5.0 SAFETY ASSESSMENT OF THE DESIGN BASIS

5.1 CONDUCT OF REVIEW

This chapter of the draft Safety Evaluation Report (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 Construction Authorization Request (CAR) (Reference 5.3.11). 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 CAR, other sections of the CAR, supplementary information provided by the applicant, and relevant documents available at the applicant's offices but not submitted by the applicant. The review of PSSCs and their design bases and strategies was closely coordinated with the review of evaluations performed in other chapters of this DSER.

The staff reviewed how the safety assessment information in the 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.

- Section 70.61 of 10 CFR requires that the performance requirements (i.e., consequences and associated likelihoods; and the risk of nuclear criticality accidents) be satisfied.

- 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 (Reference 5.3.12) 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 operating license application.

- 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; 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 will be designed to meet the performance requirements of 10 CFR 70.61 during operation of the MFFF. Much of the review was directed at the applicant's consequence analysis (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.

The safety assessment review was an integrated team approach. Team members with expertise in the various areas of technical review such as chemical, electrical, mechanical, fire protection engineering, radiation protection, nuclear criticality safety and other disciplines reviewed their respective CAR chapters as well as CAR Chapter 5. These CAR chapters or discipline reviews often identified issues that were fed back to the safety assessment review where they were either resolved or carried as open items regarding 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 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 DSER.

- Process description. The process description should provide 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 DSER

5.1.2 Safety Assessment Team Description

The safety assessment team is described in Section 5.2 of the CAR. The CAR describes the safety assessment team as a team of individuals experienced in hazard identification, hazard evaluation techniques, accident analysis including dose consequence assessment, and probabilistic analysis. The CAR describes the safety assessment manager as having overall responsibility for preparation of the safety assessment. The safety assessment manager reports to the Nuclear Safety Leader, who reports to the MFFF design manager. The safety assessment manager provides overall direction for the analysis, organizes, and executes safety assessment activities. The safety assessment team leader reports to the safety assessment manager and is responsible for the technical analysis methodologies and technical information. The safety assessment 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. The staff concludes that the applicant's description of the safety assessment team is adequate.

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 DSER.

5.1.4 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 completeness review of natural phenomena and external man-made hazards consisted of evaluating the screening criteria to determine if it was appropriate for identifying all credible events. The completeness of the internal process hazards review was based on a review of the plant processes, experience with hazard reviews of other similar facilities, and feedback from the discipline specific reviews (such as chemical safety or fire safety).

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. No quantitative likelihood values are included in 10 CFR Part 70. In the CAR, the applicant has not provided any numerical definitions of the terms "not unlikely, unlikely, highly unlikely, credible," and "not credible" but has defined them qualitatively. All initiating events were assumed to have a likelihood of "not unlikely" which the staff interprets as having a probability of 1.0 per year. In a response to NRC (Reference 5.3.7, RAI 39), the applicant stated that for events identified as above low consequence (where PSSCs are identified), the accident sequences will be made to be highly unlikely. In the same response, the applicant further defines "highly unlikely" in terms of deterministic criteria for protection of the facility worker, site worker, and the public. 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. According to the applicant "This supplemental likelihood assessment will be based on the guidance provided in the NUREG-1718) and will demonstrate a target likelihood index comparable to a 'score' of -5 as defined in Appendix A of the SRP (Reference 5.3.12)." In regard to probability, this statement is a commitment to select and design PSSCs so as to keep the accident sequence to a likelihood of less than approximately 10^{-5} per year.

The applicant's methodology for developing the PSSCs and their functions is presented graphically in the flowchart in 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 hazard analysis (PHA).

An early step in the PHA, the correlation of process units with facility workshops and process support units is shown in CAR Table 5.5-1(a) and (b), the radioactive material inventory in each facility location is shown in Table 5.5-2. The summary hazard identification matrix of hazards versus workshops and process support groups is shown in 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 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 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 to prevent/mitigate common events into event groups. This simplifies 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 is mitigated, the resulting bounding mitigated consequences are compared against the performance requirements of 10 CFR 70.61(c). If mitigation is successful, 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. The applicant also in CAR Section 5.4.4.1.2, pursuant to 10 CFR 70.61(c)(3), 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). In the applicant's analyses, the environmental release was not a controlling factor for categorizing any of the accident sequences in terms of consequence category. However, the staff determined that, for certain events, the methodology used by the applicant to show compliance with 10 CFR 70.61(c)(3) used less conservative values for certain groups than for others. The staff is continuing its review and this is therefore an open item. This open issue is also described in DSER Section 10.1.3.2.

5.1.4.1 Natural Phenomena Hazards (NPH) Methodology

Natural phenomena having a credible potential effect on MFFF operations were identified through a screening process were 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 to be acceptable for the purpose of meeting the performance requirements of 10 CFR 70.61. A comprehensive list of NPH were initially evaluated and the rational for further considering or excluding each NPH is provided in CAR Table 5.5-5.

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[1] Five rem total total effective dose equivalent (TEDE) to any individual outside controlled area, 25 rem TEDE to a facility worker, or chemical safety criteria.

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

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. The staff considers the methodology used in the screening of external man-made events to be appropriate. A summary of the EMMH screening is provided in Table 5.5-8 of the CAR.

External man-made events that were evaluated and screened out as not applicable to the site or of 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 considers the applicant's methodology for screening external man-made events to be acceptable because it adequately addresses all credible hazards that may apply to the MFFF. However, the aircraft hazard analysis provided is insufficient to exclude the consideration of aircraft impact load for Seismic Cat. I structures because the analysis provided did not consider projected flight information that could affect the site. This is an open item.

5.4.1.3 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 CAR submittal, DCS only presented numerical consequence values for the most severe event in each of the above major categories. Because various systems are used for mitigation and/or prevention for different events within the major categories, the staff requested the calculated consequences for all hazard assessment events listed in Tables 5.5-9, 5.5-12, 5.5-15, and 5.5-18. DCS replied that all hazard assessment events were either categorized by their unmitigated consequence into one of two categories: low consequence or above low consequence. For low consequence events, no PSSC are identified. With the exception of the five bounding events, no other consequence calculations have been presented. The staff review of the process hazard methodology found it to be generally adequate, with the following exceptions:

- A steam explosion was not identified as a credible event in the sintering furnace. This is discussed in DSER Section 11.3.1.2.4.

- High temperature non-fire related failure of glovebox windows resulting in a loss of confinement was not identified as a credible event. This is discussed in DSER Section 11.7.1.

- Buildup of flammable gas from an overvoltage condition in the dissolution unit electrolyzer potentially resulting in an explosion was not identified as a credible event. This is discussed in DSER Sections 11.2.1.2 and 11.2.1.10.

- Breach of solvent waste confinement outside the restricted area which would lead to an intermediate consequence event under the environmental release provisions of 10 CFR 70.61(c)(2) was not identified as a credible event. This is discussed in DSER section 10.1.3.5.

- The accident scenario of a hydrogen explosion in the glovebox outside of the sintering furnace airlock due to insufficient purging in the airlock was not identified as a credible event. This is discussed in DSER Section 11.9.1.1.

- Events involving titanium, such as titanium fires that the staff believes can occur in the silver recovery and dissolution unit were not identified as credible events. This is discussed in DSER Sections 11.2.1.2 and 11.2.1.10.

- The staff evaluated the possible consequences from a fire or loss of confinement in the secure warehouse building and concludes that it could be an above-the-threshold event regarding the performance requirements of 10 CFR 70.61. This may require the development of a safety strategy and identification of PSSCs for this structure and possible events. Additional detail on the consequence evaluation may be found in DSER Section 8.1.2.4.1.

- The loss of nitrogen to the bearings of the calciner, causing the bearings to overheat resulting in damage to the calciner and potential loss of plutonium was not identified as a credible event. This is discussed in DSER Section 11.9.1.1.

- Fire events associated with the pyrophoric nature of some uranium and plutonium oxide powders were not identified as credible events. This is discussed in DSER Sections 11.3.1.2.1 and 11.3.1.2.3.

5.1.4.4 Baseline Design Criteria

The baseline design criteria (BDC) are listed in 10 CFR 70.64(a) and cover ten design issues: (1) quality standards and records; (2) natural phenomena hazards; (3) fire protection; (4) internal environmental conditions and dynamic effects; (5) chemical protection; (6) emergency capability; (7) utility services; (8) inspection, testing and maintenance; (9) criticality control; and (10) instrumentation and controls. In the DSER sections referenced below, the staff states whether or not the MFFF preliminary design satisfies the BDC, pursuant to 10 CFR 70.64(a).

