the waste transfer line are controlled to within the bounds oft the values used to demonstrate that the consequences of outside explosions are acceptable.	Limit quantities and distancesof deliveries so that they are within the bounds found acceptable in the safety analyses performed for potential explosives in F-area.	8.1.2.1.3
Instrument Air System (Emergency Scavenging Air)	Provide sufficient scavenging airflow to dilute the hydrogen produced by radiolysis such that an explosive condition does not occur	Limiting hydrogen concentration to1% or less. Initiated by low pressure alarms on bubbling air buffer tank. Two 100% capacity banks of compressed air available. Will be constructed to ASME B&PV and B31.3 standards. Also RG 1.100 or IEEE 344. Hydrogen limit based upon radiolysis by plutonium only	11.9.1.1, 11.9.1.2, open item 11.2.1.11, 8.1.2.5.2.1.2
Laboratory Material Controls	Minimize quantities of hazardous chemicals in the laboratory	Procedures will be established at OL stage to limit sample size, number, and reagent quantity, in accordance with safe laboratory operating practices.	8.1.2.1..2.3
	Minimize quantities of radioactive materials in the laboratory	Procedures will be established at OL stage to limit sample size, number, and reagent quantity, in accordance with safe laboratory operating practices.	8.1.2.1.2.3
Material Handling Controls	Ensure proper handling of primary confinement types outside of gloveboxes	Management Measures including: training and qualification of personnel, approved procedures including precautions and limitations, use of proper equipment, testing and surveillances	11.7.1.2
	Ensure that design bases lift heights are not exceeded	MOX Fresh Fuel Casks - 30 ft drop (9.14 m) MOX Waste containers - 3.28 ft drop (1 m) 3013 outer can - 30 ft. drop (9.14 m)	11.7.1.2
	Prevent load handling activities that could potentially lead to a breach in the final C4 HEPA filters	PSSC for structural protection is C4 confinement system	11.4.1.3

TABLE 5-2, PRINCIPAL SSCs AND DESIGN BASES FUNCTIONS AND VALUES DEVELOPED FROM THE SAFETY ASSESSMENT

PSSC	Design Bases Safety Function	Design Bases Values	DSER Section
Material Handling Controls	Prevent impacts to the inside or outside of glovebox during normal operations	Engineered equipment used to reduce likelihood of failures causing glovebox breaches	11.7.1.2
	Prevent potential overpressurization of the reusable plutonium dioxide cans due to radiolysis or oxidation of Pu(III) oxalate and its subsequent impact to the glovebox.	The reusable can is designed to withstand the maximum pressure attainable from radiolysis and plutonium(III) oxalate reactions, plus 10%.	11.3.1.2.3
	Prevent load handling events that could breach primary confinements	During normal operations; Material handling equipment, material handling controls, and the glovebox will prevent breaches. During maintenance operations the above plus training and procedures will be used.	11.7.1.2
Material Handling Equipment	Limit damage to fuel rods/assemblies during handling	Designed using hardware stops, limit switches, speed controllers, bumpers to limit travel of equipment. Will fail to safe condition upon loss of power.	11.7.1.1, 11.7.1.2
	Prevent impacts to the glovebox through the use of engineered equipment	Same as above	same
Material Maintenance and Surveillance Programs	Detect and limit the damage resulting from corrosion	Deterministic criteria based on Industry experience.	11.8.1.3
MFFF Tornado Dampers	Protect MFFF Ventilation systems from differential pressure effects of the tornado	Designed per ASME AG-1	11.4.1.3

TABLE 5-2, PRINCIPAL SSCs AND DESIGN BASES FUNCTIONS AND VALUES DEVELOPED FROM THE SAFETY ASSESSMENT

PSSC	Design Bases Safety Function	Design Bases Values	DSER Section
Missile Barriers	Protect M FFF and EDG building internal SSCs from damage caused by tornado or wind-driven missiles.	Designed for impacts from: 2X4 in timber plank, 15 lb 150 mph horz. Speed, 100 mph vert. Speed. 3-in steel pipe, 75 lb, 75 mph horz. Speed, 50 mph vertical speed 3000-lb automobile, 25 mph horz. Speed	11.1.1.3.2.1
MOX Fuel Fabrication Building Structure (including vent stack)	Maintain structural integrity and prevent damage to internal SSCs from external events	***Text removed under 10 CFR 2.390.**	7.1.5.4 11.1.1.3.2.2
	Withstand the effects of load drops that could potentially impact radiological material.	NUREG -0612	11.1.1.3.2.1
MOX Fuel Transport Cask	Withstand the design basis fire	Thermal design per 10 CFR 71.73, 800EC for 30 minutes.	7.1.5.2
	Withstand the effects of design basis drops without release of radioactive material.	Mechanical design per 10 CFR 71.73, certified to withstand 30 ft. drop.	11.7.1.2
Offgas Treatment System	Provide an exhaust path for the removal of gases in process vessels	Process vessels do no pressurize	11.2.1.15
Pressure vessel controls	Ensure that primary confinements are protected from the impact of pressure vessel failures (Bulk gas, breathing air, service air, and instrument air systems)	Limited by ASME Section VIII & ASME B31.3 code design	11.8.1.3 11.9.1.2
Process Cells	Contain Fluid leaks within process cells	Fully welded, designed to handle maximum inventory of largest vessel in cell.	11.7

