11.0 PLANT SYSTEMS

11.1 CIVIL STRUCTURAL SYSTEMS

11.1.1 CONDUCT OF REVIEW

This chapter of the Safety Evaluation Report (SER) contains the staff's review of the civil structural systems described by the applicant in Chapter 11 of the Construction Authorization Request (CAR). The objective of this review is to determine whether the principal, structures, systems, and components (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 for the civil structural systems by reviewing Chapter 11 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 the civil structural systems design bases and strategies was closely coordinated with the review of the civil structural aspects of accident sequences described in the Safety Assessment of the Design Bases (see Chapter 5 of this SER), and the review of other plant systems.

The staff reviewed how the information in the CAR addresses the following regulations:

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

- 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. With respect to structural systems, 10 CFR 70.64(a)(2) requires that the Mixed Oxide Fuel Fabrication Facility (MFFF) design "provide for adequate protection against natural phenomena with consideration of the most severe documented historical events for the site."

The review for this construction approval focused on the design basis of the civil structural systems, their components, and other related information. For each civil structural system, 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 used Chapter 11 in NUREG-1718, "Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility," as guidance in performing the review.

The following three general areas of Section 11.1, "Civil Structural Systems," of the CAR are reviewed for this section of the SER:

- Classification of Civil-Structural Systems.

- Codes and Standards.

- Structural Design Criteria.

11.1.1.1 System Description

The civil structural systems for the MFFF include the buildings, support structures, and facilities that house, support, confine, or contain various plant systems, components, and equipment associated with licensed nuclear materials, or hazardous chemicals associated with licensed nuclear materials, as well as support buildings.

11.1.1.2 Classification of Civil-Structural Systems

The classification outlined in Section 11.1, "Civil Structural Systems," of the CAR consisted of three levels: Seismic Category I, Seismic Category II, and Conventional Seismic Structures. The design loadings considered for the civil structures in each category are:

- Seismic Category I (SC-I)—Normal, severe, and extreme environmental loads, including the design basis earthquake and tornado.
- Seismic Category II (SC-II)—Normal, severe, and design basis earthquake.
- Conventional Seismic (CS)—Normal, severe, and conventional seismic loads as specified by the Uniform Building Code.

11.1.1.1.1 Function

As described in Sections 11.1.1 and 11.1.7 of the CAR, the safety functions for the civil structural systems would be to:

- Support PSSCs during normal, severe, and extreme environmental conditions.
- Provide confinement functions as part of secondary and tertiary confinement systems.
- Protect PSSCs from the effects of normal, severe, and extreme environmental loads.
- Protect PSSCs from the effects of temperature extremes, including design basis internal and external fires.
- Protect PSSCs from the effects of design basis man-induced events, including potential load drops.

11.1.1.1.2 Major Components

The civil-structural systems considered to be Seismic Categories I and II or Conventional Seismic were identified in Section 11.1.3 of the CAR. The major components for each of the seismic categories are shown below.

Seismic Category I structures - included the Mixed Oxide Fuel Fabrication Building (which includes the MOX Processing Area, Aqueous Polishing Area, and the Shipping and Receiving Area) and the Emergency Diesel Generator Building.

Seismic Category II structure - includes the Safe Haven Buildings.

Conventional Seismic structures - includes the Reagent Process Building, Administration Building, Secured Warehouse Building, Technical Support Building, and the Standby Diesel Generator Building and miscellaneous site structures, e.g., the bulk gas storage pad, HVAC pads, and the electric transformer pads, specified in section 11.1.3.9 of the CAR.

A detailed description for each major component is provided in Section 11.1.3 of the CAR.

11.1.1.1.3 Control Concepts

This section is not applicable to civil structural systems.

11.1.1.2 System Interfaces

Civil structural systems interface with the site and all plants systems because they provide protection and support for structures, systems, and components.