- Quality Standards and Records, DSER Section 15.1.

- Natural Phenomena Hazards, DSER Section 5.1.

- Fire Protection, DSER Sections 7.1 and 11.2.2.

- Environmental and Dynamic Effects: Environmental and dynamic effects have been addressed through reviews of chemical and radioactivity releases, control room habitability, seismic qualification of safety equipment, and environmental qualification of gloveboxes. At this time, there are open items in Chapter 8 regarding control room habitability and possible operator actions required outside of the control room; and in Chapter 7 regarding environmental qualification of gloveboxes. The staff finds that, due to these open items, DCS has not met the BDC set forth in 10 CFR 70.64(a)(4), for environmental and dynamic effects.

- Chemical Protection, DSER Section 8.1 and 11.2.2.

- Emergency Capability, DSER Chapter 14.0

- Utility Services, DSER Section 11.5: Based on the safety assessment of the facility, the only utility with safety significance is electrical power. Fire suppression systems required for safety are clean agent systems which do not rely on the offsite water supply.

- Inspection, Testing, and Maintenance, DSER Section 15.3.

- Criticality Control, DSER Chapter 6.0

- Instrumentation and Controls, DSER Section 11.6.

5.1.4.5 Defense-in-Depth

Under 10 CFR 70.64(b), the MFFF 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 MFFF 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 MFFF 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 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 selection of reasonably extreme natural phenomena hazards and its commitments to normally accepted industry standards demonstrates the incorporation of features that 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 6.1.3.1 of the DSER. The applicant's implementation of single failure criterion as described in section 5.5.5.2 of the 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.

5.1.5 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 Table 5-1 of the DSER. Table 5-1 also lists the safety functions of these PSSCs and the design bases associated with such functions, and references the DSER sections which describe and evaluate each of the PSSCs in more detail.

In each referenced 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.

5.1.5.1 Natural Phenomena Results

As stated in DSER Section 5.1.4, the staff has determined the screening methodology for NPHs to be acceptable. The result of the screening methodology which is the selection of design bases natural events and PSSCs, was evaluated based on the likelihood of the selected event (it should be sufficiently low to assure that 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 MFFF has an annual exceedance probability of 10^{-4} per year (Reference 5.3.11, Section 5.5.2.6.5.1). The PSSCs which could be affected are the MOX fuel fabrication building, emergency diesel 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 staff also considers the applicant's strategy and selection of PSSCs to be in accordance with accepted industry practice.

The design basis earthquake selected for the MFFF also has an annual exceedance probability of 10^{-4} (Reference 5.3.11, Section 5.5.2.6.5.2). The PSSCs which could be affected are the waste transfer line, MFFF Building, Emergency Diesel Generator Building, qualification of internal SSCs and support systems. The primary safety function of these 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. For 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 design criteria and NRC 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 DOE-STD-1020-94 (Reference 5.3.16). 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 5.3.14), 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. More recent analyses in NUREG/CR-6728 (Reference 5.3.13) also shows that risk reduction factors of between 5 and 10 are achieved by following design evaluations in NRC SRPs. In additional information provided to NRC (Reference 5.3.9, Enclosure B at 97), 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. However, the staff has an open item in regard to the applicant's mitigation strategy not including the seismic isolation valves as a PSSC in Table

5.5-21. Seismic isolation valves should either be listed as a PSSC or an explanation should be provided regarding potential hazards from ruptured flammable gas lines. Seismic isolation valves are further discussed in DSER section 11.9.2.

The design basis tornado selected for the MFFF has an annual exceedance probability of 2 X 10^{-6} (References 5.3.11, Section 5.5.2.6.5.3). The PSSCs affected are the MFFF Building, Emergency Diesel Generator Building, associated missile barriers, and waste transfer line. The safety functions of these PSSCs are to withstand the design basis tornado wind loads, tornado-generated missiles, 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 staff also considers the applicant's strategy and selection of PSSCs to be in accordance with accepted industry practice.

The design basis for external fire was assumed to be a forest fire near the MFFF (Reference 5.3.11, Section 5.5.2.6.5.4). The plant exterior is designed to withstand a fire duration of at least 3 hours (further information may be found in section 7.1.5.4 of the DSER). This is considered by the staff to be adequate based on the availability of an onsite fire brigade and the fuel loading around the building. The principal SSC affected 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 staff also considers the applicant's strategy and selection of PSSCs and safety functions to be in accordance with accepted engineering practice

The design basis rainfall has an annual exceedance probability of 10^{-5} (Reference 5.3.11, 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 (Reference 5.3.9, Enclosure A, page 60). 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 in accordance with accepted industry practice and is acceptable for meeting the performance requirements of 10 CFR 70.61

The design basis for lightning was protection in accordance with National Fire Protection Association (NFPA) 780-1997 (Reference 5.3.11, 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. 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.

5.1.5.2 External Man-Made Events Results

As stated in DSER Section 5.1.4, the staff has determined the screening methodology for external man-made hazards to be acceptable. The result of the screening methodology which is the selection of design bases events and PSSCs, was evaluated based on the likelihood of the selected event (it should be sufficiently low to assure that 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.

Events that were not screened out include:

- Potential hazardous chemical or radioactive releases from 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 MFFF operations personnel. 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 MFFF facility. The staff will consider possible risks from these facilities at the OL stage.

- 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 the impacts of explosions in the F-area. The staff has requested that the applicant obtain data from DOE verifying overpressure assumptions used in the analysis. This will remain as an open item until the data is evaluated.

- Loss of offsite power from EMMHs is considered similar in potential for consequences as loss of offsite power. PSSCs requiring power are supplied with emergency power upon loss of offsite power. The adequacy of the power supply in terms of the baseline design criteria and the performance requirements has been evaluated in 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 MFFF to withstand the effects of external fires is discussed in 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

5.1.5.3 Internal Process Hazard Events Results

The staff review of the Internal process hazards results 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, the estimation 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. 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 availability (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 description of a high availability AEC (such as the C4 confinement system) and assigned it an index of -4 or -5. In addition to the base reliabilities that the staff determined for the PSSCs based on their descriptions in the 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 surveillable, surveillance intervals would be adjusted at the OL stage to achieve the desired reliability.

Feedback from the technical reviews was also used to evaluate the acceptability of the PSSCs or safety strategy. This feedback was used to assure that the proposed strategies did not significantly deviate from accepted 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 separate from the one performed for protection of the site worker and the public. If the specific prevention measures are considered sufficient to make the accident sequence highly unlikely, dose to the worker does not need to be evaluated. 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 a dose calculation, and accepted the applicant's assumption that worker actions could be taken within 30 seconds.

5.1.5.3.1 Confinement Events

Confinement of radioactive material at the MFFF is provided by static confinement boundaries in conjunction with ventilation systems and sealed confinement barriers (e.g., containers and fuel rods). Potential causes of loss of confinement in terms of ventilation and/or barriers were grouped as over-temperature, corrosion, glovebox breaches or backflows, leaks in the aqueous polishing (AP) process vessels or pipes, 3013 canister handling operations, over- or under-pressurization of glovebox, over-temperature due to radioactive decay, and glovebox dynamic exhaust failure. Twenty-eight separate events were analyzed to determine the bounding consequences from a potential loss of confinement event.

Over-Temperature (Confinement)
The controlling 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 source term 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 sequence to be above the 10 CFR 70.61(c) threshold for facility workers, site workers, and members of the public and has opted to protect potentially affected workers and members of the public through a strategy of prevention and mitigation. The PSSC for protection of the facility worker listed for this event the process safety instrumentation and control (I&C) system which will shut down process equipment prior to exceeding temperature 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. The staff considers the selection of SSCs for protection of the public and site worker to be adequate.   Clarification of the system name and description in regard to process safety I&C has been requested from DCS (Reference 5.3.8, Enclosure B at 3). The issue of adequate protection of the facility worker will remain open until the issues associated with process safety I&C are resolved.

