Enclosure 8 to E-55362

SAR Changed Pages

(Public Version)

1.2.2 Principal Design Criteria

The WCS CISF principal design criteria are based on the site characteristics, the design criteria associated with the cask systems listed in Table 1-1 that have been previously approved by the NRC, and specific criteria required for the WCS CISF design.

The cask systems listed in Table 1-1 meet the WCS CISF design criteria. Table 1-2 provides a summary of the WCS CISF principal design criteria.

1.2.3 Facility Descriptions

The major facilities at the WCS CISF are the Cask Handling Building and the storage area. The Cask Handling Building is approximately *175* feet long by *193* feet wide by *72* feet high. The building is a two-bay steel structure designed to support two commercial overhead cranes used to move transportation casks from the rail car to the transport vehicle. One bay of the building will house the Canister Transfer System described in Section 1.3.1.2 and the other bay will be available for direct transfer of transportation casks from the rail car to the transport vehicle. A 2,400 square foot area of the building is set aside for cask storage. The building plan view is shown in Figure 1-7. Figure 1-8 is a section through the building showing the overhead crane location. Air monitors and dosimeters are located in the building for monitoring purposes. The building is not designed or intended to provide confinement or shielding for SNF or GTCC materials. The building is classified as ITS - Category *B*. The purpose of the Cask Handling Building is to receive and prepare for storage shipments of dual-purpose canister systems. It will also receive GTCC waste canisters for storage at the site. It is also designed to process canisters stored at the site for off-site shipment. The Cask Handling Building is designed to handle canisterized material and does not have the capability to handle bare fuel.

As Low As Reasonably Achievable (ALARA) principles are incorporated, to the maximum extent practical, throughout the facility design to reduce radiation exposure to facility personnel. Cranes/lifting devices for transferring the NUHOMS® transportation/transfer casks from the transportation skid to the transfer trailer/skid are designed to minimize the need for facility personnel to be near the loaded cask. This equipment is NITS as the lift heights of the loaded casks are maintained below 80 inches at all times after removal of the impact limiters. The analysis of bounding drop scenarios shows that a NUHOMS® transportation/transfer cask will maintain structural integrity of the DSC confinement boundary and maintain basket geometry from an 80 inch (from the bottom of the cask to the “ground”) drop. The ITS canister transfer system for the vertical transfer of canisters is remotely operated and the transfer equipment used to make the transfer to the storage overpacks is substantially identical to that used to transfer the canister into dry storage at the reactor facilities where the material was initially stored.

All Indicated Changes are in response to RAI NP-3-5

Table 1-2
Summary of WCS CISF Principal Design Criteria
(3 pages)

Design Parameter	Design Criteria	Condition	Applicable Codes, Standards and Basis
Extreme Temperature (NAC Systems)	Maximum Temperature 113°F Minimum Temperature -1°F	Accident	Section 2.3.3.1
Snow and Ice	Snow Load 10 psf	Normal	Section 2.3.2.4
Dead Weight	Per design basis for systems listed in Table 1-1	Normal	N/A
Internal and External Pressure Loads	Per design basis for systems listed in Table 1-1	Normal	N/A
Design Basis Thermal Loads	Per design basis for systems listed in Table 1-1	Normal	N/A
Operating Loads	Per design basis for systems listed in Table 1-1	Normal	N/A
Live Loads	Per design basis for systems listed in Table 1-1	Normal	N/A
Radiological Protection	Public wholebody ≤ 5 Rem Public deep dose plus individual organ or tissue ≤ 50 Rem Public shallow dose to skin or extremities ≤ 50 Rem Public lens of eye ≤ 15 Rem	Accident	10 CFR 72.106
Radiological Protection	Public wholebody ≤ 25 mrem/yr (1) Public thyroid ≤ 75 mrem/yr(1) Public critical organ ≤ 25 mrem/yr(1)	Normal	10 CFR 72.104
Confinement	Per design basis for systems listed in Table 1-1	N/A	N/A
Nuclear Criticality	Per design basis for systems listed in Table 1-1	N/A	N/A
Decommissioning	Minimize potential contamination	Normal	10 CFR 72.130
Materials Handling and Retrieval Capability	Cask/canister handling system prevent breach of confinement boundary under all conditions Storage system allows ready retrieval of canister for shipment off-site	Normal	10 CFR 72.122(1)
Cask Handling Building	Prevent building collapse *under design-basis tornado and tornado-generated missile loading, prevent building collapse under design-basis seismic loading*	Accident	*Section 7.5.3.2*

Note:

1. In accordance with 10 CFR 72.104 (a)(3) limits include any other radiation from uranium fuel cycle operations within the region.

All Indicated Changes are in response to RAI NP-7-9

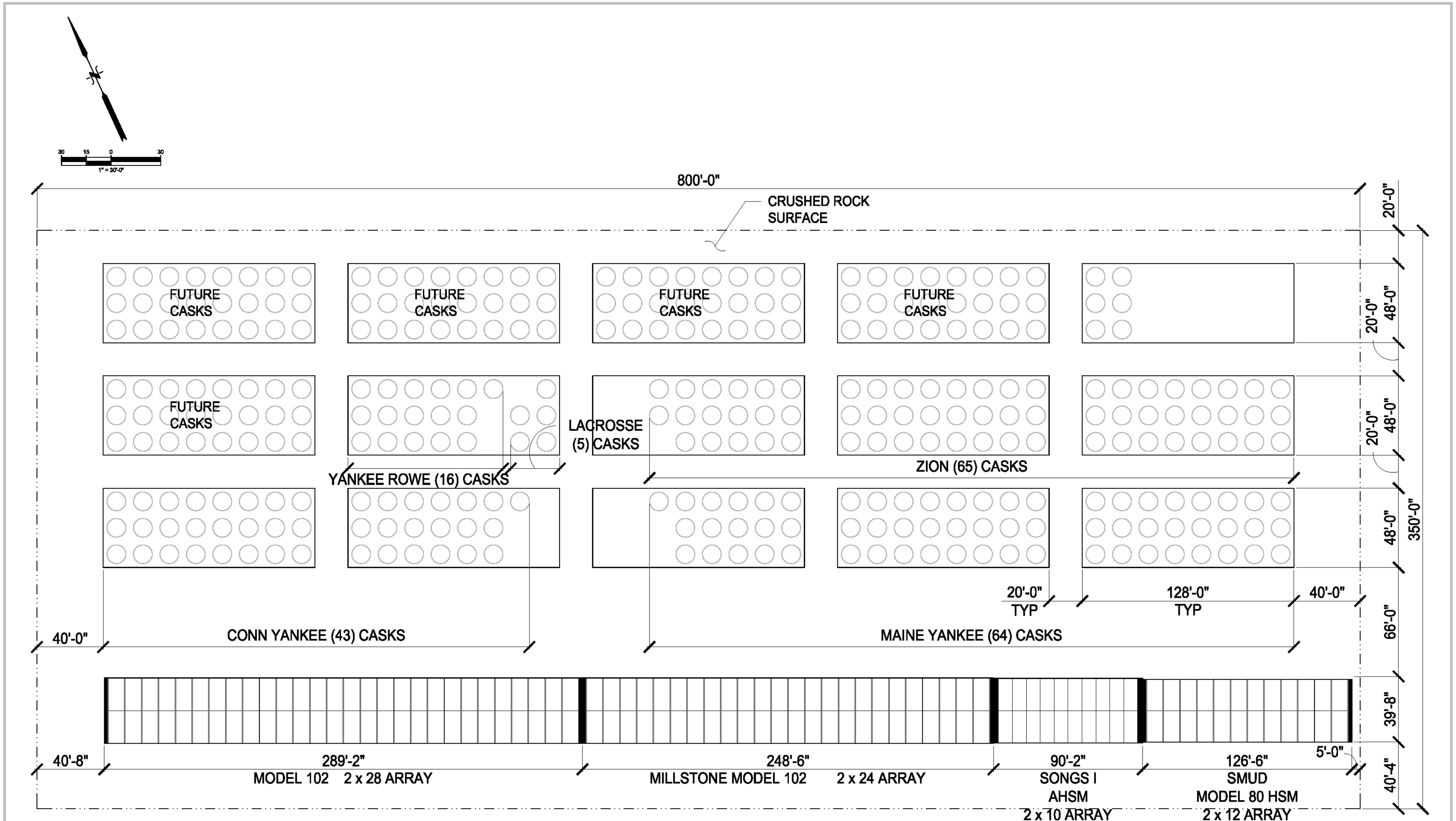


Figure 1-6
WCS CISF Storage Pad Layout

All Indicated Changes are in response to RAI P-9-4

2.2 Nearby Industrial, Transportation and Military Facilities

The only industrial facilities located within *five* mile of the WCS CISF boundary are URENCO USA, Permian Basin Materials*, the Lea County landfill, a future travel stop* and Sundance Services, Inc. (Figure 2-3). URENCO USA is a uranium enrichment facility that uses centrifuge technology to provide uranium enrichment services. Waste Control Specialists operates several permitted and licensed facilities immediately south of the WCS CISF, including a RCRA landfill, a low-level radioactive waste facility and a byproduct materials landfill. *The WCS Facilities include several fuel (diesel, gasoline, and propane) tanks used for fueling heavy equipment and facility operations. Tanks range in size from 350 gallons to 8,000 gallons. These tanks are identified in Table 2-20.* RAI NP-12-4

RAI NP-12-3

Permian Basin Materials operates a quarry and crushing operation, wherein caliche, sand and gravel are mined, crushed and screened for commercial sales and used in making concrete (Permian, 2016[2-29]). *Occasional blasting is a normal part of quarry operations. Accident hazards associated with blasting activities are evaluated in SAR Chapter 12.* Sundance Services, Inc. provides oilfield waste disposal services. Sundance Services is authorized by the New Mexico Energy, Minerals and Natural Resources Department to operate the waste oil treating plant, and also manages produced water, solids and drilling muds. Sundance Services is also authorized to landfarm solids (Sundance, 2016[2-30]).