11.1.1.3 Design Basis of the PSSCs

11.1.1.3.1 Codes and Standards

This section contains a review of Sections 11.1.6.1.3, “Codes and Standards for SC-II Structures,” and 11.1.7.3, “Codes and Standards for SC-I Structures,” of the CAR.

The designs of the Seismic Category I civil-structural systems and the associated steel and concrete components conform to standard engineering practice. A comprehensive list of the applicable codes and standards was provided in Section 11.1.7.3 of the CAR. American Concrete Institute (ACI) ACI 349.1R–91 (American Concrete Institute, 1996) and American National Standards Institute/American Institute of Steel Construction (ANSI/AISC) N690–1994 would be supplemented by specific provisions. In section 11.1.6.1.3 of the CAR, the applicant referenced the same codes and standards as those for the Seismic Category I structures for the design of the Seismic Category II civil-structural systems except for the American Concrete Institute ACI 349.1R–91, ACI 349–97, ACI 349.2R–97 and ANSI/AISC N690–1994.

The staff reviewed the codes and standards for the designs of Seismic Categories I and II civil-structural systems and concludes that the cited codes and standards are consensus standards and provide reasonable guidance consistent with the categorization assigned to the buildings.

11.1.1.3.2 Structural Design Criteria

This section contains a review of the structural design criteria and load combinations for the civil-structural systems discussed in the CAR.

Structural design loads for Seismic Categories I and II structures were discussed in Section 11.1.7.4, “Values for SC-I Structures” of the CAR. Design criteria and loads anticipated for the structures were divided into three groups: normal loads, severe environmental loads, and extreme environmental loads. The normal loads included dead, live, hydrostatic fluid pressure, lateral soil pressure, thermal, and component reaction loads. The severe environmental loads would include wind and flood loads. The extreme environmental loads would include seismic, tornado, and explosive loads.

11.1.1.3.2.1 Normal Loads

- Dead Loads

  Dead loads were gravity loads induced by the mass of the structure, permanent equipments, and any permanent hydrostatic loads with constant fluid levels. This definition for dead loads is consistent with the American Society of Civil Engineers Standard (ASCE) 7-98, “Minimum Design Loads for Buildings and Other Structures,” (Reference 11.1.3.8) and is acceptable to the staff.

- Live Loads

  Live loads were loads produced by the use and occupancy of the building. The live loads considered for the civil structures of the MFFF include the following: floor; rain; snow and ice; transportation vehicle and heavy floor; and crane, elevator, and hoist loads.

  <u>Floor Live Loads</u>

  The minimum uniformly distributed live loads for the civil structures were established by the applicant in accordance with the ASCE Standard 7-98, “Minimum Design Loads for Buildings and Other Structures,” (Reference 11.1.3.8). Specifically, the floor live loads identified include

Platform and Work Area	125 psf [6.0 kN/m^2]
Light Storage	125 psf [6.0 kN/m^2]
Heavy Storage	250 psf [12.0 kN/m^2]
Heavy Operation	250 psf [12.0 kN/m^2]
Office	100 psf [4.79 kN/m^2]
Computer Room	150 psf [7.18 kN/m^2]
Dining/Meeting Rooms	100 psf [4.79 kN/m^2]
Laboratory	200 psf [9.58 kN/m^2]
Toilet Areas	100 psf [4.79 kN/m^2]
Mechanical (Utility) Rooms	150 psf [7.18 kN/m^2]
Electrical Rooms	150 psf [7.18 kN/m^2]
Stairs, Fire Escapes, and Corridors	100 psf [4.79 kN/m^2]
Roof	50 psf [2.4 kN/m^2]
Transportation Vehicle Loads	300 psf [14.37 kN/m^2] or forklift truck of 6 kips [26.69 kN] capacity

  The staff reviewed the design basis floor live loads discussed in Section 11.1.7.4.1.1 of the CAR and additional information provided in the March 8, 2002, letter (Reference 11.1.3.11) provided by the applicant and determined that the floor live loads and the roof loads are appropriate and acceptable for the design of the MFFF civil structures.