Corrosion (Confinement)
The controlling 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 source term was the maximum inventory in the Pneumatic Pipe Automatic Transfer System. The applicant has determined this sequence to be above the 10 CFR 70.61(c) threshold for the facility worker and below the 10 CFR 70.61(c) threshold 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 prevention. The PSSCs for facility worker protection are the material transfer and surveillance programs which will detect and limit the damage resulting from corrosion; and the fluid transfer systems which limit system corrosion through the use of materials compatible with environment and system fluids. No PSSCs are listed as required for public and site worker protection. Based on normally accepted industry practice, 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 controlling 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 operation or maintenance) resulting in a breach of glovebox primary confinement and dispersal of radiological materials to where workers might be present. The source term 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 has determined this sequence to be above 10 CFR 70.61(c) threshold for the facility worker and below 10 CFR 70.61(c) threshold 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 for facility worker protection 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 listed as required for public and site worker protection. Based on normally accepted industry practice 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.

AP Process Vessels or Pipes (Confinement)
The controlling 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 in the silver recovery process resulting in a breach of confinement, and the dispersal of radiological materials. The source term was the maximum inventory of radioactive materials in the raffinates tank in the AP Process cell. Corrosion and mechanical failure were listed as potential causes. The applicant has determined this sequence to be above 10 CFR 70.61(c) threshold for the facility worker and below 10 CFR 70.61(c) threshold for the public and site worker. The applicant has opted to protect the facility worker through a strategy of prevention. The PSSCs 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. No PSSCs are listed as required for public and site worker protection. The staff independently evaluated this accident sequence and concludes that the applicant may not have evaluated the effects of toxic chemicals (evolved from licensed materials) released through the process cell ventilation system. The staff considers this to be an open issue which is further discussed in DSER section 11.2.1.2. The staff also considers this issue to be potentially applicable to the acid recovery unit, oxalic mother liquor unit, the dissolution unit, and the waste reception unit.

3013 Canister Handling Operations (Confinement)
The controlling event for 3013 canister handling operations in the confinement events accident category was inadvertent opening or damage to the inner can of a 3013 storage can, while opening the 3013 storage can resulting in the breach of the inner can and the dispersal of radiological materials. The source term was the maximum inventory of radioactive material in a 3013 container in the C2 area. Human error or equipment failure were cited as potential causes. The applicant has determined this sequence to be above 10 CFR 70.61(c) threshold for the facility worker and the site worker but below 10 CFR 70.61(c) threshold for the public. 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 PSSC listed for facility worker protection is the 3013 canister outer can opening device which is designed to prevent the spread of radioactive material during 3013 canister outer can opening operations. The same PSSC is listed as required for protection of the site worker. Based on normally accepted industry practice and the NUREG-1718 Table A-5 descriptions (passive engineered control plus administrative control), the staff agrees that this PSSC and its associated controls and procedures are sufficient to meet the performance requirements of 10 CFR 70.61.

Rod Handling Operations (Confinement)
The controlling 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 source term was the maximum inventory of radioactive material in fuel rods. Human error or

equipment failure were listed as potential causes. The applicant has determined this sequence to be above the 10 CFR 70.61(c) threshold for the facility worker and below the 10 CFR 70.61(c) threshold 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 prevention. The PSSCs listed for protection of the facility worker are facility worker actions which ensure that facility workers take proper actions to limit dose; 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 listed as required to protect the public and site worker. 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. The staff considers these PSSCs to be an acceptable strategy for meeting the performance requirements of 10 CFR 70.61.

Breaches in Containers Outside of Gloveboxes (Confinement)
The controlling event for breaches in containers outside of glove boxes due to handling operations in the confinement events accident category was the failure of a container of radioactive material (i.e., a transfer container or a 3013 container) damaged while being handled by miscellaneous handling devices in a C2 area, resulting in breach of the container and dispersal of radioactive materials. The source term is the maximum inventory of radioactive material in the container. The applicant has determined this sequence to be above the 10 CFR 70.61(c) threshold for the facility worker and below the 10 CFR 70.61(c) threshold for the public and site worker. The applicant has opted to protect the facility worker using a strategy of prevention and the public and site worker using a strategy of prevention and mitigation. PSSCs listed 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 training and procedures. 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. The staff agrees that these PSSCs are an acceptable strategy for meeting the performance requirements of 10 CFR 70.61. PSSCs listed as required for protection of the public and site workers are material handling controls to ensure proper handling of primary confinement types outside of gloveboxes; transfer container, 3013 canister, and the C3 confinement system which will provide filtration to mitigate dispersions from the C3 areas. Based on normal accepted industry practice and the descriptions in NUREG-1718 table A-5, (passive engineered controls and active engineered 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 controlling 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 rupture of a high flow or high pressure supply line or by high efficiency particulate air (HEPA) filter clogging resulting in a ventilation air flow reversal into a C3 area. The source term was the maximum inventory of radioactive material in the glovebox. Potential causes of this event were listed as rupture of a high flow or a high pressure supply line or a clogged outlet HEPA filter. The applicant has determined this sequence to be above the 10 CFR 70.61(c) threshold for the facility worker and below the 10 CFR 70.61(c) threshold 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 prevention. The PSSCs listed for facility worker protection are facility worker training, process safety I&C system to warn operators of glovebox pressure discrepancies prior to exceeding differential pressure limits; and glovebox pressure controls to maintain glovebox pressure within design limits. No PSSCs were listed as required for public or site worker protection. Clarification of the name and description in regard to the process safety I&C system has been requested from DCS (Reference 5.3.8, Enclosure B at 3). In addition, the staff questioned the consequence calculation from a leak in the sintering furnace which was considered an event in this event group but was not determined to be the controlling event. The staff is specifically concerned about how nearby workers will become aware of a leak before receiving a significant dose. The safety strategy in regard to the facility worker is an open item and is further discussed in Section 9.1.2.4 of the DSER.

Excess Decay Heat from Radioactive Materials (Confinement)
The controlling event for the excess decay heat from radioactive materials event group in the confinement events accident category was excessive temperature of the C2 powder storage area. The source term was the maximum inventory of radioactive material in the powder storage area in the plutonium oxide (PuO_2) 3013 storage unit. Potential causes of this event were listed as loss or blockage of the heating, ventilation, and air conditioning (HVAC) system or loss of power to the HVAC system. The applicant determined this to be an above the 10 CFR 70.61(c) threshold consequence event and has opted to protect potentially affected workers and members of the public through a strategy of prevention. The PSSC listed for facility worker protection and protection of the site worker and public was the high depressurization exhaust system which will ensure that temperatures in the 3013 canister storage structure are maintained within design limits. Based on normal accepted industry practice and the NUREG-1718 Table A-5 descriptions (active engineered control), the staff considers this to be an acceptable strategy for meeting the 10 CFR 70.61 performance requirements.

Glovebox Dynamic Exhaust Failure (Confinement)
The controlling 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 results in a ventilation air flow reversal into a C3 area. The source term 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 the10 CFR 70.61(c) threshold consequence event and has opted to protect potentially affected site and facility workers through a strategy of prevention. The PSSC listed for site and facility worker protection is the C4 confinement system. Based on normal accepted industry practice 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.

5.1.5.2 Fire Events

The potential consequences of fire events at the MFFF 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.

- Release of nuclear and chemical material to the environment.

Potential causes for fire events within the MFFF 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.

Potential fire events were grouped in accordance with fire areas, confinement zones, and confinement types. These groupings are:

- The AP process cells.
- AP/mixed oxide process (MP) C3 glovebox area.
- 3013 Canister in the C2 confinement area.
- Fuel rod in the C2 confinement area.
- 3013 transport cask in the C2 confinement area.
- Transfer container in the C2 confinement area.
- Waste container in the C2 confinement area.
- Final C4 HEPA filter in the C2 confinement area.
- Outside MOX fuel fabrication building.
- Facility-wide systems.
- Facility.

Altogether 35 separate fire events were analyzed.

AP Process Cell (Fire)

The controlling 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 source term was taken to be the maximum inventory of radioactive material in the cell containing the process tanks. A fire was hypothesized 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 and has opted to protect potentially affected workers and members of the public 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 are also listed as the PSSC for public and site worker protection. Based on normal accepted industry practice 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.

AP/MP C3 Glovebox Area (Fire)

The controlling 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 source term is the maximum inventory of radioactive material within the fire area. The specific cause of a fire in this area was not addressed but could be one or more of those causes listed earlier. The applicant determined this to be an above the 10 CFR 70.61(c) threshold consequence event and has opted to protect potentially affected workers and members of the public through a strategy of prevention and mitigation. The PSSC listed for protection of the facility worker was facility worker action. The PSSC listed for protection of the public and site worker was the C3 confinement system. 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 the area which is classified as a PSSC for the purpose of defense in depth. Based on normally accepted industry practice and NUREG-1718 Table A-5 descriptions (AEC and fire suppression system), the staff considers this to be an acceptable strategy for meeting the performance requirements of 10 CFR 70.61 in regard to the public and site worker. The staff, however, has an open item regarding HEPA filter performance during a fire as noted in DSER Section 5.1.5.6. 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.