The Lea County (New Mexico) Municipal Landfill is located to the southwest and across New Mexico Highway 234 from WCS CISF. This landfill disposes of municipal solid waste for the Lea County Solid Waste Authority under New Mexico Environmental Department Permit Number SW-98-08(P). The landfill services Lea County and its municipalities. The Lea County Municipal Landfill does not generate or receive hazardous waste (Lea, 2016[2-16]).

Construction has started on a travel stop operated by Love's Travel Stops & Country Stores located at the intersection of New Mexico State Highway 18 and Hwy 176. This facility, which will provide fuel for highway vehicles, is located more than 3.5 miles from the WCS CISF.

DD Landfarm, a non-hazardous oilfield waste disposal facility that closed in August 2013 and is undergoing decommissioning and post-closure monitoring, is located approximately 4 km (2.5 miles) west of the proposed WCS CISF.

There are no military facilities within a mile of the WCS CISF. The closest military facility is Cannon Air Force Base is the closest at a distance of approximately 135 miles.

Table 2-20
Waste Control Specialists Facility Fuel Tank Capacity and Proximity

Waste Control Specialists Facility Fuel Tank Description	***Capacity (gal)***	***Distance to CISF PA[1] (ft)***
Treatment Storage and Disposal Facility Propane Tank	*1,000*	*4,950*
Mixed Waste Treatment Facility Propane Tank	*5,000*	*4,340*
Mixed Waste Treatment Facility Gasoline Tank	*5,000*	*4,400*
Mixed Waste Treatment Facility Diesel Tank (Red)	*8,000*	*4,400*
Mixed Waste Treatment Facility Diesel Tank (Green)	*500*	*4,400*
Low-Level Radioactive Waste Facility Diesel Tank	*3,484*	*3,025*
Treatment Storage and Disposal Facility Fire Pump (Diesel)	*850*	*5,000*
Low-Level Radioactive Waste Facility Generator (Diesel)	*310*	*2,970*
Low-Level Radioactive Waste Facility Fire Pump (Diesel)	*850*	*2,750*
Security Generator (Diesel)	*350*	*5,550*
Mixed Waste Treatment Facility Generator (Diesel)	*280*	*4,500*
NOC Generator (Diesel)	*350*	*4,500*

Note 1: Protected Area (PA)

Lateral Soil Pressure	X	X	
Thermal Loads	X	X	X
Explosion Overpressure			X
Drop/Tipover			X
Accident Pressurization			X
Fire			X
Tornado Wind/Missiles			X
Floods			X
Earthquake			X

Design criteria for these loads are described in this chapter and are used in the design of all SSCs classified as ITS. The SSCs that are classified as ITS are discussed in Section 3.4.

The NUHOMS® and vertical storage system design criteria are fully described in Appendices A-G. Chapter 12 addresses site specific accident conditions and Table 12-1 provides a cross-walk that points to the appropriate Appendix for each authorized canister/cask system.

3.2.1 Tornado and Wind Loadings

The design of SSCs considers the loads resulting from tornado and extreme wind. The design basis tornado is presented in Table 1-2. Design basis tornado characteristics are based on NRC Regulatory Guide 1.76 [3-2], and NUREG-0800 [3-3].

3.2.1.1 Applicable Design Parameters

The facility, except the cask storage system components, is designed for wind velocities of *120* mph as shown in *Figure 26.5-1D of ASCE 7-16 [3-35]*. The design basis wind is defined as a 3-second gust for Exposure C category.

The cask storage systems are designed to withstand a tornado from Region II as defined by Regulatory Guide 1.76 [3-2]. The design basis tornado characteristics for Region II are listed in Table 1-2.

3.2.1.2 Determination of Forces on Structures

Forces on structures from the design basis wind and the design basis tornado are addressed in the design. The method used to convert wind loading into forces on a structure is in accordance with NUREG-0800 (Section 3.3.1, Wind Loadings, and Section 3.3.2, Tornado Loadings) [3-3].

All Indicated Changes are in response to RAI NP-7-9

3.2.1.3 *Not Used*

3.2.1.4 Tornado Missiles

SSCs that are classified as ITS are designed for tornado-generated missiles. The loaded storage overpacks are designed to remain stable and to maintain the confinement boundary when subjected to tornado-generated missiles. *The Cask Handling Building (CHB) is designed to withstand tornado-generated wind loading and missiles without collapse so as to prevent reducing packaging effectiveness of casks contained within. Preventing penetration of tornado-generated missiles is not considered a CHB structural design requirement, as the casks themselves are designed to withstand these impacts.* Tornado-generated missiles are not required to be considered in the design of the canister since the canister is protected by the storage overpack.

Tornado missile load conditions are based on the design basis tornado addressed in Section 3.2.1.1. The evaluation cases required by NUREG-0800, Section 3.5.1.4 [3-3] include at least three objects as potential tornado missiles: a massive high kinetic energy missile which deforms on impact, a rigid missile to test penetration resistance, and a small rigid missile of a size sufficient to just pass through any openings in protective barriers. Tornado missile load cases are established in Table 1-2.

3.2.2 Water Level (Flood) Design

The WCS CISF is located in Andrews County, Texas which has a semi-arid climate with approximately 16 inches of rain per year. There are no lake systems or flowing or intermittent streams nearby.

3.2.2.1 Flood Elevations

The Probable Maximum Flood (PMF) elevation established in the Floodplain analysis (Chapter 2, Attachment B) is 3488.9 ft msl at the WCS CISF. The elevations of the storage pads vary with the lowest point being 3489 ft msl. The finish floor elevation of the CHB is 3493 ft msl and the finish floor elevation of the Security and Administration Building is 3496 ft msl.

Table 3-1 provides the cross reference to the applicable appendix for each canister/storage overpack for the systems authorized for storage at the WCS CISF. In general, these systems are designed to withstand severe flooding, including full submergence as described in the reference appendices in Table 3-1 for each system. However, the WCS CISF site will remain dry in the event of a flood because the site location and site grade is above the elevation of the PMF from offsite sources as documented in Section 2.4.2.2. The site area is designed to assure adequate drainage for heavy rainfall, including the 100-year event. Therefore, a flood event will not impact SNF and GTCC waste storage or transfer operations.

3.2.2.2 Phenomena Considered in Design Load Calculations

SSCs are not in a floodplain and are above the PMF elevation. Therefore, they are not required to consider flood design loads.

3.2.2.3 Flood Force Application

SSCs are not in a floodplain and are above the PMF elevation. Therefore, they are not required to consider flood design loads.

3.2.2.4 Flood Protection

SSCs are not in a floodplain and are above the PMF elevation. Therefore, they are not required to consider flood design loads.

3.2.3 Seismic Design

The design of SSCs classified as ITS consider loadings based on the WCS CISF design basis ground motion, which was determined by a probabilistic seismic hazard analysis (PSHA) as discussed in Section 2.6. Probabilistic analysis does not result in the determination of a unique Design Earthquake, such as is the case for a deterministic analysis. Instead, several scenarios and models are used to estimate the likelihood of earthquake ground motions at a site and systematically take into account uncertainties that exist in various hazard parameters. The outcomes are in the form of hazard curves that show the mean annual probabilities or frequencies with which various levels of fault displacement and ground motion are expected to be exceeded.

3.2.3.1 Input Criteria

Andrews County is located within the Southern Great Plains physiographic and tectonic province. As described in Section 2.6, a PSHA was performed to establish the appropriate seismic design basis for the facility. A return period of 10,000 years was determined to be appropriate.

Section 2.6.2 documents the evaluation that demonstrates that the ground surface design response spectrum peak horizontal acceleration for 0.01 seconds is 0.25 g and the vertical is 0.175 g.

To estimate ground motions, four Next Generation of Attenuation (NGA)-West2 ground motion prediction models for the western U.S. (WUS) and the EPRI [3-32] models for the central and eastern U.S. (CEUS) were utilized. For the NGA-West2 models, a time-averaged shear wave velocity (VS) in the top 100 ft (VS30) of 760 m/sec was used. The EPRI [3-32] ground motion models are defined for hard rock or a VS30 of 2,830 m/sec and greater. It is unclear whether the site area should be considered a tectonically active region like the WUS or a stable continental region like the CEUS. It may likely be located in a transition between the WUS and CEUS.

All Indicated Changes are in response to RAI NP-7-10

3.2.3.3 Design Response Spectra Derivation

The seismic analysis for the CISF swas performed to be consistent with 10 CFR 72.103 [3-23], U.S. Nuclear Regulatory Commission's NUREG- 0800 "Standard Review Plan (SRP) for the Review of Safety Analyses Reports for Nuclear Power Plants: LWR Edition" [3-3] and NUREG/CR-6728 "Technical Basis for Revision of Regulatory Guidance on Design Ground Motions: Hazard- and Risk-Consistent Ground Motion Spectra Guidelines" [3-25].

3.2.3.4 Design Time History

Consistent with NRC requirements, horizontal and vertical DRS for a 10,000 year return period and associated strain-compatible properties were developed and provided for the SSI analysis. Three three-component sets of time histories were developed through spectral matching. A final report was produced that describes and summarizes the above analyses in Chapter 2, Attachment D. All calculations were performed in accordance with AECOM's NQA-1 Program. Detailed calculations are contained in calculation WCS-12-05-200-001 in Chapter 2 Attachment D.