  <u>Rain Loads</u>

  The design basis rain loads for the civil structures were determined by the applicant in accordance with the requirements of the ASCE Standard 7-98 (Reference 11.1.3.8). The design basis rain is 7.4 in/hr [18.8 cm/hr] and 3.9 in [9.91 cm] per 15 min, which correspond to a 100,000 yr recurrence period. The design rain load for the roof system of the Seismic Category I structures is 50 psf [2.4 kN/m^2], which is equivalent to more than 9.6 in [24.4 cm] of standing water on the roof due to deflection of the roof or blockage of the primary roof drains. The staff reviewed the design basis rain load and determined that it is appropriate and acceptable. The staff also agrees with the applicant's March 8, 2002 letter which adds a paragraph to CAR section 11.1.7.4.1.1 that states that "parapets or other structures, which could potentially contribute to significant ponding, are not used on the roofs of SC-1 structures."

Snow and Ice Loads

The design snow and ice load was determined by the applicant to be 10 psf [0.48 kN/m^2]. This value was estimated based on the 100-yr maximum ground snow and ice loads. The staff reviewed the design basis maximum ground snow and ice loads and found that they were determined based on acceptable methods.

Transportation Vehicle Loads and Heavy Floor Loads

The design basis load for transportation vehicular truck traffic in designated building areas was determined in accordance with the standard loadings defined by the American Association of State Highway and Transportation Officials (Reference 11.1.3.1). The minimum truck loading of HS 20–44 is used for wheel-loading design. The heavy floor loading considered in areas used for transportation, transfer, and storage of finished fuel assemblies is 300 psf [14.37 kN/m^2] or forklift truck of 6 kips [26.69 kN] capacity. The staff reviewed the design basis transportation vehicle loads and heavy floor loads and determined that they are appropriate and acceptable.

Crane, Elevator, and Hoist Loads

These design loads apply to structural members and components to support permanently installed cranes, elevators, and hoists. Section 11.1.7.4.1.1 of the CAR stated that the design basis crane, elevator, and hoist loads would envelop the full-rated capacity of the cranes, elevators, and hoists, including impact loads and test load requirements. The staff reviewed the design basis crane, elevator, and hoist loads and found that these design basis loads are appropriate and acceptable.

- Hydrostatic Fluid Pressure Loads

The CAR indicates that no hydrostatic fluid pressure loads caused by fluid held inside the buildings of the Mixed Oxide Fuel Fabrication Facility are currently identified. The staff agrees with this statement. However, if the applicant later determines that there is fluid inside the building of the MFFF, hydrostatic fluid pressure loads should be included in the design.

- Lateral Soil Pressure Loads

Section 11.1.7.4.1.1 of the CAR indicated that determination of the lateral soil pressure loads on structures and/or elements of structures due to retaining soil would be based on the density of the soil and any surcharge load, plus the hydrostatic pressure caused by ground water or soil saturation.

The minimum lateral soil pressure loads on structures and/or elements of structures due to retaining soil are defined in the ASCE Standard 7-98 (Reference 11.1.3.8). Earthquake-induced soil pressure on structures or embedded wall design would be developed in accordance with the ASCE Standard4-98, “Seismic Analysis of Safety-Related Nuclear Structures and Commentary,” (Reference 11.1.3.7).

The staff reviewed the approach presented by the applicant for determining lateral soil pressure loads and found that the approach is based on acceptable standards and engineering practices.

- Thermal Loads

Thermal loads consist of thermally induced forces and moments on structural components of buildings. These loads would result from operation and environmental conditions. The thermally induced loads would be design dependent. Consequently, determination and consideration of these thermally induced loads would be an integral part of a design. For the design of civil-structure systems, the applicant would consider the effects due to thermal expansion loads caused by axial restraint of the structural components and loads resulting from thermal gradients. The applicant also indicated that it would determine these thermally induced loads based on the most critical transient or steady-state condition. The staff reviewed the information presented in the CAR and found that considering thermal expansion loads and thermal gradient loads for the design of civil-structural systems is acceptable.