3013 Canister (Fire)
The controlling event for a fire affecting a 3013 canister event group in the fire event accident category is a fire in the 3013 storage area. The source term for this fire is the maximum inventory of radioactive material in the fire area. The specific causes of the fire were not listed but could be one or more of those listed earlier. The applicant determined this to be an above the 10 CFR 70.61(c) threshold consequence event and has opted to protect potentially affected workers and members of the public through a strategy of prevention. The PSSC listed for protection of the facility worker was combustible loading controls which are intended to limit the quantity of combustibles in a fire area containing 3013 transport canisters to ensure that the canisters are not adversely impacted by a fire. Combustible loading controls were also listed as the PSSC for protection of the public and site worker. In additional information provided by the applicant (Reference 5.3.8, Enclosure A at 29), the applicant stated that its ISA -- to be performed in support of its Part 70 operating license application -- will demonstrate that credible fires including the effects of transient combustible loading will not significantly affect confinement barriers. Based on this commitment and normally accepted industry practice 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.

3013 Transport Cask (Fire)
The controlling event for a fire affecting a 3013 transport cask fire events accident category 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 cause of the fire would be a fuel fire involving a truck. The applicant determined this to be an above the 10 CFR 70.61(c) threshold consequence event and has opted to protect potentially affected workers and members of the public through a strategy of prevention. The PSSCs listed for protection of the facility worker 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. The transport cask and combustible loading controls were also listed as PSSCs for protection of the public and site worker. In addition to the listed PSSCs, there will also be a fire suppression system which is considered an additional protective feature. Additional information provided by the applicant (Reference 5.3.8, Enclosure A at 29), stated that the applicant's ISA -- to be performed in support of its Part 70 operating license application -- will demonstrate that credible fires including the effects of transient combustible loading will not significantly affect confinement barriers. If necessary, controls will be placed on the amount of fuel allowed for the shipping vehicles. Based on this commitment, accepted industry practice and the NUREG-1718 Table A-5 descriptions (passive engineered control 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 controlling event for a fire affecting fuel rods in the fire event accident category is a fire in the fuel assembly storage area. The source term for this fire is the maximum inventory of radioactive materials in the storage area. Combustible loading in this area is low but the fire is still assumed to cover the whole area. The applicant has determined this sequence to be above the 10 CFR 70.61(c) threshold for the facility worker and site worker but below the 10 CFR 70.61(c) threshold for the public. The staff independently evaluated this accident sequence and agrees to its categorization The PSSC listed for protection of the facility worker 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. Combustible loading controls are also listed as the principal SSC for protection of the site worker. In additional information provided by the applicant (Reference 5.3.8, Enclosure A at 29), the applicant stated that its ISA -- to be performed in support of its Part 70 operating license application -- will demonstrate that credible fires including the effects of transient combustible loading will not significantly affect confinement barriers. Based on this commitment and normally accepted industry practice, the staff considers this to be an acceptable strategy for meeting the 10 CFR 70.61 performance requirements.

MOX Fuel Transport Cask (Fire)
The controlling 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 applicant has determined this sequence to be above the 10 CFR 70.61(c) threshold for the facility worker and site worker but below the10 CFR 70.61(c) threshold for the public. The staff independently evaluated this accident sequence and agrees to its categorization The PSSC listed for protection of the facility worker and the site worker 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. In addition to the listed PSSCs, there will also be a fire suppression system which is considered an additional protective feature. Additional information provided by the applicant (Reference 5.3.8, Enclosure A at 29), stated that the applicant's ISA -- to be performed in support of its Part 70 operating license application -- will demonstrate that credible fires including the effects of transient combustible loading will not significantly affect confinement barriers. If necessary, controls will be placed on the amount of fuel allowed for the shipping vehicles. Based on this commitment, accepted industry practice and the NUREG-1718 Table A-5 descriptions (passive engineered control 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 controlling event for a fire affecting a waste container event group in the fire event accident category was determined to be a fire located in the assembly packaging area. The source term 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 has determined this sequence to be above the10 CFR 70.61(c) threshold for the facility worker but below the 10 CFR 70.61(c) threshold 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 using a strategy of mitigation. The PSSC listed for protection of the facility worker is facility worker action to ensure that facility workers take proper actions to limit dose. No SSCs are listed as required to protect the public and site workers. The primary protection of the worker will be early detection of the fire and the ability to evacuate the area

before a release. The staff considers this to be an acceptable strategy for meeting the 10 CFR 70.61 performance requirements.

Transfer Container (Fire)

The controlling event for a fire affecting a transfer cask outside of a C3 area event group in the fire event accident category was determined to be a fire in either the air locks, corridors, stairways, or safe areas (worst case not specified). The source term is the maximum inventory in a transfer container. The source of the fire was listed as electrical equipment, transient combustibles or a HEPA filter. The applicant has determined this sequence to be above the 10 CFR 70.61(c) threshold for the facility worker but below the 10 CFR 70.61(c) threshold 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 using a strategy of prevention. The PSSC listed for protection of the facility worker 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 SSCs are listed as required for protection of the public or site worker. In additional information provided by the applicant (Reference 5.3.8, Enclosure A, page 29), the applicant stated that its ISA -- to be performed in support of its Part 70 operating license application -- will demonstrate that credible fires including the effects of transient combustible loading will not significantly affect confinement barriers. Based on this commitment, accepted industry practice and the NUREG-1718 Table A-5 descriptions (passive engineered control and 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 controlling 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 source term for this event is based on a conservative estimate of material present on the C4 HEPA filters. The applicant has determined this sequence to be above the 10 CFR 70.61(c) threshold for the facility worker and site worker but below the 10 CFR 70.61(c) threshold 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 and site worker using a strategy of prevention and mitigation. The PSSC listed for protection of the facility workers is the C4 confinement system which will have design features to ensure that the final C4 HEPA filters are not impacted by fire. The PSSCs listed for site worker protection are the C4 confinement system and combustible loading controls. No SSCs are listed as required for protection of the public. In additional information provided by the applicant (Reference 5.3.8, Enclosure A, page 29), the applicant stated that its ISA -- to be performed in support of its Part 70 operating license application -- will demonstrate that credible fires including the effects of transient combustible loading will not significantly affect confinement barriers. Based on this commitment and normally accepted industry practice, the staff considers combustible loading controls and the C4 confinement system to be an adequate strategy for meeting the 10 CFR 70.61 performance requirements in regard to the site worker. In addition, the staff considers the fire protection features of the C4 confinement system to be an adequate strategy for meeting the 10 CFR 70.61 performance requirements in regard to the facility worker. The staff, however, has an open item regarding HEPA filter performance during a fire as noted in DSER Section 5.1.5.6.

Fire Outside of MFFF Building (Fire)

The controlling 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 source term is the maximum inventory of radioactive material in the MFFF which is susceptible to the effects of external fires. The applicant has determined this sequence to be above the 10 CFR 70.61(c) threshold for the facility worker, site worker, and the public and has opted to meet the performance requirements using a strategy of prevention and mitigation. The PSSCs listed to protect the facility worker were the MFFF building structure which is designed to maintain structural integrity and prevent damage to internal PSSCs from external fires, 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. The same PSSCs were listed for protection of the public and site workers. Based on accepted industry practice and the NUREG-1718 Table A-5 descriptions (passive engineered control and active engineered control), 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 controlling 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 source term is the maximum inventory of radioactive material in the pneumatic pipe automatic transfer system. The fire is expected to be caused by electrical equipment and transient combustibles. The applicant has determined this sequence to be above the 10 CFR 70.61(c) threshold for the facility worker but below the 10 CFR 70.61(c) threshold 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 dose to the facility worker and site using a strategy of mitigation. The PSSC listed for protection of facility workers is facility worker actions. The primary protection of the worker will be early detection of the fire and evacuation of the area before a release. No PSSCs are listed as required for protection of public and site workers. The applicant is presently evaluating the propagation of hot gases through pneumatic tubes. The acceptability of the above strategy will be an open item until the evaluation is completed and reviewed (DSER Section 7.1.5.6).