TABLE 5-2, PRINCIPAL SSCs AND DESIGN BASES FUNCTIONS AND VALUES DEVELOPED FROM THE SAFETY ASSESSMENT

PSSC	Design Bases Safety Function	Design Bases Values	DSER Section
Process Cell Entry controls	Prevent the entry of personnel into process cells during normal operations	Engineered and administrative controls, including Radiation Work permits, signs and postings, and barricades to restrict access.	9.1.2.3
	Ensure that workers do not receive a dose in excess of limits while performing maintenance. (Protection from chemical consequences needs to be considered)	Same as above and Procedures which implement 10 CFR 20.1602 controls for very high radiation areas. Chemical consequence limits with adequate basis and margin need to be identified.	9.1.2.3 Open item 8.1.2.4.1
Process Cell Fire Prevention Features	Ensures that fires in process cells are highly unlikely	Combustible loading fire controls per NFPA 801 Ignition source controls Maintain temperature to avoid formation of flammable vapors	7.1.5.3
Process Cell ventilation System passive boundary	Provide filtration to limit the dispersion of radioactive material	HEPA filter release fraction: 1E-4; Two 100 percent capacity filtration stages (using electric heaters and two HEPA filter stages); Two-stage spark arrestors and prefilters in each final filtration assembly; HEPA filter design temperature of 450 F; System design in accordance with Regulatory Guide 3.12; HEPA filter design; HEPA filter housing design, construction and testing; and HEPA filter housing isolation dampers in accordance with ASME N509; HEPA filter design and testing; HEPA filter housing design and testing; ductwork and pipe flexible connections; and fan design, construction, and testing in accordance with ASME AG-1; Sheet metal ductwork design, construction, and testing; "bubble tight" isolation damper construction and testing; HEPA filter housing testing; and HEPA filter testing in accordance with ERDA 76-21; Filter testing in accordance with ASME N510 with each HEPA stage having a leakage efficiency of 99.95 percent; Final filters and downstream ductwork remain structurally intact during and after tornadoes and and design basis earthquakes;	11.4.1.3

TABLE 5-2, PRINCIPAL SSCs AND DESIGN BASES FUNCTIONS AND VALUES DEVELOPED FROM THE SAFETY ASSESSMENT

PSSC	Design Bases Safety Function	Design Bases Values	DSER Section
Process Safety Control Subsystem	Prevent the formation of an explosive mixture of hydrogen within the MFFF associated with the use of the hydrogen-argon gas.	I & C aspects same as Emergency Control System. Setpoints for action levels to be determined.	11.6.1.3.1 Open item 8.1.2.5.2.5
	Ensure isolation of sintering furnace humidifier water flow on high water level.	I & C aspects same as Emergency Control System No overflow or liquid water into furnace.	11.6.1.3.1 11.3.1.2.4
	Ensure the temperature of solutions containing HAN is limited to temperatures within safety limits.	I & C aspects same as Emergency Control System Control flow of HAN/hydrogen solution such that chemical consequence limits are not exceeded in the oxidation column Maintain temperature of HAN within safety limits	11.6.1.3.1 11.3.1.2.4 Open item 8.1.2.4
	Control the N_2O_4 Flowrate into the oxidation column	I & C aspects same as Emergency Control System Flow rate not to exceed 44 kg/hr, this may be revised if chemical consequence limits change.	11.6.1.3.1 8.1.2.4.1
	Ensure the temperature of solutions containing organic is limited to temperatures within safety limits	I & C aspects same as Emergency Control System Temperature limited to less than 135EC.	11.6.1.3.1 Open item: 8.1.2.5.2.5 red oil
	Limit the residence time of organics in process vessels containing oxidizing agents and potentially exposed to high temperatures and in radiation fields.	I & C aspects same as Emergency Control System No design basis values provided.	11.6.1.3.1 Open item: 8.1.2.5.2.5 red oil