- Equipment Reaction Loads

The equipment reaction loads included those from pipes; heating, ventilation, and air conditioning ducts; conduits; and cable trays. These loads would be design dependent and need to be assessed during design. The applicant stated that the equipment reaction loads would be determined based on the most critical transient or steady-state condition. The applicant further indicated that it would make sure that the final designs envelop the actual equipment reaction loads. The staff reviewed the information presented regarding consideration of equipment reaction loads in the design and found that the bounding/enveloping approach is acceptable.

11.1.1.3.2.2 Severe Environmental Loads

- Wind Loads

Figure 6-1b in the ASCE Standard 7-98 (Reference 11.1.3.8) identifies a design basis wind speed of 100 mph [160.93 km/hr] for the region. Information provided in Table 11.1-2 of the CAR for the Savannah River Site identified the design basis wind speed of 130 mph [209.22 km/hr], which is higher than the value provided in the ASCE 7-98. The CAR also indicated that the wind loads calculated based on the design basis wind would be determined by the procedures provided in the ASCE 7-98. The approach for determining the wind loads is acceptable to the staff because the approach used is the same or similar to consensus standards approved by the U.S. Nuclear Regulatory Commission (NRC) staff.

The applicant also includes the consideration of wind-borne missiles in the design of the civil-structure systems. The missile considered is a 15-lb [6.82-kg] 2- by 4-in [5.08- by 10.16-cm] timber plank that impacts at a 50-mph [80.47-km/hr] horizontal wind and a maximum height of 50 ft [15.24 m]. Considering the effects of wind-borne missiles in the design is consistent with the ASCE Standard 7-98 (Reference 11.1.3.8), which requires inclusion of design for wind-borne debris in areas where the basic wind speed is equal to or greater than 120 mph [193.12 km/hr]. The inclusion of wind-borne missiles in the design is acceptable to the staff because it meets the guidance provided in ASCE 7-98.

- Flood Loads

The maximum probable flood level for the site is at elevation 224.5 feet [68.43 m] above mean sea level. The corresponding site grade level is approximately 272 feet [82.91 m] above mean sea level. Because the site grade level is much higher than the maximum probable flood level at the site, the proposed MFFF is considered to be a flood-dry site and will be free from the adverse effects of the maximum probable flood. Consequently, the loads due to flood water do not need to be considered in the design of civil structure systems. Analysis of the maximum probable flood level was based on the surface hydrology of the region and potential dam failure due to seismic events given in Section 1.3.4.2, “Floods,” of the CAR.

The staff reviewed the discussion regarding the flood loads and concludes that the facility design is consistent with the design criteria of Regulatory Guide 3.40 (Reference 11.1.3.19) and the approach used for conducting the flood analysis is consistent with that outlined in Section 5.1.3 of the American National Standards Institute/American Nuclear Society (ANSI/ANS) Standard 2.8-1992, determining design basis flooding at power reactor sites (Reference11.1.3.6) therefore, the information provided is acceptable to the staff.

11.1.1.3.2.3 Extreme Environmental Loads

- Seismic Loads

Table 11.1-2 and Section 1.3.6, “Seismology,” of the CAR listed the design basis earthquake ground motions based on probabilistic seismological studies specific to the Savannah River Site. The applicant’s design basis horizontal and vertical response spectra for the Mixed Oxide Fuel Fabrication Facility were developed based on the Regulatory Guide 1.60 (Reference 11.1.3.16) horizontal and vertical spectrum shapes anchored at a peak ground acceleration of 0.20 g. A more detailed discussion on the applicant’s design spectra is provided in Section 1.3.1.5.5 of this SER.

According to the CAR, the design seismic loads for the Seismic Category I structures of the MFFF would be determined by considering the design basis earthquake accelerations in the three orthogonal directions (two horizontal and one vertical).