Fire Involving More than One Fire Area (Fire)
The controlling 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 MFFF susceptible to a facility-wide fire. The applicant has determined this sequence to be above the 10 CFR 70.61(c) threshold for the facility worker, site worker and the public and has opted to meet the performance requirements using a strategy of prevention and mitigation. The PSSCs listed for protection of the facility worker are worker actions and fire barriers that will contain the fires within the fire area. The PSSC listed for protection of the site worker and the public is fire barriers. In addition to the listed PSSCs, there will also be a fire suppression system which is considered an additional protective feature. Based on accepted industry practice and the NUREG-1718 Table A-5 descriptions (passive engineered control), the staff considers this to be an acceptable strategy for meeting the 10 CFR 70.61 performance requirements. However, the staff has an open item in regard to the design bases of the fire barriers (DSER Section 7.1.5.6).

5.1.5.3 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.

Load handling events were hypothesized to occur in the following areas:

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

The following event groups were evaluated by the applicant:

AP Process Cells (Load Handling)
The controlling 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 source term was the maximum inventory of radioactive material in the AP Process cell containing the dissolution tanks. The applicant has determined this sequence to be above the 10 CFR 70.61(c) threshold for the facility worker but below the 10 CFR 70.61(c) threshold for the public and the site worker. The staff independently evaluated this accident sequence and agrees to its categorization. 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 PSSCs for the protection of facility workers are the process cells which contain fluid leaks 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. No SSC are listed as required to protect the public and site workers. Based on normally accepted industry practice and the NUREG-1718 Table A-5 descriptions (robust passive engineered 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 controlling 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 source term is the maximum inventory of radioactive material in the glovebox. The breach of the glovebox is expected to occur from a lifting device or a lifted load. The applicant has determined this sequence to be above the 10 CFR 70.61(c) threshold for the facility worker, site worker and the public and has opted to meet the performance requirements

using a strategy of prevention and mitigation. The PSSCs for protection of the facility worker 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 actions. The PSSC for protection of the public and site workers is the C3 confinement system. Based on normally accepted industry practice and the NUREG-1718 Table A-5 descriptions (high availability active engineered control), the staff considers this to be an acceptable strategy for meeting the 10 CFR 70.61 performance requirements.

3013 Canister (Load Handling)
The controlling event for the 3013 canister event group 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 source term 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 has determined this sequence to be above the 10 CFR 70.61(c) threshold for the facility worker, site worker, and the public and has opted to meet the performance requirements using a strategy of prevention. The PSSCs listed for protection of the facility worker are the 3013 canister and material handling controls. The PSSCs listed for protection of the public and the site worker are also the 3013 canister and the material handling controls. Based on normally accepted industry practice and the NUREG-1718 Table A-5 descriptions (passive engineered control plus administrative control), the staff considers this to be an acceptable strategy for meeting the 10 CFR 70.61 performance requirements.

3013 Transport Canister (Load Handling)
The controlling event for the 3013 transport canister event group 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 source term was the maximum inventory of radioactive material in two 3013 transport canisters. The applicant has determined this sequence to be above the 10 CFR 70.61(c) threshold for the facility worker, site worker and the public and has opted to meet the performance requirements using a strategy of prevention. The PSSCs listed for protection of the facility worker are the 3013 transport cask and material handling controls. The PSSCs listed for protection of the public and the site worker are also the 3013 canister and the material handling controls. Based on normally accepted industry practice and the NUREG-1718 Table A-5 descriptions (passive engineered control plus administrative control), 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 controlling 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 radiological 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 has determined this sequence to be above the 10 CFR 70.61(c) threshold for the facility worker but below the 10 CFR 70.61(c) threshold for the public and the site worker. The staff independently evaluated this accident sequence and agrees to its categorization. The PSSC listed for protection of the facility worker is worker actions. No PSSC are required for protection of the public and site worker. 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 staff agrees that these PSSCs are an acceptable strategy for meeting the performance requirements of 10 CFR 70.61.

MOX Fuel Transport Cask (Load Handling)
The controlling event for the MOX fuel transport cask event group 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 applicant has determined this sequence to be above the 10 CFR 70.61(c) threshold for the facility worker but below the 10 CFR 70.61(c) threshold 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 using a strategy of prevention. The PSSCs listed for protection of the facility worker are the MOX fuel transport cask and material handling controls. No PSSCs are required for protection of the site worker and the public. Based on normally accepted industry practice and the NUREG-1718 Table A-5 descriptions (passive engineered control plus administrative control), the staff considers this to be an acceptable strategy for meeting the 10 CFR 70.61 performance requirements.

Waste Container (Load Handling)
The controlling event for the waste container event group 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 applicant has determined this sequence to be above the 10 CFR 70.61(c) threshold for the facility worker but below the 10 CFR 70.61(c) threshold 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 using a strategy of mitigation. The PSSCs listed for protection of the facility worker are worker actions. 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 staff agrees that these PSSCs are an acceptable strategy for meeting the performance requirements of 10 CFR 70.61.

Transfer Container (Load Handling)
The controlling event for the transfer container event group in the load handling accident category was the drop of a transfer container containing a HEPA filter with PuO_2 in powdered form. The applicant has determined that the consequences from this event sequences are above the10 CFR 70.61(c) threshold for the facility worker, site worker and the public and has opted to meet the performance requirements using a strategy of prevention. The PSSCs listed for protection of the facility worker are the transfer container and material handling controls. The principal SSCs listed for protection of the public and the site worker are also the transfer container and the material handling controls. Based on normally accepted industry practice and the NUREG-1718 Table A-5 descriptions (passive engineered control and administrative control), the staff considers this to be an acceptable strategy for meeting the 10 CFR 70.61 performance requirements.

Final C4 Filter (Load Handling)
The controlling 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 applicant has determined this sequence to be above the 10 CFR 70.61(c) threshold for the facility worker and the site worker but below the 10 CFR 70.61(c) threshold 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 and the site worker using a strategy of prevention. Material handling controls were identified as the PSSC for protection of the facility worker and the site worker. In additional information provided by the applicant (Reference 5.3.8, Enclosure A at 10), 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. In addition, the applicant has stated (Reference 5.3.8, Enclosure A, page 1) that specific material handling controls will be identifed in the ISA. Based on this committment, the staff finds material handling controls to be an acceptable strategy for meeting the 10 CFR 70.61 performance requirements.

C4 Confinement (Load Handling)
The controlling 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 applicant has determined this sequence to be above the 10 CFR 70.61(c) threshold for the facility worker and the site worker but below the 10 CFR 70.61(c) threshold 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 and the site worker using a strategy of mitigation. The C4 confinement system is identified as the PSSC for protection of the facility worker and the site worker. The applicant has determined that the consequences from this event sequences are above the 10 CFR 70.61(c) threshold for the facility worker, site worker, and the public and has opted to meet the performance requirements using a strategy of prevention. The PSSCs listed for protection of the facility worker are the transfer container and material handling controls. The PSSCs listed for protection of the public and the site worker are also the transfer container and the material handling controls. Based on normally accepted industry practice and the NUREG-1718 Table A-5 descriptions (passive engineered control plus administrative control), the staff considers this to be an acceptable strategy for meeting the 10 CFR 70.61 performance requirements.

Outside MFFF Buildings (Load Handling)
The controlling 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 applicant has determined that the consequences from this event sequences are above the 10 CFR 70.61(c) threshold for the facility worker, site worker and the public and has opted to meet the performance requirements using a strategy of prevention. The PSSC listed for protection of the facility worker is the waste transfer line which is double walled and buried. The same PSSC is also listed for protection of the public and the site worker. Based on normally accepted industry practice and the NUREG-1718 Table A-5 descriptions (robust passive engineered control), the staff considers this to be an acceptable strategy for meeting the 10 CFR 70.61 performance requirements.

Facility Wide (Load Handling)
The controlling event in the load handling event category for the facility wide event class is the breach of the MFFF 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 applicant has determined that the consequences from this event sequences are above the 10 CFR 70.61(c) threshold for the facility worker, site

worker and the public and has opted to meet the performance requirements using a strategy of prevention. The PSSCs listed for protection of the facility worker 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 drops that would exceed the design of the building. Based on normally accepted industry practice and the NUREG-1718 Table A-5 descriptions (passive engineered control and administrative control), the staff considers this to be an acceptable strategy for meeting the 10 CFR 70.61 performance requirements.

5.1.5.4 Explosion Events

Explosion events that are postulated by the applicant to occur within the MOX fuel fabrication facility may be from process hydrogen, radiolysis induced hydrogen, hydroxylamine nitrate (HAN)/Hydrazine, hydrogen peroxide, solvent, and TBP-Nitrate (Red Oils) explosion. In addition, AP vessel and pressure vessel over-pressurization explosions, laboratory explosions, and explosions outside the facility are also evaluated in this section.