Design time histories are used to verify all required components are considered acceptable. Chapter 7 includes further details.

3.2.3.5 Use of Equivalent Static Loads

Chapter 7 of the SAR details the load analyses used in the seismic design and analysis.

RAI NP-3-6

For the Vertical Storage Systems storage pad *and the NUHOMS® NITS storage pad,* the soil material properties used are the static properties, equal to or lower than the dynamic soil properties and, therefore, conservative for use in an equivalent static analysis. The soil properties used in the equivalent static *analyses* for the Vertical Storage System storage pads *and the NUHOMS® NITS storage pads* are given in Appendix C of [3-33] and are listed in Table 7-38.

RAI NP-3-1

The design criteria used for the Canister Transfer System (CTS) is specified in ASME NOG-1, Section 4000 [*3-34*]. All of the load combinations identified in paragraph 4140 have been evaluated. Controlling load combinations have been used to determine component stresses and then are compared to applicable allowable stresses. The sum of simultaneously applied loads (static and dynamic) do not result in stress levels which would cause any permanent deformation, and thus, the CTS fully meets the requirements of ASME NOG-1 [*3-34*].

RAI NP-7-10

CHB structural steel components are analyzed and designed *using static* analysis methods for determining forces and moments on structural steel members as a result of applied service loading conditions. Dynamic analysis methods are used for determining structural steel member forces and moments for factored loading conditions where structural components are subjected to seismic loads.

Seismic analysis information for the NUHOMS® and Vertical Storage System design criteria are fully described in Appendices A.3, B.3, C.3, D.3, E.3, F.3 and G.3.

3.2.3.6 Critical Damping Values

Critical damping values are in accordance with Regulatory Guide 1.61 [3-27] for a SSE.

3.2.3.7 Basis for Site-Development Analysis

Site-specific vibratory ground motion is determined through evaluation of the seismology, geology, and the seismic and geologic history of the site and surrounding region. This information is contained in the site-specific PSHA (Chapter 2, Attachment D).

3.2.3.8 Soil Supported Structures

The soil supported structures that are analyzed for the CISF design basis ground motion are the ITS Storage Pads*, the CTS, and the CHB.*

3.2.3.9 Soil-Structure Interaction

Soil-structure interaction (SSI) is considered in the design of the storage pads and the CTS. *Assessment of the site soil properties and the CHB dynamic response indicates that Soil-Structure Interaction (SSI) effects are minimal, such that the criteria of ASCE 4-16 Section 5.1.1 can be applied to justify fixed-base analysis in lieu of detailed SSI analysis. Refer to Section 7.5.3.2.* The soil-supported structures requiring SSI are evaluated by considering the properties and effects of the subsurface established during the geotechnical investigation (Chapter 2, Attachment E). Soil boring logs and soil properties of the WCS CISF site are contained in Chapter 2, Attachment E.

3.2.3.10 Seismic-Systems Analysis

3.2.3.10.1 Seismic Analysis Methods

Seismic Analysis for SSCs designated ITS can be found in Chapter 7.

3.2.3.10.2 Natural Frequencies and Response Loads

A modal analysis studies the dynamic properties of structures under vibrational excitation and determines modes of the structure defined by natural frequencies and other factors. Response loads are developed based on the response-spectrum analysis at the appropriate frequencies.

All Indicated Changes are in response to RAI NP-7-10

3.2.8.1 NUHOMS® and Vertical Cask Systems

The NUHOMS® storage systems and the Vertical storage systems are designed to provide long-term storage of SNF. The canister materials are selected to protect against degradation during the storage period, including the application of system specific aging management programs.

3.2.8.2 Cask Storage Pad Load Combinations

The storage pads for the Vertical system storage modules are ITS. Load combinations are provided in Section 7.6.1.4.

3.2.8.3 Canister Transfer System

The CTS is ITS. Load combinations are in accordance with ASME NOG-1 [3-34].

3.2.8.4 Cask Handling Building Load Combinations

RAI NP-3-5

The CHB is a structural steel building with metal siding. The building will support two overhead cranes *(themselves evaluated in accordance with NOG-1-2015 [3-36])* and consider their effects on loading combinations. The design of the structure is in accordance with *nuclear facility codes.* The design will consider load combinations as required by *these codes*. Section 7.5.3 provides additional information on the CHB design criteria.

3.2.8.5 Cask Handling Building Foundation

RAI NP-7-11

The foundation for the CHB is a conventional mat foundation of reinforced concrete construction. *Loads, load combinations, load factors,* and allowable stresses used in the design *are* in accordance with *ACI 349-13, refer to Section 7.5.3.2.3*.

3.2.8.6 Cask Handling Building Cranes

The overhead bridge cranes are classified as Not-Important-to-Safety (NITS), *with the exception of seismic clips and runway beams and supports, but are* designed *as Single Failure Proof (SFP)* in accordance with *ASME NOG-1-2015, "Rules for Construction of Overhead Gantry Cranes (Top Running Bridge, Multiple Girder)" [3-36] for defense in depth*. The overhead bridge cranes rails are attached to the CHB structure in a manner that provides adequate assurance that the rails will remain attached to the CHB structure. The cranes are procured and designed to follow the loading conditions and combinations established in *NOG-1-2015*.

There is a fire suppression system in the CHB that is installed to mitigate the consequences of a fire.

WCS CISF initiated explosions are not considered credible since no explosive materials are present. The effects of externally initiated explosions are bounded by the design basis tornado generated missile load analysis performed for the authorized storage systems.

3.3.7 Material Handling and Storage

This section of the principal design criteria establishes requirements that satisfy 10 CFR 72.128(a) and (b) [3-23], which identify general design criteria that requires SNF storage and handling systems be designed to ensure adequate safety under normal and accident conditions and that radioactive waste treatment facilities be provided.

3.3.7.1 Spent Fuel or High-Level Radioactive Waste Handling and Storage

To meet WCS CISF functional requirements to receive, transfer, store and retrieve canisterized SNF and GTCC waste, the following criteria are established for the WCS CISF design.

Storage and handling systems are designed to allow ready retrieval of the canisters for shipment off-site, and the cask/canister handling systems are designed in accordance with 10 CFR 72.128(a) [3-23] to ensure adequate safety under normal and accident conditions. The following criteria for cask systems are also satisfied.

- Cask systems are designed and certified to withstand a drop event from heights specified in the Technical Specifications [3-1] for each individual system. WCS CISF operation procedures and limitations ensure casks are within these heights.
- Cask systems designed to transfer canisters are designed to withstand the impact of the postulated tornado missiles during transfer operations. For this event, "designed to withstand" is defined as no impact on ITS functions except the following: A partial loss of shielding is allowed to the extent evaluated.
- Cask systems utilizing vertical transfer must be qualified for a 6-inch drop of the storage overpack or transportation cask lid during transfer operations.

The CHB cranes and associated cask/canister lifting equipment are designed utilizing the standards identified in the Technical Specifications [3-1].

3.3.7.2 Radioactive Waste Treatment

Radioactive contamination is anticipated to be negligible because SNF and GTCC waste is packaged in sealed canisters. Small volumes of solid radioactive wastes are expected. Waste will be managed in accordance with Section 3.3.7.3.

Criteria utilized for criticality safety of the canister/cask systems are not based on site-specific criticality safety criteria, therefore no additional criticality evaluations are required specific to this application. Chapter 10 addresses the criticality criteria for each of the canisters authorized for storage at the WCS CISF identified in Table 1-1.

Table 3-5 describes the Quality Assurance classifications for major SSCs as utilized at the WCS CISF per NUREG/CR-6407 [3-31]. Quality Assurance Classifications for each of the Storage Systems SSCs are addressed in Table 3-4. The canisters are classified as Category A because a failure could lead in loss of primary containment. The Storage Overpacks, CTS, VCT*, and CHB* have been classified as Category B because the failure of these components would require the failure of an additional component to result in an unsafe condition. The Storage Pads for the Vertical Storage System *have* been classified as Category C because the failure of these components would not likely result in an unsafe situation.

All other components are NITS because their failure would not result in an unsafe condition.

The classification of the components that make up the cask systems authorized for storage at the WCS CISF, including canister, transfer casks, storage overpacks, transfer equipment and storage pads are provided in Appendices A.3, B.3, C.3, D.3, E.3, F.3 and G.3, depending on the canister/cask system. Section 2.1 of the Technical Specifications [3-1] lists the SNF canisters authorized for storage at the WCS CISF. Table 3-1 provides the cross reference to the applicable appendix and section for each canister/storage overpack where the classifications of the components of that system are identified.

3.4.1 Cask Handling Building Quality Classification

The purpose of the CHB and associated lifting equipment is to receive, inspect and prepare for storage, shipments of canisterized SNF and GTCC waste canisters and to provide for cask and rail car light maintenance. The CTS and associated lifting hardware used for stack up and transfer operations for the NAC canisters is located inside the building. The 130-ton overhead crane and associated NUHOMS® MP197HB and MP187 Casks Lift Beam Assembly are NITS because the NUHOMS® cask and canister are not lifted above the Technical Specifications [3-1] height limits *and seismic clips provide reasonable assurance against crane structural collapse onto canisters, but the crane is designed to NOG-1-2015 [3-36] Type 1, Single Failure Proof specifications to provide defense in depth*. The building structure (structural steel and column foundations) is classified as ITS, Category *B* to meet the requirements of 10 CFR 72.122(b)(2)(ii) [3-23] and to prevent massive building collapse onto cask systems and related ITS SSCs. The overhead crane bridge trucks and trolley seismic clips are ITS. The balance of the facility is also NITS as the fuel remains sealed from the environment inside the confinement boundary provided by the canister for all operations and the overpacks provide protection from natural phenomena and postulated off-normal and accident events.