To support soil-structure interaction analysis, synthetic time histories for the three components of the design basis ground motion would be generated. The response spectra of the synthetic time histories would envelop the design response spectra and meet the minimum power spectral density requirement in accordance with the criteria in Section 3.7.1, “Seismic System Analysis,” of NUREG–0800 (Reference 11.1.3.13) according to the CAR.

Three-dimensional lumped mass stick models representing the building characteristics and the assumption that the roofs and floors are rigid diaphragms would be used for the soil-structure interaction analysis of the Seismic Category I civil structures.

According to the CAR, the soil model for the soil-structure interaction analysis would include a soil model of a sufficient number of idealized soil layers from the ground surface to the bedrock. This soil model was developed using the information from the soil exploration and site-response analysis. The structural damping values used in the analysis would be in accordance with Regulatory Guide 1.61 (Reference 11.1.3.17) for a safe shutdown earthquake and are acceptable to the staff. From the soil-structure interaction analysis, the response spectra at the foundation and each floor and roof level would be obtained for developing acceleration profiles for building design.

Three soil conditions (lower-, best-, and upper-bound) accounting for material property uncertainties would be considered in the soil-structure interaction analysis to develop the in-structure response spectra at each direction and a given structural level. A broadening of the spectrum peak(s) by 15 percent would then be applied to the spectrum envelope to account for structural material properties. The staff determined that the approach for consideration of uncertainties associated with structural and soil material properties is consistent with the design guidance in Regulatory Guide 1.122 (Reference 11.1.3.15).

The fundamental mode frequency for the stick model in each ground motion direction would closely match the corresponding modal frequency of a three-dimensional finite element structural model based on the structural drawings. The three-dimensional finite element model would be used for conducting a static analysis using the acceleration profiles developed from the three-dimensional soil-structure analysis. The acceleration profiles that envelope the acceleration profiles from the three soil conditions would be used for finite element analysis.

For Seismic Category I civil structures, the results from the equivalent static three-dimensional finite element analysis based on the acceleration profiles applied in the three directions would be combined using the 100–40–40 percent rule as described in Section 3.2.7.1.2 of the ASCE Standard 4-98 (Reference 11.1.3.7).

For other structures, the approach of applying the applicable seismic response to the base of the finite element models may be used. Guidance provided by Regulatory Guide 1.92 (Reference 11.1.3.18) and the ASCE 4-98 would be used for combining modal responses and collinear responses from the individual earthquake components.

The staff reviewed the approach presented by the applicant for determining the seismic loads and found the approach to be acceptable.

- Tornado Loads for Seismic Category I Structures

Table 11.1-2 of the CAR provided the design basis tornado wind speed, atmospheric pressure change, and rate of pressure drop. In determining design tornado loads, the procedure provided in the ASCE Standard 7-98) (Reference 11.1.3.8) would be used. The staff reviewed the approach presented by the applicant and found the approach to be acceptable based on the guidance provided in ASCE 7-98. The three types of tornado loads on the MFFF structures are the following:

<u>Tornado Wind Pressure Loads</u>

The tornado wind pressure loads are defined in Table 11.1-2 of the CAR. These pressure loads are based on section 6 of the ASCE 7-98, which is an industry consensus standard that has been accepted by the staff therefore, the information presented is acceptable to the staff.

Tornado-Created Differential Pressure Loads

The tornado-created differential pressure loads are defined in Table 11.1-2 of the CAR. These pressure loads are based on guidance provided in NUREG-0800, Section 3.3.2, therefore, it is acceptable to the staff.