These explosions may be caused by loss of scavenging air or offgas flow in units where radiolysis may occur, pressurizing reactions or over temperature occurrences in vessels or tanks, incorrect reagent addition or preparation, hydrogen leakage and accumulation, excessive hydrogen in the sintering furnace, and vapors from organic liquids.

The explosions are postulated to occur in the process and reagent preparation areas inside of the MOX fuel fabrication Building. Outside of the building explosion events are postulated to occur in support facilities such as the reagent processing building, gas storage area, and the diesel generator buildings.

Hydrogen (Explosion)
The controlling 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 has determined that the consequences from this event sequences are above the 10 CFR 70.61(c) threshold for the facility worker, site worker, and the public and has opted to meet the performance requirements using a strategy of prevention. The PSSC listed for prevention of this event is the Process Safety I&C System which will consist of hydrogen monitors, pressure sensors, and electronically activated shutoff valves. Clarification of the system name and description in regard to process safety I&C has been requested from DCS (Reference 5.3.8, Enclosure B at 3). The staff considers this to be an open item until more detail is provided. Additional concerns about the adequacy of the strategy are provided in DSER Section 11.3.1.2.4.

Radiolysis (Explosion)
The controlling 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 has determined that the consequences from the first two event sequences are above the 10 CFR 70.61(c) threshold for the facility worker, site worker, and the public and the last event is above the 10 CFR 70.61(c) threshold for the site worker only. The applicant has opted to meet the performance requirements using a strategy of prevention. The PSSC listed for prevention of these events are the offgas treatment system, the instrument air

system (scavenging system), and waste containers, respectively. Because of the slow buildup of radiolytic hydrogen, and the reliability of the offgas and scavenging systems, the staff agrees that the selection of these PSSCs is sufficient to meet the performance requirements of 10 CFR 70.61. 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**.** Based on normally accepted industry practice the staff considers this to be an acceptable strategy for meeting the 10 CFR 70.61 performance requirements. However, the staff has an open item concerning the design bases of the offgas treatment system regarding allowable hydrogen concentrations. (DSER Section 11.2.1.11)

HAN/Hydrazine (Explosion)
The controlling event for the HAN/hydrazine explosion class was determined to be an event involving either HAN/nitric acid or hydrazine/hydrazoic 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 has determined that the consequences from this event sequences are above the 10 CFR 70.61(c) threshold for the facility worker, site worker, and the environment and has opted to meet the performance requirements using a strategy of prevention. The PSSCs listed for prevention of this event are Process Safety I&C Systems to shutdown the process prior to exceeding HAN/hydrazine temperature or flow limits and concentration controls to ensure that hydrazine concentrations are controlled to within safe limits. The staff does not consider this strategy adequate for all potentially affected units and components. The applicant has committed to renaming the process safety I&C system to more accurately clarify its role (Reference 5.3.8, Enclosure B at 1). 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. At a minimum this applies to the following areas: purification event, recovery, offgas. In addition, the staff also concludes that additional PSSCs or expanded functions may be necessary for preventing azide formation. (DSER Section 8.1.5.2.3)

Hydrogen Peroxide (Explosion)
The controlling 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 has determined that the consequences from this event sequences are above the 10 CFR 70.61(c) threshold for the facility worker, site worker, and the public and has opted to meet the performance requirements using a strategy of prevention. The PSSCs listed for prevention of this event are concentration controls to ensure that concentrations of hydrogen peroxide do not exceed 75 percent by weight. Based on normally accepted industry practice 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 controlling 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 has determined that the consequences from this event sequences are above the 10 CFR 70.61(c) threshold for the facility worker, site worker and the public and has opted to meet the performance requirements using a strategy of prevention. The PSSCs listed for prevention of this event are Process Safety I&C Systems to shutdown the process prior to exceeding solvent temperature limits and the offgas treatment system which

will provide exhaust to ensure that an explosive build-up of explosive vapors does not occur. Clarification of the system name and description in regard to process safety I&C has been requested from DCS (Reference 5.3.8, Enclosure B, page 3). The staff also has an open item in regard to the design basis for flammable vapor concentrations in the offgas treatment unit. (DSER Section 11.2.1.11)

TBP-Nitrate (Red Oil)

The controlling 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 has determined that the consequences from this event sequences are above the10 CFR 70.61(c) threshold for the facility worker, site worker and the public and has opted to meet the performance requirements using a strategy of prevention. The principal SSCs listed for prevention of this event are Process Safety I&C Systems to ensure that the evaporator process temperature conditions do not exceed 135 degrees C in the presence of TBP. Clarification of the system name and description in regard to process safety I&C has been requested from DCS (Reference 5.3.8, Enclosure B, page 3). In addition, the staff concludes that the red oil phenomena analysis is not complete and that PSSCs and their functions and design bases for preventing red oil explosions are not adequate for all potentially affected components. At a minimum, this applies to the following areas: purification, solvent recovery, calciner, oxalic mother liquor, acid recovery, and offgas. The staff considers the above concerns to be open items. (DSER Section 8.1.2.5.2.5).

AP Vessel Over-Pressurization (Explosion)

The controlling event in AP vessel over-pressurization explosion class was 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 MFFF. The applicant has determined that the consequences from this event sequences are above the 10 CFR 70.61(c) threshold for the facility worker, site worker, and the public and has opted to meet the performance requirements using a strategy of prevention. The PSSCs listed for prevention of this event are the fluid transfer 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 ensure venting of vessels/tanks to prevent over-pressurization conditions; and chemical safety controls to ensure control of the chemical makeup of the reagents and ensure segregation/separation of vessel/components from incompatible chemicals. Based on normally accepted industry practice the staff considers this to be an acceptable strategy for meeting the 10 CFR 70.61 performance requirements.

Pressure Vessel (Explosion)

The controlling 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 has determined that the consequences from this event sequences are above the 10 CFR 70.61(c) threshold for the facility worker, site worker, and the public and has opted to meet the performance requirements using a strategy of prevention. The PSSCs listed for prevention of this event are the pressure vessel controls which ensure that primary confinement are protected from the impact of of pressure vessel failures. Based on normally accepted industry practice, the staff considers this to be an acceptable strategy for meeting the 10 CFR 70.61 performance requirements.

Laboratory (Explosion)
The controlling 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 has determined that the consequences from this event sequences are above the 10 CFR 70.61(c) threshold for the facility worker, site worker and the public and has opted to meet the performance requirements using a strategy of prevention and mitigation. The PSSC for protection of the site worker and the public is the C3 confinement system which provides filtration to mitigate dispersions from the C3 areas. Based on normally accepted industry practice the staff considers this to be an acceptable strategy for meeting the 10 CFR 70.61 performance requirements in regard to site workers and the public. However, the staff lacks assurance that the facility worker is protected by the C3 confinement system. Therefore, the applicant is expected to clarify its strategy for protecting the facility worker from this event. A safety strategy for protection of a facility worker from a laboratory explosion has not been identified. This is an open item. (DSER Section 8.1.2.1.2.3)

Outside (Explosion)
The controlling events for the outside explosion class in the 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 has determined that the consequences from this event sequences are above the10 CFR 70.61(c) threshold for the facility worker, site worker, and the public and has opted to meet the performance requirements using a strategy of mitigation of the effects of the explosion (prevention of 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. Based on normally accepted industry practice and the NUREG-1718 Table A-5 descriptions (robust passive engineered control), the staff considers this to be an acceptable strategy for meeting the 10 CFR 70.61 performance requirements.

5.1.5.5 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 dilutents and the proximity of potential reflectors.

The most immediate potential consequences from a criticality event is direct radiation exposure to the worker. Distance from the event normally protects the site worker and members of the public. Shielding materials can also reduce the dose. However, criticality accidents can also produce airborne exposure to radioactive material which can affect the public and site workers.

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

- Geometry control.
- Mass control.
- Density control.
- Istopics control.

- Reflection control.
- Moderation control.
- Concentration control.
- Interaction control.
- Neutron absorber control.
- Volume control.
- Heterogeneity control.
- Process variable control.

Potential locations of criticality accidents within the MFFF are limited to areas where fissionable materials such as ^{235}U or ^{239}Pu are present in sufficient quantities to obtain a self sustaining fission reaction under optimal conditions.