All Indicated Changes are in response to RAI NP-3-5

3-22 Title 10, Code of Federal Regulations, Part 20, "Standards for Protection Against Radiation."

3-23 Title 10, Code of Federal Regulations, Part 72, "License Requirements for the Independent Storage of Spent Nuclear Fuel, High-Level Radioactive Waste, and Reactor-Related Greater than Class C Waste."

3-24 ASCE-7 (formerly ANSI A58.1), Minimum Design Loads for Buildings and Other Structures, American Society of Civil Engineers, 1995.

3-25 McGuire, R.K., Silva, W.J. and Constantino, C.J., 2001, Technical basis for revision of regulatory guidance on design ground motions: Hazard- and risk-consistent ground motion spectra guidelines, U.S. Nuclear Regulatory Commission NUREG/CR-6728.

RAI NP-3-1

3-26 *Not Used*.

3-27 Regulatory Guide 1.61, Damping Values For Seismic Design of Nuclear Power Plants, U.S. Nuclear Regulatory Commission, October 1973.

3-28 *Not Used*.

3-29 NUREG-0554, Single-Failure-Proof Cranes for Nuclear Power Plants, U.S. Nuclear Regulatory Commission, 1979.

3-30 ASME B30.2-2005 Overhead and Gantry Cranes.

3-31 NUREG/CR-6407, (INEL-95/0551), Classification of Transportation Packaging and Dry Spent Fuel Storage System Components According to Importance to Safety, 1996.

3-32 Electric Power Research Institute (EPRI), 2013, Ground motion model (GMM) review project, Final Report.

3-33 Geoservices, LLC, Project No. 31-151247, "Report of Geotechnical Exploration: Consolidated Interim Storage Facility (CISF) Andrews, Texas," August 20, 2015.

3-34 ASME NOG-1-2010, "Rules for Construction of Overhead Gantry Cranes (Top Running Bridge, Multiple Girder)," The American Society of Mechanical Engineers, 2010.

RAI NP-7-9

3-35 ASCE 7-16, "Minimum Design Loads for Buildings and Other Structures."

3-36 ASME NOG-1-2015, "Rules for Construction of Overhead Gantry Cranes (Top Running Bridge, Multiple Girder)," The American Society of Mechanical Engineers, 2015.

Table 3-5
Quality Assurance Classification of Structures, Systems, and Components as Utilized at the WCS CISF[1]

Important-To-Safety	Not Important-To-Safety
Classification Category A	Facility Infrastructure
SNF Canister	Security and Administration Building
	Storage Pads (NUHOMS® Storage Overpacks)
Classification Category B	Overhead Building Cranes
Storage Overpacks	Overhead Building Crane Lifting Devices
Canister Transfer System *(See Note 3)*	Electrical Power
Vertical Cask Transporter	
Cask Handling Building (Crane Runway Beams and Support Structures)	
Overhead Crane Bridge Truck Seismic Clips and Trolley Seismic Clips	
Classification Category C	Facility Lighting
Storage Pads (Vertical Concrete Storage overpacks)	NUHOMS® Cask Transfer Trailer
	Radiation Monitors
	Temperature Monitoring System
Treated as Category C	Communication System
Derailer (See Note 2)	Fire Protection System
CAS (See Note 2)	Potable Water System
Security Lighting (See Note 2)	Sanitary Waste/Septic Systems
Security Cameras (See Note 2)	Facility Roads
Security Alarm Systems (See Note 2)	Railroad Line Components
Backup Electric Power (Generators) (See Note 2)	Associated Support Equipment

Notes:

(1) Quality Assurance Classifications for each of the Storage Systems SSCs are addressed in Table 3-4.

(2) Treated as ITS Category C with the exception 10 CFR Part 21 does not apply.

(3) The Canister Transfer System includes transfer casks for the NAC MAGNASTOR, UMS, and MPC systems.

RAI NP-3-3

RAI NP-3-5

RAI NP-3-5

RAI NP-3-3

4.3.8.4 Inspection and Testing Requirements

Inspection and preoperational testing of the fire detection and fire suppression systems will be performed in accordance with the requirements of Section 13.2.2.1. Preoperational and periodic inspection and testing will be performed in accordance with NFPA 25 [4-12].

4.3.8.5 Personnel Qualification and Training

Training and qualification requirements for the testing, inspection, and operation of the fire systems will be in accordance with the requirements of NFPA 25 [4-12].

4.3.9 Maintenance System

4.3.9.1 Major Components and Operating Characteristics

No special maintenance techniques are necessary that would require a safety analysis. There is preventative maintenance performed on a regular basis on the CTS, transfer equipment and transportation casks. Maintenance of these SSCs, which are classified as ITS, ensure that they are safe and reliable throughout the life of the WCS CISF per 10 CFR 72.122(f).

The storage systems at the WCS CISF have minor maintenance requirements due to their passive design and function. Periodic inspection and maintenance to keep the storage overpack air vents unobstructed is required to meet the requirements given in the Technical Specifications [4-3]. *Likewise, the CHB structural members, with their passive design function to prevent structural failure, require infrequent periodic inspection to ensure structural function is not significantly degraded, e.g. by weathering effects.* Other components at the WCS CISF that require routine periodic maintenance include the overhead bridge crane, fire suppression system located in the CHB, the rail cars, the cask transporters, the backup diesel generator, and the temperature monitoring equipment.

4.3.9.2 Safety Considerations and Controls

Preventive and routine maintenance activities are scheduled and established to ensure that SSCs are being maintained according to equipment manufacturer's recommended standards. WCS CISF procedures prevent maintenance activities of equipment in the CHB when overpacks loaded with canisters are in the building to minimize personnel radiation doses. Maintenance activities at the storage area will be monitored and controlled by WCS CISF procedures to ensure that inspections and maintenance work is performed ALARA.

4.3.10 Cold Chemical Systems

There are no cold chemical systems at the WCS CISF.

All Indicated Changes are in response to RAI NP-3-5

4.4 Decontamination Systems

4.4.1 Equipment Decontamination

The WCS CISF handles only canisterized SNF and GTCC waste; therefore, the only radioactive wastes are solid wastes generated from residual quantities of radioactive contamination that may be encountered on the surfaces of the transportation casks due to weeping *(See Reference [4-13] for discussion related to weeping)*.

The potential for radionuclide contamination of the outside surface of the canisters *and inner surfaces of the transportation/transfer casks* is minimized by using design concepts for each of the canisters identified in Table 1-1 that preclude intrusion of spent fuel pool water into the annular gap between the transfer cask and the canister while they are submerged in the pool water at the originating nuclear power plants. *Similarly, the transfer casks used to transfer the canisters included as part of the NAC vertical systems from their transportation casks to the VCCs are never submerged in contaminated water and, as the exterior surfaces of the canisters are clean, the transfer cask does not require decontamination.*

The transportation cask externals are also surveyed and decontaminated, as necessary, before the cask leaves the originating site for transport to the WCS CISF. Radioactive wastes generated during the canister and transportation cask loading operations are processed at the originating site.

After a transportation cask arrives at the WCS CISF, if the outer surface of the transportation cask is found to be contaminated, decontamination methods would be conducted using dry decontamination methods only resulting in the generation of Dry Active Wastes (DAW). The DAW that may be generated would consist of anti-contamination garments, rags, and associated health physics material. This solid waste would be packaged and temporarily stored in a designated radiologically controlled area until the waste is characterized and shipped to a licensed disposal facility. Section 6.1 addresses onsite waste sources.

4.4.1.1 Major Components and Operating Characteristics

The WCS CISF is designed as a "start-clean/stay-clean" facility. The spent fuel storage canisters are sealed by welding at the originating nuclear power plants to preclude any leakage of radionuclides. As a result of the "start-clean/stay-clean" operational design, incidental radioactive waste volumes generated by the WCS CISF operations are reduced to the extent practicable, in compliance with 10 CFR 72.24(f) and 10 CFR 72.128(a)(5).

All Indicated Changes are in response to RAI NP-4-5

4.5 Transportation Casks and Associated Components

Transportation casks are used to transport the canisters from the originating sites to the WCS CISF. The transportation casks are designed in accordance with 10 CFR Part 71 *requirements*.

The transportation casks are shipped by rail to and from the WCS CISF with impact limiters, a shipping cradle, and tie downs. At the WCS CISF, the transportation cask is unloaded from the rail car inside the CHB and, depending on the Cask System, moved to the CTS where the transportation cask is opened and the canister is removed or transferred to the Storage Pad where the canister is removed. After the canister is unloaded, the transportation cask is resealed and shipped off site.

Transportation casks used at the WCS CISF are referenced in Sections 1.6.1.1 and 1.6.2.1. The additional components discussed in this section include:

- Transportation Cask repair and maintenance
- Rail Side Track
- Transportation Cask Queuing Areas
- Receiving Area
- Temporary Isolation Areas

4.5.1 Transportation Cask Repair and Maintenance Activities

If visual inspections reveal the need for repairs or maintenance, these activities will be performed either at the WCS CISF or in another appropriate location, based on the nature of the work to be performed. Radiation protection personnel will provide input and monitor these activities. Work will be performed under the NRC approved WCS CISF Quality Assurance Program Description [4-4] in accordance with written procedures that meet the transportation license requirements under 10 CFR Part 71.

If transportation cask repair or maintenance activities are necessary, the designated location for them to be conducted is in a section of the CHB as shown on Figure 1-7 or at a vendor designated location. Special contamination control measures are not required because the SNF or GTCC waste is contained within a sealed canister.