TABLE 5-2, PRINCIPAL SSCs AND DESIGN BASES FUNCTIONS AND VALUES DEVELOPED FROM THE SAFETY ASSESSMENT

PSSC	Design Bases Safety Function	Design Bases Values	DSER Section
Process Safety Control Subsystem (continued)	Ensure the temperature of solutions potentially containing hydrazoic acid is limited to prevent an explosive concentration of hydrazoic acid from developing.	I & C aspects same as Emergency Control System Temperature not exceeding 60EC	11.6.1.3.1 Open item 8.1.2.5.2.2.2
	Limit and control conditions under which dry-out can occur.	I & C aspects same as Emergency Control System Dry-out does not occur	11.6.1.3.1 8.1.2.5.3.3
	Ensure the temperature of solutions potentially containing metal azides is insufficient to overcome the activation energy needed to initiate the energetic decomposition of the azide.	I & C aspects same as Emergency Control System Temperature is not to exceed 140EC.	11.6.1.3.1 8.1.2.5.3.3
	Ensure the normality of the nitric acid is sufficiently high to ensure that the offgas is not flammable and to limit excessive hydrogen production.	I & C aspects same as Emergency Control System Limit hydrogen concentration to under 50% of LFL. Nitric acid normality not specified. Electrical design basis not identified	Open item: 11.2.1.5
	Warn operators of glovebox pressure discrepancies prior to exceeding differential pressure limits	I & C aspects same as Emergency Control System Redundant pressure sensors monitor differnetial pressure with respect to the process room and alert the operators to upset conditions. The instruments remain operational following facility fires in unaffected areas, tornadoes, and design basis earthquakes.	11.6.13.1 11.4.1.3
	Shut down process equipment prior to exceeding temperature safety limits	I & C aspects same as Emergency Control System Temperature design basis not identified (HAN/hydrazine: no NOx addition	11.6.1.3.1 open item: 8.1.2.5.2.3.1

TABLE 5-2, PRINCIPAL SSCs AND DESIGN BASES FUNCTIONS AND VALUES DEVELOPED FROM THE SAFETY ASSESSMENT

PSSC	Design Bases Safety Function	Design Bases Values	DSER Section
Process Safety Control Subsystem (continued)	Ensure the temperature of solutions containing solvents is limited to temperatures within safety limits.	I & C aspects same as Emergency Control System Temperature is not to exceed temperature at which the vapors become flammable.	11.6.1.3.1 Open item: 8.1.2.5.2.2
	Ensure the flow rate of nitrogen dioxide/dinitrogen tetroxide is limited to the oxidation column of the purification cycle.	I & C aspects same as Emergency Control System Flow rate limited to under 44 kg/hr.	11.6.1.3.1 8.1.2.4.1
Seismic Monitoring System and Associated Seismic Isolation valves	Prevent fire and criticality as a result of an uncontrolled release of hazardous material and water within the MFFF Building in the event of an earthquake	Seismic Monitoring and Trip System are same as Emergency Control System	11.6.1.3
Sintering Furnace	Provide a primary confinement boundary against leaks into the C3 areas	Seals designed for peak temperature of 316EC Furnace shell and airlocks designed to withstand an overpressure of 36.3 psi. leak tightness is 5E-5 leaked vol/hr at 2.2 psi. Controls to prevent overpressure. Furnace is designed to maintain confinement function during design basis earthquake.	11.4.1.3
Sintering Furnace Pressure Controls	Maintain sintering furnace pressure within design limits.	Same as Process safety Control Subsystem	11.6.1.3

TABLE 5-2, PRINCIPAL SSCs AND DESIGN BASES FUNCTIONS AND VALUES DEVELOPED FROM THE SAFETY ASSESSMENT

PSSC	Design Bases Safety Function	Design Bases Values	DSER Section
Supply Air System	Provide unconditioned emergency cooling air to the storage vault and designated electrical rooms.	Provide supply air for emergency cooling; HEPA filter stages for static confinement; HEPA filter design temperature of 450 F; System design in accordance with Regulatory Guide 3.12; HEPA filter design; and isolation dampers in accordance with ASME N509; HEPA filter design and testing; ductwork and pipe flexible connections; and fan design, construction, and testing in accordance with ASME AG-1; Sheet metal ductwork design, construction, and testing; “bubble tight” isolation damper construction and testing; HEPA filter housing testing; and HEPA filter testing in accordance with ERDA 76-21;	11.4.1.3
Transfer Container	Withstand the effects of design basis drops without breaching	Designed to withstand 30 ft. drop. DOE -STD-3013-2000	11.7.1.27
Waste Container	Ensure that hydrogen buildup in excess of limits does not occur while providing appropriate confinement of radioactive particles	Meet 49 CFR 178.350 requirements for certification. Withstand 3.3 ft. drop	11.7.1.3
Waste Transfer Line	Ensure that the waste transfer line is protected from activities taking place outside of the MFFF	Double walled SS piping w/leak detection designed to DBE (0.2g horz, 0.13g vertical) RG 3.10, ANSI N13.10-1974, ANSI N317-1980, ASME B31.3	11.8.1.3
	Prevent damage to the line from external events	Same as above	11.8.1.3