The applicant will use a strategy of prevention to protect the facility worker from a criticality accident. The applicant did not list specific PSSCs as part of its prevention strategy. The applicant cited adherence to the double contingency principal as specified in American National Standards Institute/American Nuclear Society (ANSI/ANS) 8.1-1983 (Reference 5.3.1) as the means of assurance that a criticality accident would be highly unlikely. The staff does not agree that double contingency is equivalent to highly unlikely in all cases. Therefore, this is an open item (DSER Section 6.1.4.2).

5.1.5.6 Consequence Assessment

The applicant has performed an analysis of the bounding mitigated consequences of each event type. It demonstrates that the bounding events result in low consequences for 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 bounding loss of confinement event is the same as the bounding internal fire event.

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

The bounding load handling event is a drop event involving the glovebox in the jar storage and handling unit.

***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.

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

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 suficient justification from DCS, the staff's present position is that it would not approve MFFF 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 DSER. While this may not change the acceptability of the facility performance in terms of dose to workers and the public it may have an adverse effect on the acceptability of the environmental releases.

5.1.6 Description of PSSCs

In addition to identifying the hazards associated with MFFF design and operations, DCS in its safety assessment of the design bases of PSSCs also identified the PSSCs required to mitigate or prevent these hazards. The specific designs or "design bases" of the PSSCs as determined through the DCS Safety Assessment but are discussed in their appropriate sections of this DSER.

5.2 EVALUATION FINDINGS

In Section 5 of the CAR, DCS provided a description of the safety analysis that it performed and the identified PSSCs for the proposed MFFF. Based on the staff's review of the 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 SA was found to be adequate.

- The Safety Assessment Team description was found to be adequate.

The methodology for the safety assessment of the design basis was found to have the open items shown below. The designation after the open item identifies the item on the open item list in Appendix A of the DSER.

- The methodology used by the applicant to show compliance with 10 CFR 70.61(c)(3) was not adequate. (ES-1)

- The evaluation of aircraft accidents should not have been screened out without considering the effects of future projected flight paths. (SA-3)

- A steam explosions in the water cooled sintering furnace was not identified as a credible event. (MP-3)

- High temperature non-fire related failure of glovebox windows resulting in a loss of confinement was not identified as a credible event. (FS-4)

- Buildup of flammable gas from an overvoltage condition in the Dissolution unit electrolyzer potentially resulting in an explosion was not identified as a credible event. (AP-2)

- Breach of solvent waste confinement outside the restricted area which would lead to an intermediate consequence event under the environmental release provisions of 10 CFR 70.61(c)(2) was not identified as a credible event. (ES-2)

- The accident scenario of a hydrogen explosion in the glovebox outside of the sintering furnace airlock due to insufficient purging in the airlock was not identified as a credible event. (FLS-1)

- Events involving titanium, such as titanium fires were not identified as credible events. (AP-3)

- A fire or loss of confinement in the secure warehouse building resulting in a significant release of depleted uranium resulting in toxic intakes was not identified as a credible event. (CS-8)

- The loss of nitrogen flow to the bearings of the calciner, causing the bearings to overheat resulting in damage to the calciner and potential loss of plutonium was not identified as a credible event. (FLS-3)

- Fire events associated with the pyrophoric nature of some uranium and plutonium oxide powders were not identified as credible events. (MP-1 and MP-2)

The results of the safety assessment of the design basis was found to have the open items shown below. Open issues from the results section regarding design bases values only are not listed as open items in Chapter 5.0 They are however referenced in Table 5-1 where appropriate.

- The applicant needs to justify the mitigation strategy of the seismic event in regard to isolation of flammable gas lines. The applicant should explain why the seismic isolation valves were not included as PSSCs in Table 5.5-21. (SA-4)

- The applicant needs to provide documentation from DOE showing that quantities of potential explosive substances in F-area are limited to quantities below that calculated to damage the MFFF. (SA-2)

- The applicant needs to clarify the name of the PSSC (“process safety I&C system) and its functions in the over temperature event group in the confinement events accident category so that its prevention strategy can be evaluated. (SA-1)

- The applicant needs to consider the consequences of chemical releases in the leaks within process cells in the confinement events accident category so that the staff can evaluate the proposed mitigation strategies. (AP-13)

- The applicant needs to provide an unmitigated dose calculation to the facility worker for the leak in the sintering furnace and demonstrate a means of warning the worker in the confinement events accident category so that the mitigation strategy can be evaluated. (RS-1)

- The applicant needs to clarify the name of the PSSC (“process safety I&C system) and its functions in the over/under pressurization of a glovebox events group in the confinement events accident category so that its prevention strategy can be evaluated. (SA-1)

- The applicant is presently evaluating the propagation of hot gases through pneumatic transfer tubes. The acceptability of the strategy for mitigation of fires affecting facility wide systems will depend upon review of this evaluation. (FS-3)

- The applicant needs to clarify the name of the PSSC (process safety I&C) and its functions in the hydrogen explosions event group in the explosion accident category so that its prevention strategy can be evaluated. (SA-1, MP-4)

- The applicant needs to clarify the name of the PSSC (process safety I&C) and its functions in the HAN/hydrazine explosions event group in the explosion accident category. In addition, the staff does not consider the applicants strategy for preventing HAN/Hydrazine explosions nor azide buildup are not adequate for all potentially affected units and components. (SA-1, CS-2, CS-3)

- The applicant needs to clarify the name of the PSSC (process safety I&C) and its functions in the solvent explosions event group in the explosion accident category so that its prevention strategy can be evaluated. (SA-1, CS-9)

- The applicant needs to clarify the name of the PSSC (process safety I&C) and its functions in the TBP-nitrate explosions event group in the explosion accident category. In addition, the safety function listed (evaporator process temperature) is not considered by the staff to be sufficient to be an adequate safety strategy for prevention of an explosion. (SA-1, CS-1)

- The applicant needs to develop a strategy to mitigate the dose to the facility worker from a laboratory explosion. (CS-6)

- The staff does not accept adherence to the double contingency rule by itself as an acceptable means of demonstrating that criticality accidents are highly unlikely. (NCS-5)

- 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 general SA commitments proposed by the applicant were found to be acceptable.

DCS has stated that it will provide additional information concerning the safety assessment open items identified by the staff as SA-1, 2, 3, 4 (Reference 5.3.14). DCS has stated that it will provide additional information for open items in areas other than safety assessment, shown in the respective sections of this DSER.

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

5.3.3 Chen, J.T; Chokshi, N.C.; Kenneally, R.M.;Kelly, G.B.;Beckner, W.D.; McCracken, C; Murphy, A.J.; Reiter, L.; Jeng, D. "Procedural and Submital Guidance for the Individual Plant Examination of External Events (IPEEE) for Severe Accident Vulnerabilities." Final Report 1-26, June 1991.

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; Response to "Request for Additional Information", July 18, 2001

5.3.8 Hastings, P., Duke Cogema Stone & Webster, letter to U.S. Nuclear Regulatory Commission, RE; Clarification of response to "Request for Additional Information" January 7, 2002

5.3.9 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

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

5.3.11 Ihde, R. Duke, Cogema Stone & Webster, letter to W. Kane, U.S. Nuclear Regulatory Commission, RE MOX Fuel fabrication Facility- Construction Authorization Request, February 28, 2001.

5.3.12 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

5.3.13 _____. NUREG/CR-6728, “Technical Basis for Revision of Regulatory Guidance on Design Ground Motions: Hazard- and Risk-consistent Ground Motion Spectra Guidelines.” . NRC: Washington, D.C.