The following describes the types of repair and maintenance activities that will be performed at the CHB on the transportation casks transporting canisters to the WCS CISF. Maintenance activities are limited primarily to those needed to support routine use of transportation casks. Those maintenance activities are required in the transportation certificates, which reference Chapter 8 of the Transportation Cask SARs. The only expected radiological hazards would be from surface contamination on the outsides of the casks due to weeping from the cask surfaces that were exposed to contaminated SNF pool water. Prior to performing any maintenance activities, health physics personnel will survey the casks as required and incorporate the appropriate restrictions and controls to be observed during the planned maintenance activity.

All Indicated Changes are in response to RAI NP-4-6

RAI NP-4-1

The maintenance activities *that may be* carried out at the CHB include*, but are not limited to*:

- Leak Tests
- Fastener Inspections and Replacement
- Impact Limiter Inspections
- Seal Areas and Groove Inspections
- Trunnion Inspections
- Rupture Disk and Gasket Inspections

Any transportation cask maintenance and repair activity conducted at WCS CISF will be performed in accordance with the applicable NRC Certificate of Compliance for Radioactive Materials Packages (Part 71), and Chapter 8 of the Transportation SAR referenced in the Certificate. ISP will be a registered user for all transportation casks used at WCS CISF and perform any transportation cask maintenance and repair activity under an approved NRC Quality Assurance Program.

4.5.2 Rail Side Track

A rail side track will depart from the existing Waste Control Specialists rail loop and extend *southwest* into the PA and the CHB. There is sufficient rail length for 10 rail cars to be inside the PA before proceeding to the CHB. Unloaded rail cars will exit the CHB *and when all casks have been removed, the train will back up onto the Waste Control Specialists rail loop from the direction it came.* Figure 1-1 shows the Waste Control Specialists Site, Existing Rail Loop, and the new WCS CISF Side Track.

4.5.3 Transportation Cask Queuing Areas

The rail side track that brings rail cars to the CHB has queuing length of approximately 1,000 feet inside of the PA. This length will accommodate five primary rail cars and five accompanying buffer cars, all within the PA. Once a rail car has been unloaded, it will be released through the east end of the CHB and outside of the PA.

In addition to the main side track, there is an additional parallel storage rail line that departs the new sidetrack to inside the PA. This line terminates near the eastern edge of the PA. This provides approximately 800 feet of additional track length inside the PA for rail car storage and staging. Figure 1-3 shows the main side track as well as the parallel storage rail line.

4.5.4 Receiving Area

When the transportation cask arrives at the WCS CISF, the transportation cask and cradle are visually inspected for damage prior to entry into the OCA. The receiving area is shown on Figures 1-2 and 1-3.

4.5.5 Temporary Isolation Areas

Transportation casks arriving at the CISF via rail spur will be visually inspected and radiation dose rate and contamination surveys will be performed.

If initial radiological surveys preclude completion of the other steps of receipt inspection, ISP will isolate the rail car or move the rail car to the CHB and establish appropriate radiological controls. ISP will document the damage, notify the NRC of the condition and develop a corrective action plan. ISP will evaluate the use of movable shielding to protect personnel from radiation exposure while the damaged cask is on site.

If initial radiological surveys do not prevent further receipt inspection, ISP will move the transportation cask to the CHB. ISP will assess the safety features of the transportation cask including seal leak testing and *an evacuated volume helium leak test of each canister as prudent measures to verify* that the canister integrity is intact. If ISP concludes that the transportation cask is capable of performing its intended safety functions, ISP will proceed with the receipt as per established procedure.

If the assessment indicates that the transportation cask integrity is not intact, ISP will ensure the cask continues to be isolated, document the damage, notify the NRC of the condition and develop a corrective action plan. ISP will establish measures to ensure control for contamination and maintain doses ALARA.

ISP will utilize swipes and air samples that will be processed on ISP calibrated Canberra® gas flow proportional gross alpha/beta counters, ISP calibrated Perkin & Elmer® Liquid Scintillation Counters, and ISP calibrated Ortec® Gamma Spectroscopy counters or equivalent equipment. Sipping analysis will be performed on a calibrated gas chromatograph or equivalent equipment.

4.7.1 Cask Handling Building

Transfer of each canister from the rail car to the transfer vehicle or VCT occurs inside the CHB. The CHB contains two overhead cranes capable of lifting and manipulating the transportation cask and canister. For canisters stored in horizontal storage overpacks, the overhead bridge crane is used to transfer the transportation cask from the rail car to a transfer vehicle that will move the canister to the concrete pad. For canisters stored in VCCs, the CTS and VCT are used to transfer the canister from the transportation cask to a VCC that is then moved to the Storage Area. Figures 1-7 and 1-8 show the CHB layout and elevation section. The CHB does not provide confinement or radiation shielding other than a concrete masonry unit wall between the main building section and the office area. Section 7.5.3 describes building design criteria for protection from natural phenomena and accidents.

The CHB loading bays are used to receive and prepare for shipment of all transportation casks arriving at and departing from the WCS CISF. Rail shipments of transportation casks enter the loading bays through rollup doors. Two rail/truck lanes are provided in this area to meet the expected WCS CISF throughput requirements. The rail line serving the CHB is equipped with a derail device to prevent inadvertent vehicular impacts. Two 130-ton overhead bridge cranes unload the NUHOMS® transportation cask from its transfer vehicle after appropriate contamination surveys and decontamination activities (if necessary) and place the transportation cask onto the on-site transfer vehicle. Empty NUHOMS® transportation casks are returned to the transfer vehicle and shipped, reversing the process. The VCT is used to unload the NAC transportation casks from their railcar, upright the cask and place it under the CTS. The CTS is used to transfer the canister from the NAC transportation cask to the VCC. The VCT is also used to return the empty NAC transportation casks to the railcar by reversing the process.

RAI NP-3-5

The CHB is commercially designed and fabricated steel framed structure with metal siding designed to support two commercial overhead cranes. The CHB is classified as ITS, Category *B*. Section 7.5.3 provides additional information about the building.

There are several doors in the building to allow access by railroad cars and transfer vehicles. Roll-up or sliding doors will be provided to minimize the potential for rain and snow that may blow into the building. No floor drains are located in the CHB to preclude the possibility of contamination entering a sanitary waste system. If there is any water collected in the building, it will be sampled to ensure no contamination is present and then pumped for discharge.

4.7.1.1 Design Specifications

The CHB structure is designed to withstand snow, rain, wind, *and tornado* loads. Section 7.5.3.2 describes the design specifications for the CHB.

RAI NP-7-9

4.7.1.2 Plans and Sections

The CHB is shown in Figures 1-7 and 1-8.

4.7.1.3 Confinement Features

The CHB is not counted on to provide confinement for SNF or GTCC waste.

4.7.1.4 Function

The CHB facilitates cask handling operations at the WCS CISF. Those operations are described in more detail in Chapter 5. The functions of the CHB include: loading and unloading transportation casks from rail cars; general weather protection for the handling operations; a location for the CTS; support structure for overhead cranes; staging area for storage overpacks; and storage and staging for other transfer and shipping equipment. The CHB is not counted on to provide shielding or confinement.

4.7.1.5 Components

The major components that comprise the CHB are two 130 ton overhead bridge cranes. Minor components include a compressed air supply system for tools as discussed in Section 4.3.3 and the CHB will have a standard commercial HVAC system in the Utility and Storage room area of the building. The larger building will not be heated or cooled. Ventilation will be commercial grade equipment and materials.

In addition to components that are part of the CHB, all or parts of the transfer systems will operate within the building. Six storage systems were evaluated for storage in the WCS CISF Storage Area. These storage systems use various cask transfer systems. These transfer systems are described in Sections 4.7.3 and 4.7.4. Table 4-1 provides a cross-reference to the applicable appendix and section for each canister/storage overpack where the individual cask transfer systems are discussed.

RAI NP-3-5

4.7.1.6 Design Bases and Safety Assurance

The CHB is classified as being ITS *Category B*. The design bases for the CHB are described in Section 7.5.3.

4.7.2 Overhead Bridge Cranes

RAI NP-4-3

The CHB houses two 130 ton overhead bridge cranes. These cranes are classified as NITS*, with the exception of seismic clips and runway beams and support structures, but are designed as Type 1, Single Failure Proof cranes in accordance with NOG-1-2015 to provide defense in depth*. The cranes are provided for the purpose of loading and unloading NUHOMS® transportation casks off or on the rail car and to or from the Transfer Trailer. The cranes *shall include limit switches that shall be procedurally verified to be pre-set, limiting the travel (lifting height)* so that they do not lift the NUHOMS® casks above their analyzed drop height. Section 7.5.3.1 provides additional information on the overhead bridge cranes. The NUHOMS® casks will be lifted by the crane utilizing the WCS Lift Beam Assembly, which is referenced in Section 4.10.

4.9 References

4-1 NUREG-1567, "Standard Review Plan for Spent Fuel Dry Storage Facilities," Revision 0, U.S. Nuclear Regulatory Commission, Office of Nuclear Material Safety and Safeguards, March 2000.

4-2 NRC Regulatory Guide 3.48, "Standard Format And Content For The Safety Analysis Report For An Independent Spent Fuel Storage Installation Or Monitored Retrievable Storage Installation (Dry Storage)," Rev 1.

4-3 Proposed SNM-1050, WCS Consolidated Interim Storage Facility Technical Specifications, Amendment 0.

4-4 "TN Americas LLC Quality Assurance Program Description Manual for 10 CFR Part 71, Subpart H and 10 CFR Part 72, Subpart G," current revision.