Tornado-Generated Missile Loads

The design basis for tornado-generated missiles were presented in Table 11.1-2 of the CAR. In Section 11.1.7.2.1.2 of the CAR, the applicant stated that the analysis for tornado-generated missiles was complete. However, in the March 8, 2002, letter, the applicant stated that the CAR incorrectly implied that the analysis for tornado-generated missiles had been completed. The applicant revised the CAR to say that the analysis will be completed in the final design. The design bases for tornado-generated missiles are appropriate and acceptable to the staff because they are based on guidance provided in NUREG-0800, Sections 3.5.3 and 3.5.2. It is also acceptable to the staff that the applicable will complete the tornado-generated missiles analysis in the final design.

Text removed under 10 CFR 2.390.

- Site Proximity Missile (Except Aircraft) Load

  The applicant indicated that the distance from the nearest transportation route to the MFFF and the Emergency Diesel Generator Buildings is greater than the safe distance established based on the available inventories of hazardous materials. Therefore, the effects of explosion generated missiles from the transportation route were not a concern for design. Furthermore, the applicant stated that analyses to identify site proximity missiles that might be generated from events within the safe distance are currently being performed (Reference 3.1.3.11). The applicant intends to demonstrate that the effects of these missiles are bounded by the design of the Mixed Oxide Fuel Fabrication Facility through calculations and security studies. This approach is acceptable to the staff.

- Foundation Design Criteria

  Foundation design criteria were discussed in a MFFF site geotechnical report (Reference 11.1.3.10) supporting the CAR. The Mixed Oxide Fuel Fabrication Building has two foundation levels: main level and sublevel. The sublevel is for the Aqueous Polishing Area. The foundations for the Mixed Oxide Fuel Fabrication Building will be 4 feet [1.22 m] thick and they will be 2 feet [0.61 m] thick for the Emergency Diesel Generator Building. Some soils at the foundation locations will be removed and replaced with engineered structural fill. Approximately 10 feet [3.05 m] of the engineered fill material will be placed beneath the Mixed Oxide Fuel Fabrication Building and approximately 5 feet [1.03 m] beneath the Emergency Diesel Generator Building. The engineered fill will be extended at least 10 feet [3.05 m] beyond the edges of the foundations, and will be compacted to at least 95 percent of the maximum density.

The allowable static bearing pressure to prevent bearing capacity failure at the edge of the foundation mat was estimated to be 60 ksf [2.87 MPa] in the below grade areas and 30 ksf [1.44 MPa] for the portion of the structure at grade. For the final design, a minimum factor of safety of 3.0 will be maintained for the design static loads and a safety factor of 1.1 will be maintained for the combination of design static loads and seismic loads due to the design basis earthquake or wind loads due to the design basis tornado. The staff reviewed the estimated bearing capacities and found the values provided are acceptable. Also, the minimum safety factors to be used to limit the allowable design loads are acceptable to the staff. Effects of settlements of soil beneath the engineered fill are addressed in a separate analysis.

- Settlements

The MFFF site geotechnical report (Reference 11.1.3.10) correctly pointed out that the critical foundation load condition that limits the allowable foundation bearing capacity will be settlement. The settlements at the site come from two potential sources: compaction of soft soil materials, including soft zones, and localized liquefaction.

Two methods were used to estimate settlements for the Seismic Category I structures: recompaction indices and numerical modeling. The estimated settlement based on the recompaction indices for the Mixed Oxide Fuel Fabrication Building was approximately 1.4 inches [3.56 cm] at the edge of the foundation and 2.5 inches [6.35 cm] at the center of the foundation. The numerical modeling considered both the best and lower estimates of the engineered fill material properties. All soft zones and soft material locations were included in the cross sections of the soil profiles modeled. The numerical modeling results indicated that the settlements estimated using the best-estimate engineered fill properties were more comparable to those from the recompaction indices. The settlement results using the best-estimate engineered fill properties were recommended by the applicant to evaluate the Seismic Category I structures for total and differential effects during design.

The staff reviewed the information presented in the site geotechnical report regarding settlement analysis and determined that the suggested approach for estimating settlement effects during design is acceptable because it is based on current industry guidance and analysis techniques.