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

TABLE 5-1, 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.	11.7.1.3
3013 Outer Canister Opening Device	Prevent spread of radioactive material during 3013 canister outer can opening operations.	Guillotine type door, inflatable seal, lid cutter decon unit DOE -STD-3013. Contamination to outer container < 2000 dpm/100 sq. cm.	11.7.1.3 9.1.2.6
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	11.7.1.3
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; 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;	11.4.5.2

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;	9.1.3
	Remain operable during design basis fire and effectively filter any release	Spark arrestors 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
	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;	11.4.5.2
C4 Confinement System	Limit dispersion of radioactive material	Designed to maintain exhaust safety function assuming single active component failure; Final HEPA filter assembly release fraction: 1E-4 Two 100 percent capacity redundant assemblies of two HEPA filter banks prior to discharge;	11.4.5.2
	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;	11.4.5.2
	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;	11.4.5.2

PSSC	Design Bases Safety Function	Design Bases Values	DSER Section
	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; 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;	11.4.5.2
	Operate continuously	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;	11.4.5.2
	Provide fire design features to ensure that final C4 filter is not impacted by fire	Final HEPA filter design temperature of 450 F; Spark arrestors and prefilters in each filtration assembly upstream of HEPA filters; Fire-rated dampers between designated fire areas;	Open item: 7.1.5.5
Chemical Safety Controls	Ensure control of the chemical makeup of reagents and ensure segregation/separation of vessels/components from incompatible chemicals	Provide admin. controls to ensure control of the chemical makeup of the reagents and to ensure segregation and separation of vessels and components from incompatible chemicals.	8.1.2.2.2 8.1.2.5.1
Combustible Loading Controls	Limit combustibles in C4 filter area	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 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 fuel transport casks	Same as above	7.1.5.1

PSSC	Design Bases Safety Function	Design Bases Values	DSER Section
	Limit the quantity of combustibles in areas containing transfer containers.	Same as above	7.1.5.1
Concentration Controls	Ensure that concentrations of hydrogen peroxide do not exceed 75%	35% hydrogen peroxide	8.1.2.5.2.4
	Ensure that hydrazine concentrations are controlled to within safety limits.	35% hydrazine hydrate	8.1.2.5.2.3
Criticality Control	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
Criticality controls (continued)		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).	

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 tray 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
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;	11.4.5.2 8.1.2.6 (open item)

PSSC	Design Bases Safety Function	Design Bases Values	DSER Section
Emergency Control System	Provide controls for high depressurization exhaust system	Two redundant, separate, and independent trains. Two independent trains for 125VDC and 120 VAC. 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 spans, setpoints and control ranges 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, RG 1.61, 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
	Provide controls for very high depressurization exhaust 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 system	11.6.1.3.1

PSSC	Design Bases Safety Function	Design Bases Values	DSER Section
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, 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, 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.	11.5.1.3.5
	Provide DC power for VH depressurization exhaust system	Same as above	11.5.1.3.5
	Provide DC power for emergency AC power system controls	Same as above	11.5.1.3.5
	Provide DC power for emergency control room air-conditioning system	Same as above	11.5.1.3.5
	Provide DC power for emergency control system	Same as above	11.5.1.3.5
	Provide DC power for emergency generator ventilation system	Same as above	11.5.1.3.5
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
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;	11.4.5.2
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
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

PSSC	Design Bases Safety Function	Design Bases Values	DSER Section
Fire Detection and Suppression	Support fire barriers as necessary (also, according to CAR section 7.5.3 Provide defense-in-depth to fire barriers that protect radioactive material.)	Detection & Alarm per NFPA 72-1996 Suppression per NFPA 2001-1996 (clean agent) where 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 8.1.2.5.2.3 Open item, 8.1.2.5.2.5 open item
	Limit system corrosion	Adequacy of Material Maintenance and Surveillance Program Under review. Specific corrosion may not be adequately monitored	Open item, 11.8.1.3 &11.8.2, open item 11.2.1.2
Glovebox	maintain confinement integrity	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	Open item: 11.7.1.3, 11.7.2
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;	11.4.5.2
Glovebox Fire Protection Features	Ensure that fires in fire areas with gloveboxes are unlikely to result in intermediate consequences to the environment.	Not provided	Open item 7.1.5.8
High Depressurization Exhaust System	Temperature in 3013 canister storage	Part of C3 confinement, same design bases.	
	Cooling air exhaust from electrical rooms	Part of C3 confinement, same design bases.	

PSSC	Design Bases Safety Function	Design Bases Values	DSER Section
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, 11.9.1.3, open item 11.2.1.11, 8.1.2.5.2.1.2
Material Handling Controls	Ensure proper handling of primary confinement types outside of gloveboxes	Management Measures	11.7.1.1.2, 11.7.1.3
	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)	11.7.1.3
	Prevent damage to C4 HEPA filters from load handling activities	PSSC for structural protection is C4 confinement system	
	Prevent impacts to the inside or outside of glovebox during normal operations	Engineered equipment used to reduce likelihood of failures causing glovebox breaches	11.7.1.1, 11.7.1.3
	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.	11.7.1.3
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, 11.7.1.3
	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. Specific corrosion may not be adequately addressed.	Open item 11.2.1.2
MFFF Tornado Dampers	Protect MFFF Ventilation systems from differential pressure effects of the tornado	Designed per ASME AG-1	11.4.1.1.1 11.4.1.1.2

PSSC	Design Bases Safety Function	Design Bases Values	DSER Section
Missile Barriers	Protect MOX FFF and EDG building internal SSCs from damage caused by tornado or wind-driven missiles.	***Text removed under 10 CFR 2.390.**	
MOX Fuel Fabrication Building Structure	Maintain structural integrity and prevent damage to internal SSCs from external events	***Text removed under 10 CFR 2.390.**	7.1.5.4
	Withstand the effects of load drops that could potentially impact radiological material.	NUREG -0612	
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	Mechanical design per 10 CFR 71.73, certified to withstand 30 ft. drop.	11.7.1.3
Pressure vessel controls	Ensure that primary confinements are protected from the impact of pressur4e 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 11.9.1.3
Process Cell Entry controls	Prevent the entry of personnel into process cells during normal operations	See Chapter 9.	9.1.2.3
	Ensure that workers do not receive a dose in excess of limits while performing maintenance.	See Chapter 9.	9.1.2.3
Process cell Fire prevention Features	Ensures that fires in process cells are highly unlikely	Combustible loading controls per NFPA 801	7.1.5.3
Process Cells	Contain fluid leaks within cells	Fully welded, designed to handle maximum inventory of largest vessel in cell.	11.7.1.2

PSSC	Design Bases Safety Function	Design Bases Values	DSER Section
Process Safety I&C System (All functions to be part of either "Safety Control Subsystems" or "Emergency Control System")	Ensure that evaporator process temperature conditions do not exceed 135C The staff review indicates that other safety functions may be necessary.	Same as for emergency control system	11.6.1.3.2 Open item 8.1.2.5.2.5
	Ensure that the flow of hydrogen is terminated. Hydrogen flow to the sintering furnace is not terminated under all credible off-normal conditions	Same as above	11.6.1.3.2 11.3.1.2.4
	Ensure that a non-explosive mixture of hydrogen/Argon is introduced into the MOX Fuel Fabrication building	Same as above Hydrogen is maintained at 1-9% in argon.	11.6.1.3.2 11.3.1.2.4
	Ensure isolation of pressurization sources following exceedance of the associated glovebox pressure setpoints.	Same as above	11.6.1.3.2
	Warn operators of glovebox pressure discrepancies prior to exceeding differential pressure limits	Same as above	11.6.1.3.2
	Shutdown process equipment prior to exceeding temperature safety limits	Same as above General temperature values not identified; specific values for solvent an red oil.	11.6.1.3.2
	Shut down process prior to exceeding HAN/hydrazine temperature or flow limits	Same as above Design basis temperature and other DB values not completely identified.	11.6.1.3.2 Open item 8.1.2.5.2.3
	Shut down process prior to exceeding solvent temperature limits	Same as above. Solvent temperature design basis of 50E C does not provide adequate margin from flashpoint.	11.6.1.3.2 Open item 8.1.2.5.2.2

PSSC	Design Bases Safety Function	Design Bases Values	DSER Section
Offgas Treatment System	Ensure venting of vessels/tanks to prevent over-pressurization conditions	Two 100% capacity filtration stages and two fans, Designed for single failure, HEPA filter release fraction : 1E-4, System design in accordance with ASME N509, Filter testing in accordance ASME N510 Venting for vessels containing reactive mixtures may require additional design bases.	11.5.4.2 Open item 8.1.2.5.2.3 & 8.1.2.5.2.5
	Provide exhaust to ensure that an explosive buildup of vapors does not occur.	Design bases for flammable gases and vapors not provided.	Open item 11.2.1.11
	Provide exhaust to ensure that an explosive buildup of hydrogen does not occur.	Design basis of 1% H2 in air is based upon plutonium radiolysis	open item 11.2.1.11
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; 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;	11.4.5.2
Training and procedures (Facility worker actions)	Ensure that the facility worker takes action to limit dose.	Worker response-- see Chapter 9.	9.1.2.4
Transfer Container	Withstand the effects of design basis drops without breaching	Designed to withstand 30 ft. drop. DOE -STD-3013-2000	11.4.11.7
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

PSSC	Design Bases Safety Function	Design Bases Values	DSER Section
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	