4-5 Title 10, Code of Federal Regulations, Part 72, "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel, High-Level Radioactive Waste, and Reactor-Related Greater Than Class C Waste."

4-6 IEEE 692, 2013, Institute of Electrical and Electronics Engineers, "Criteria for Security Systems for Nuclear Power Generating Stations".)

4-7 NFPA 70, 2016, National Fire Protection Association, "National Electric Code"

4-8 IBC, 2009, International Building Code.

4-9 NFPA 101, 2015, National Fire Protection Association, "Life Safety Code."

4-10 Not Used.

4-11 Drawing NAC004-C-002, Rev. 0, "ISFSI Pad Licensing Design Structural Concrete Plan, Sections, and Details."

4-12 NFPA 25. 2014, National Fire Protection Association, "Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems

4-13 *NRC Information Notice No. 85-46, "Clarification of Several Aspects of Removable Surface Contamination Limits for Transport Packages," dated June 10, 1985.*

All Indicated Changes are in response to RAI NP-4-5

5.2.1.2 Canister Handling

5.2.1.2.1 Functional Description

The Cask Handling Building is a two bay ITS – Category *B* steel structure designed to support two commercial bridge cranes used to lift loaded transportation casks from rail cars and to remove / install personnel barriers, impact limiters and small items from the transportation casks upon receipt of the rail car at the Cask Handling Building.

NUHOMS®

After receipt inspection and removal of the impact limiters, the cask lifting device is attached to the top and bottom of the cask and the cask is lifted from the rail car onto the transfer cask support skid on the transfer trailer. The yard tractor moves the transfer trailer to the storage pad and HSM.

Vertical Storage Systems

After a preliminary receipt inspection, the rail car and the transportation cask are moved into the Cask Handling Building where the receipt inspection is completed. The transportation cask impact limiters are removed. The VCT moves into position straddling the rail car and the transportation cask. The VCT uprights the transportation cask. The transportation cask is moved clear of the rail car, placed in the CTS and staged near a designated storage overpack.

5.2.1.2.2 Safety Features

The Cask Handling Building houses the equipment used to handle the transition between transportation configurations under 10 CFR Part 71 to transfer operations under 10 CFR Part 72 for the canisters. All transfer operations to move the NUHOMS®-MP187 and -MP197HB transportation casks are accomplished with the transportation casks in a horizontal orientation utilizing a NITS bridge crane, as all lifts are limited to a maximum height of 80 inches. The Cask Handling Building also houses the stand-alone CTS that is classified as an ITS component.

7. INSTALLATION DESIGN AND STRUCTURAL EVALUATION

This chapter presents the structural description, design, design criteria and design analysis for important-to-safety (ITS) structures to be employed at the Interim Storage Partners' (ISP's) WCS Consolidated Interim Storage Facility (WCS CISF) including:

1. The NUHOMS® system HSMs (Model 80, Model 102 and AHSM), the various models of DSCs, and the use of the MP197HB and MP187 transportation casks for on-site transfer of the DSCs.

2. The NAC system Vertical Concrete Casks (VCCs) and canisters (UMS, MPC and MAGNASTOR), Vertical Cask Transporter (VCT), and the Canister Transfer System (CTS) including transfer casks. *Note: "VCC" is used generically to refer to the different vertical concrete overpack designs for the NAC-MPC, NAC-UMS, and MAGNASTOR storage systems and includes all of the vertical overpacks listed in* Table 7-2.

Structures described in this chapter include the confinement structures, systems and components (SSCs), CTS, VCT, storage pads for the vertical systems and structures classified as ITS.

7.2 Confinement SSCs

Only NRC-approved storage systems are used at the WCS CISF. The proposed cask systems to be utilized at the WCS CISF are evaluated against site parameters and are generally shown to bound the site parameters. Sections 3.2 and 3.3 address the design criteria for the WCS CISF ITS Structures, Systems and Components. Section 3.3.2 specifically addresses confinement. Section 3.2 addresses the design criteria for the cask systems authorized for storage at the WCS CISF. Table 3-1 cross-references the appendices that discuss those design criteria in more detail. Tables A.3-1, B.3-1, C.3-1, D.3-1, E.3-1, F.3-1, and G.3-1 compare the WCS CISF design criteria with the design criteria for each cask system. Where the actual site parameters exceed the bounds of those assumed in the individual cask certificates of compliance, the difference is addressed for those areas affected by the variations and are documented in the appropriate WCS CISF SAR Chapter, and associated Appendices. No new analyses are required for the NAC storage systems *except those provided in SAR Section 7.6.3, "Soil Structure Interaction of the VCC Storage Pad," to demonstrate seismic stability of the VCCs using the site-specific design basis earthquake motions.* Tables A.3-1, B.3-1, C.3-1, and D.3-1 include cross references where new evaluations are described for the NUHOMS® Systems.

Spent nuclear fuel (SNF) characteristics are addressed in the individual canister/cask system structural evaluations which are provided in Appendices A.7, B.7, C.7, D.7, E.7, F.7 and G.7 and thermal safety evaluations which are provided in Appendices A.8, B.8, C.8, D.8, E.8, F.8 and G.8, for each canister/cask system. It is required that packages received at the WCS CISF are loaded in accordance with SAR and regulatory requirements applicable at the site where the SNF was originally loaded and stored. To provide assurance that the packages received at the WCS CISF are acceptable for storage, prior to receipt of a canister, a records review is performed to verify that the canister being received was fabricated, loaded, stored and maintained in accordance with the Site Specific or General License requirements and will comply with WCS CISF License Conditions and Technical Specifications. In addition, a receipt inspection of the canisters is performed upon arrival at the WCS CISF, which includes a post transport package evaluation in accordance with reference [7-1].

The primary confinement boundary for each of the six storage systems used at the WCS CISF is a metal canister that is welded shut. All components of the canister confinement boundary are classified as important-to-safety. Section 3.4 and Table 3-4 provide references where the classification of the SSCs can be found in the WCS CISF SAR Appendices and in the FSARs for each of the storage systems.

A description of the confinement boundary for each of the six systems used at the WCS CISF is provided in the locations in the Appendices of the WCS CISF SAR identified in Table 7-24.

- Check hose reel hoses for damage.
- Check all hoses that are exposed to sunlight for cracks.
- Check cylinder bolts and lock washers.
- Check wheel box bolts for tightness.
- Check pressure gauges and operating pressure.
- Visually check all boom and base exterior welds for cracks.
- Check the hydraulic oil filter.
- Verify lift and propel handles are shifted to the desired position.
- Thoroughly clean all hydraulic connection points.
- Engage all safety devices.
- Check all system surfaces to be sure they are clean.
- Touch-up any paint damaged areas.
- Check track and top of lift beams for debris.
- Perform a "no-load" test for the full range of motion and speed. Perform a functional test using the transfer cask and empty canister.
- *The hydraulic gantries shall be maintained in accordance with ASME B30.1-Chapter1-6 [7-27].*
- *The chain hoists shall be maintained in accordance with ASME B30.16-Chapter 16-2 [7-13].*

Local firms with hydraulic gantry crane operating and maintenance experience are used to perform specialized periodic inspection and maintenance.

7.5.1.14 Operating Manual

Operating and maintenance manuals for the gantry crane and the canister chain hoist are provided at the conclusion of shop manufacturing and load testing. The manuals incorporate features of the equipment specific to WCS CISF. The manuals provide information and procedures for use in checking, testing and operating the CTS and the canister chain hoist.

7.5.1.15 Quality Assurance

The WCS CISF Quality Assurance Program is implemented to ensure that the requirements of NUREG-0554 with regards to design, fabrication, installation, testing and operation of crane systems for safe handling of critical loads are implemented. The CTS and associated components are procured under the QA program. Detailed quality assurance requirements for suppliers are identified in the supporting QA plan. There are two graded quality categories for the CTS, defined as Quality Categories B and C.

The VCT is not an overhead hoisting system as defined by any ASME Standard, rather it is a mobile hydraulic gantry crane and adheres to applicable ASME B30.1 requirements. The lift links, lifting pins and header beam are designed, load tested and inspected in accordance with the requirements as specified in ANSI N14.6.

7.5.3 Cask Handling Building Structural Design

This section presents the structural description and design criteria*, and analysis* for the WCS CISF Cask Handling Building (CHB). The CHB *structures are designed to meet the applicable requirements for ITS structures in 10 CFR 72.122 as outlined in NUREG-1567 Section 5.4.4*. The CHB is a two bay commercially designed and fabricated steel frame structure with metal siding *and roofing designed to provide a weather-protective enclosure for cask handling operations and* to support two commercial overhead cranes used to move transportation casks from the rail car to the transfer vehicle. The CHB *and its foundations are* ITS - Category *B*. The overhead cranes will also be used to remove or install personnel barriers, impact limiters from the transportation casks. All operations to move the NUHOMS® System MP187 and MP197HB transportation casks are accomplished with the transportation casks in a horizontal orientation.

RAI NP-3-5

7.5.3.1 *Descriptions of Systems, Structures, and Components*

Three separate structural systems are included within the CHB structural design, including the steel-framed building itself, the reinforced concrete foundations for the steel building, and the two overhead bridge cranes. Arrangement of the CHB structures and description of each system are provided in the following subsections. Material specifications utilized for the primary structural components of all CHB structures are summarized in Table 15-1.