The post-earthquake dynamic settlement of the potentially liquefiable soil was estimated in the MFFF Site Geotechnical Report (Reference 11.1.3.10) based on the design basis ground motion and the 1886 Charleston motion. The settlement ranged from 0 to 1.7 inches [4.32 cm] for the design basis ground motion and 0 to 1.9 inches [4.83 cm] for the 1886 Charleston motion. The applicant indicated that these dynamic settlements might occur in loose or soft strata below the groundwater level, at a depth of 60 feet [18.29 m] or more. There are two significantly stiffer soil layers more than 40 feet [12.19 m] thick between the potentially liquefiable zones and the foundations. According to the site geotechnical report (Reference 11.1.3.10), these two soil layers would tend to redistribute the estimated dynamic settlement such that no significant differential settlement would occur at the foundation level.

The staff reviewed the information presented in the site geotechnical report regarding the dynamic settlements and concur that the post-earthquake-induced dynamic settlements due to localized liquefaction will not create stability problems for the foundations for the Seismic

Category I structures.

- Aircraft Crash Hazard

  As discussed in Section 1.1.1.9 of this SER, the estimated total aircraft crash probability per year including those induced by the federal airways and Savannah River Site helicopters for the MFFF Building was 2.99×10^{-8} and 6.67×10^{-8} for the Emergency Diesel Generator Buildings based on the applicant's calculation. Each of the estimated probability was smaller than the 10^{-7} annual probability of unacceptable radiological consequences indicated in Section 3.5.1.6 of NUREG–0800 (Reference 11.1.3.13). As a result, the applicant concluded that aircraft crash hazards at the MFFF is not a design concern.

  The staff reviewed the summary of the ongoing aircraft hazard analysis provided by the applicant and found the analysis was based on past data. The results of this analysis are not sufficient to address the risk for the facility because the analysis did not include consideration of hazards due to projected flight activities during the service life of the facility. The projected flight activities could be potentially different from those recorded in the past, thus, may pose a different risk to the MFFF. This risk needs to be assessed and factored into the design if the risk is determined to be significant.

- Load Combinations

  The load combinations for both Seismic Categories I and II civil structures were determined using NUREG–0800 (Reference 11.1.3.13), Section 3.8.4, "Other Seismic Category I Structures," as a guide. Tornado, tornado missile, and explosion loads will not be considered in the load combinations of Seismic Category II structures. The staff reviewed the various load combinations presented in Section 11.1.7.4.2.1, "Loading Combinations for SC-I Concrete Structures," and Section 11.1.7.4.2.2, "Loading Combinations for SC-I Steel Structures," of the CAR and determined that these load combinations are the same as those suggested in the NUREG–0800 (Reference 11.1.3.13) for the design of structures, therefore, the load combinations are acceptable to the staff.

11.1.2 EVALUATIONS FINDINGS

In Section 11.1 of the CAR, DCS provided design basis information for civil-structural systems that it identified as PSSCs for the proposed MFFF. Based on the staff's review of the CAR and supporting information provided by the applicant relevant to civil-structural systems, the staff finds that due to the open items discussed above and listed below, DCS has not met the BDC set forth in 10 CFR 70.64(a)(4). Further, until the open items are closed, the staff cannot conclude, pursuant to 10 CFR 70.23(b), that the design bases of the PSSCs identified by the applicant will provide reasonable assurance of protection against natural phenomena and the consequences of potential accidents.

The following are open items in Section 5 that are related to civil-structural:

- The aircraft hazard analysis provided by the applicant is insufficient to exclude the consideration of aircraft impact load from the design of Seismic Category I structures with reasonable assurance because it did not consider the projected flight information that could affect the site. (SA-3)(Sections 5, 11.1.1.3.2.3)

- The statement that any dynamic overpressure involved in an explosion near the MFFF is not greater than 10 psi [6.9 kPa] is not supported by an acceptable technical basis. (SA-2)(Sections 5, 11.1.1.3.2.3)

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