- *ANSI/AISC N690-18, Specification for Safety-Related Steel Structures for Nuclear Facilities. Applicable to definition of steel design load combinations and steel member and connection design requirements. ANSI/AISC 360-16, Specification for Structural Steel Buildings, is the baseline document modified in part by ANSI/AISC N690-18 for application to nuclear facilities.*
- *ANSI/AISC 341-16, Seismic Provisions for Structural Steel Buildings. Applicable to definition of seismic design and detailing requirements for the CHB structural steel seismic lateral force resisting system.*
- *ACI 349-13, Code Requirements for Nuclear Safety-Related Concrete Structures. Applicable to definition of concrete design load combinations and design of reinforced concrete structures and anchorages.*
- *ASCE 43-05, Seismic Design Criteria for Structures, Systems, and Components in Nuclear Facilities. Applicable to evaluation of seismic demand and capacity of the CHB structures.*
- *ASCE/SEI 4-16, Seismic Analysis of Safety-Related Nuclear Structures. Applicable to seismic analysis procedures for the Cask Handling Building and its foundations.*
- *ASCE/SEI 7-16, Minimum Design Loads and Associated Criteria for Buildings and Other Structures. Applicable to development of normal operating wind loads, snow and rain loads, and overhead crane operating loads.*
- *ASCE/SEI 7-05, Minimum Design Loads for Buildings and Other Structures. Applicable to transforming tornado wind speed into pressures applicable to the CHB, in accordance with NUREG-0800 Section 3.3.2, Tornado Loads.*
- *ASME NOG-1-2015, Rules for Construction of Overhead and Gantry Cranes (Top Running Bridge, Multiple Girder). Applicable to analysis and design of the two 130-ton overhead cranes supported by the CHB.*
- *CMAA-70 2015, Specifications for Top Running Bridge and Gantry Type Multiple Girder Electric Overhead Traveling Cranes. Applicable to design of the CHB crane runway system.*

7.5.3.2.1 *Load Definitions*

The CHB structure is designed to withstand snow and rain in accordance with the International Building Code. In addition, it is designed to resist failure of structural members under concurrent loading by design-basis tornado winds, atmospheric pressure change (APC), and tornado missiles.

RAI NP-7-9

Administrative Controls will be used to mitigate certain impacts of design-basis tornado loading. The transportation cask will not be moved into the building to begin the railcar unloading process unless current and forecasted weather for the approaching eight (8) hours indicate safe weather conditions. Eight hours is the estimated time to move any of the casks from the railcar to a stable configuration within the CHB in which the crane is no longer overhead or adjacent. For the NUHOMS® systems, eight hours bounds the approximate time (6.4 hours for MP187 casks, 4.3 hours for MP197HB casks) from entry of the cask railcar into the CHB, to the point where the cask has been placed on the transfer skid and the overhead crane can be relocated to the south end of the CHB. For the NAC systems, eight hours bounds the approximate time (5.5 hours for NAC-STC casks, 6.5 hours for NAC-UTC casks, and 8 hours for NAC-MAGNATRAN casks) from entry of the cask railcar into the CHB, to placement of the canister on the Canister Transfer Facility pad, at which point the overhead crane will no longer be overhead or adjacent to the cask on the railcar. Estimated time to perform cask receipt and transfer activities are provided as occupancy times in the occupational collective dose tables in each cask model's respective Appendix, refer to Tables A.9-2, B.9-2, C.9-2, D.9-2, E.9-1, F.9-1, and G.9-1. Administrative controls will restrict the movement of the overhead crane such that it will remain in the south-most bay of the CHB once railcar unloading has been completed. Administrative controls will prohibit additional non-empty casks on railcars inside the CHB, and thus adjacent to the crane, until the previous cask has been removed from the CHB and the next unloading evolution can proceed, weather conditions permitting. Similarly, for railcar loading operations following retrieval of a loaded canister, the loading process will not be permitted to proceed unless current and forecasted weather for the approaching eight hours indicate safe weather conditions. These actions eliminate the potential for collapse of overhead cranes onto canisters during receipt, transfer, and retrieval operations (with storage operations occurring outside the CHB).

A safe condition and forecast is considered to be the absence of: Tornado and Severe Thunderstorm Watches, Tornado and Severe Thunderstorm Warnings, and predicted wind speeds that would qualify for a Severe Thunderstorm Watch (58 mph or greater). Weather forecasts will be accessed from the NOAA Weather Forecast Office prior to each railcar loading/unloading. The nearest NOAA Weather Forecast Office to the CISF is the Midland/Odessa Office. Administrative controls triggered by the presence of Tornado and Severe Thunderstorm Watches, Tornado and Severe Thunderstorm Warnings, and predicted wind speeds that would qualify for a Severe Thunderstorm Watch ensure avoidance of atmospheric conditions which are favorable for the development of severe thunderstorms capable of producing tornados within the following eight hours.

RAI NP-7-9

This section describes loads, loading combinations and analysis methods to be met for design of the WCS CISF reinforced concrete and structural steel structures.

Loads

Loads used in analysis and design of CHB structure include the following:

- D Dead load
- L Live load
- *C – Crane operating and lifted (hoist) loads*
- *S – Snow load*
- H lateral soil pressure load
- T_o Thermal load
- W Wind load
- *W_t Tornado load*
- F' Flood load
- E' Design Basis Earthquake seismic load

RAI NP-7-9

Load Definitions

- **Dead Load *(D)* –** Defined as any load, including related internal moments and forces, that is constant in magnitude, orientation, and point of application. Dead loads include the mass of the structure, and any permanent equipment loads *including the overhead crane bridge and trolley weights*. *A* minimum uniform load allowance of 20 lb/ft^2 is applied to roof *and elevated platform* areas to account for miscellaneous electrical conduits, handrails and ladders for which the actual dead load contribution is not precisely known at the time the analysis or design is performed.
- **Live Load *(L)*** – Defined as any normal load, including related internal moments and forces that may vary with intensity, orientation and/or location of application. Movable equipment loads, *other than crane loads,* loads due to vibration and any support movement effects and operating load are types of live loads. The following descriptions provide design requirements for various types of live loads.
  - **Transportation Vehicle Loads and Heavy Floor Loads** – Loads due to vehicular truck and rail traffic in designated building areas are in accordance with standard loadings defined by the American Association of State Highway and Transportation Officials (AASHTO) and by the American Railway Engineers Association. Special heavy loading conditions resulting from transport of SNF and storage casks on truck and rail transporters/carriages are considered. Design basis cask weights bound the worst-case condition of all vendor designs handled at the WCS CISF. Floor loadings from transportation, transfer and storage mode casks are also considered, along with sufficient allowance for any impact resulting from placing the moving loads on the floor or other areas of the structure. Within the building, the floor under the

- ***Thermal Load (T_o)*** *– Consists of thermally induced forces and moments resulting from operation and environmental conditions affecting the CHB. The design temperature changes (ΔT) used for structural analysis and design of the CHB are the differences between expected construction temperatures and winter or summer operating temperatures, assuming the building is unheated and without air conditioning. The temperatures considered for these ΔT calculations are based on data for Midland, Texas in Technical Report No. 65, Expansion Joints in Buildings, which include a 66°F mean temperature during construction, a summer operating temperature of 100°F (exceeded, on average, only 1% of the time between June and September), and a winter operating temperature of 19°F (exceeded, on average, 99% of the time between December and February). This results in a positive ΔT of 34°F and a negative ΔT of 47°F for consideration in the CHB analysis. In accordance with NUREG-1536 and ANSI/ANS 57.9, thermal loads are not combined with tornado or seismic loads given that the CHB thermal loading is self-limiting and will be relieved during response of the structure to these extreme loading conditions.*

- ***Wind Loads (W)*** *– Are those pressure loads generated by the design (or "normal") wind. The basic wind speed used to determine design wind loads on the CHB walls and roof is 116 miles per hour. Design wind loads are determined in accordance with the requirements of ASCE 7-16 [7-69], which consider ultimate strength level (limit state) wind speeds rather than service level wind speeds. The resulting pressures are intended for use with unity (1.0) LRFD wind load factors in the steel and concrete design load combinations. Wind loading conditions applicable to the CHB Main Wind Force Resisting System are determined in accordance with the Directional Procedure given in ASCE 7-16, Chapter 27 Part 1. Internal pressure coefficients are based upon an enclosed structure, given use of rated doors and operational protocols to shut all CHB doors during inclement weather. Design velocity pressures (q_z) are determined using ASCE 7-16 Equation 26.10-1:*

  $$q_z = 0.00256 K_z K_{zt} K_d K_e V^2$$

  where:

  K_z = velocity pressure exposure coefficient, equal to 1.18 for Exposure Category C and eave height of 73 feet above ground

  K_{zt} = topographic factor, taken as 1.0

  K_d = wind directionality factor, equal to 0.85 for Building Main Wind Force Resisting System

  K_e = ground elevation factor, taken as 0.9 for site elevation of approximately 3500 feet

  V = basic wind speed, equal to 116 mph for the WCS CISF site.

RAI NP-7-9

- ***Tornado Loads (W_t)*** *– Are those loads generated by the design basis tornado wind speed, atmospheric pressure change (APC), and tornado missiles, determined in accordance with NRC Regulatory Guide 1.76. Per RG 1.76 Figure 1, the WCS CISF site is located in tornado intensity Region II, for which the maximum design wind speed is 200 miles per hour and the APC pressure change is 0.9 psi (130 psf). The standard spectrum of tornado missiles identified in RG 1.76 Table 2 is considered. For Region II, this includes the 6.625 inch-diameter x 15 foot-long Schedule 40 pipe, a 4000-lb automobile, and a 1 inch-diameter steel sphere travelling at the stated Region II velocities.*

  Windward, leeward, sidewall, and internal pressures due to the 200-mph tornado wind speed are calculated in accordance with ASCE 7-05 [7-34] Main Wind Force Resisting System procedures, with no variation in windward pressure vs. height of the building. All factors in the velocity pressure (q_z) equation are defined in accordance with NRC Standard Review Plan, NUREG-0800, Section 3.3.2. Operational protocols during inclement weather require all doors in the CHB to be closed. Although the siding, roofing, and doors may not remain intact under tornado wind loading, the design will conservatively assume an enclosed structure, subject to the full outward-acting APC internal pressure (130 psf).

  The tornado (W_t) primary load case within the load combinations used for CHB design comprises two basic tornado wind loading conditions, in accordance with NRC Standard Review Plan Section 3.3.2:

  $W_t = W_p$

  $W_t = W_w + 0.5W_p + W_m$

  Where:

  W_t = *total tornado load*

  W_w = *windward, leeward, sidewall, and roof pressures associated with the full tornado wind speed*

  W_p = *internal pressure from atmospheric pressure change*

  W_m = *load from tornado missile impacts*

  Since the CHB is not credited as tornado missile protection for the spent fuel casks, analysis of tornado missiles is limited to missile impacts with the potential to damage or destabilize primary framing. Preventing penetration of the steel pipe or steel sphere missiles is not considered a CHB structural design requirement, as the casks are designed to withstand these impacts. Thus, design of the building for tornado missile impacts is limited to evaluation of demands induced by impacts from the bounding design-basis missile (the automobile) on primary structural framing; i.e., columns, vertical braces, and struts required to maintain structural stability.

All Indicated Changes are in response to RAI NP-7-9

Per NRC RG 1.76, the automobile missile impact is applicable to framing members over all heights from grade to 30 feet above all grade levels within 0.5 miles of the CHB. Based on the stated automobile parking administrative control and minimal elevation changes at the WCS CISF site, the lower 30 feet of primary framing members are considered subject to missile impact. A representative set of all potential strike angles on external framing members is evaluated. Internal primary framing impacts (e.g., crane support columns) afforded by the 25-foot north-south column spacing are also evaluated.

A linear elastic analysis and design approach is taken for missile impact loading on framing members, such that calculated demands can be superimposed on those due to tornado wind, atmospheric pressure change, and other normal loading conditions. The impulsive force magnitude of the automobile traveling at the prescribed velocity is determined using an impulse-momentum procedure. The magnitudes of demands induced in the impacted framing members are a function of both the impulsive force magnitude and the dynamic behavior of the impacted structure. Therefore, for each potential impact location considered, the impulsive force is applied to the structural analysis model as a rectangular step-function load in a transient dynamic analysis. The peak structural demands resulting from these analyses are then superimposed upon those due to tornado wind, atmospheric pressure change, and gravity load cases, in accordance with the design load combinations. Design of CHB primary framing members for these load combination demands ensures that neither the building nor the crane runway support structures will fail under design basis tornado loading, thereby eliminating the potential for damage to canisters during receipt, transfer, and retrieval operations (with storage operations occurring outside the CHB).

For further discussion of tornado missile impact analysis, see Section 7.5.3.3.4.

RAI NP-7-9

- **Flood Loads (F')** – Are due to exterior flood waters from the design-basis flood exerting forces and moments on exterior buildings structures, or entering a building and exerting loads on interior building structures. As described in Chapter 2, the CHB finished floor elevation is above the PMF elevation and flood loads are not applicable.

- **Seismic Loads (E')** – *Loads are determined using nuclear facility standards, including ASCE 4-16 [7-69] and ASCE 43-05 [7-44]. In accordance with seismic analysis requirements in these codes, modal response spectrum analysis is performed to determine seismic demands for structural design of the CHB. The input response spectra for this analysis are developed from the site-specific response spectra generated by the Probabilistic Seismic Hazard Analysis for the WCS CISF site (discussed in WCS CISF SAR Chapter 2). Design spectral response accelerations will be used in the analysis and design of the building structure, crane supports, and seismic clips used as restraint for the overhead bridge crane and trolley.*

RAI NP-7-10

Assessment of the site soil properties and the CHB dynamic response indicates that Soil-Structure Interaction (SSI) effects are minimal, such that the criteria of ASCE 4-16, Section 5.1.1 can be applied to justify fixed-base analysis in lieu of detailed SSI analysis. Section 5.1.1(a) permits seismic response analysis without consideration of soil-structure interaction (i.e., fixed-base analysis) if the frequencies of a rigid structure supported on soil springs representing site-specific soil properties are more than twice the dominant frequencies of the actual structure. This condition is present for the CHB, given the stiff soils at the WCS CISF site and the relatively low dominant structural frequencies of the updated CHB design. Soil spring frequencies calculated for the soils are larger than twice the primary lateral response frequencies of the CHB, as determined from analysis of the CHB framing arrangement and structure mass. Therefore, fixed-base analysis is performed, utilizing the surface Design Response Spectra (DRS) developed in the Probabilistic Seismic Hazard Analysis for the WCS CISF (discussed in SAR Chapter 2).

RAI NP-7-10

Fixed-base analysis neglecting SSI effects is further justified by the separation between the frequency range of the amplified portion of the DRS (approximately 6-20 Hz) and the dominant structural frequencies (less than 4 Hz). ASCE 4-16, Sections 5.1(b) and C5.1.1 indicate that this assessment is a prerequisite for considering a fixed-base analysis in accordance with Section 5.1.1. Regarding the additional fixed-base analysis criteria in ASCE 4-16, Section 5.1.1(b) related to embedment effects, the CHB will be founded on shallow mat foundations in accordance with the geotechnical report recommendations (SAR Attachment E), such that embedment effects will not be significant. Finally, the criterion in ASCE 4-16, Section 5.1.1(c), which requires SSI analysis in all cases where wave incoherency effects are to be considered, is not applicable to the CHB analysis. In accordance with the provisions in ASCE 4-16, Section 5.1.10, ground motion incoherency is conservatively neglected for WCS CISF structures.

For further discussion of CHB seismic load development, see Sections 7.5.3.3.3 (steel building) and 7.5.3.6 (overhead cranes).

7.5.3.2.2 Structural Steel Load Combinations

Structural steel load combinations applicable to the CHB are based on the LRFD load combinations given in ANSI/AISC N690-18, with the following three basic assumptions:

1. *The design-basis seismic load case discussed above (E) is utilized where the safe-shutdown earthquake load (SSE) appears in the ANSI/AISC N690-18 load combinations. Load combinations with operating-basis earthquake loads applicable to nuclear power plant SSCs are not applicable to CHB design.*

2. *As previously stated, self-limiting operating thermal loads are not combined with tornado or seismic loads, in accordance with ANSI/ANS 57.9.*

3. *Since wind loads are developed per ASCE 7-16 using ultimate wind speeds, use of a 1.0 load factor on the wind load case (W) is appropriate in the severe environmental load combinations.*

4. *Crane load (C) is included with normal wind load (W) and seismic load, but is neglected with tornado loads (W_t) given the aforementioned crane administrative controls for tornado warnings. This is in accordance with ANSI/AISC N690-18 Equations NB2-4 and NB2-7.*

5. *For uplift load combinations, 90% of dead load is considered in conjunction with 100% of operating crane loads with a destabilizing effect (i.e., crane vertical impact, side thrust, and longitudinal traction loads). This is in accordance with ANSI/AISC N690-18 Section NB2.5d(4).*

The following are structural steel design load combinations that result from these assumptions, when reduced to contain only the load cases previously defined as applicable to the CHB:

1. $1.4D + C + T_o$
2. $1.2D + 1.6L + 1.4C + 0.5S + 1.2T_o$
3. $1.2D + 0.8L + 1.4C + 1.6S + 1.2T_o$
4. $1.2D + W + 0.8L + C + 0.5S + T_o$
5. $D + 0.8L + C + E$
6. $D + 0.8L + W_t$
7. $0.9D + C + W$
8. $0.9D + C + E$
9. $0.9D + W_t$

7.5.3.2.3 <u>Reinforced Concrete Load Combinations</u>

Reinforced concrete load combinations applicable to the CHB foundations and floor slab are based on the load combinations given in ACI 349-13 [7-68], with similar assumptions to those applied to the structural steel load combinations:

1. *The design-basis seismic load case discussed above (E) is utilized where the safe-shutdown earthquake (SSE) load appears in the ANSI/ACI 349-13 load combinations. Load combinations with operating-basis earthquake loads are not applicable.*

2. *As previously stated, self-limiting operating thermal loads are not combined with tornado or seismic loads, in accordance with ANSI/ANS 57.9.*

RAI NP-7-11

3. *Since wind loads are developed per ASCE 7-16 [7-69] using ultimate wind speeds, use of a 1.0 load factor on the wind load case is appropriate in the concrete load combinations.*

4. *For consistency with the CHB steel design load combinations, crane load (C) is included with normal wind load (W) and seismic load but is neglected with tornado loads (W_t) given the aforementioned crane administrative controls for tornado warnings.*

5. *For uplift load combinations, 90% of dead load is considered in conjunction with 100% of operating crane loads with a destabilizing effect (i.e., crane vertical impact, side thrust, and longitudinal traction loads).*

RAI NP-7-11

The following are concrete design load combinations that result from these assumptions, when reduced to contain only the load cases previously defined as applicable to CHB concrete structures:

1. $1.4D + T_o$
2. $1.2D + 1.6L + 1.4C + 0.5S + 1.2T_o$
3. $1.2D + 0.8L + 1.4C + 1.6S$
4. $1.2D + 1.6L + W + C$
5. $D + 0.8L + C + E$
6. $0.9D + C + W$
7. $0.9D + C + E$
8. $0.9D + W_t$

7.5.3.2.4 Overhead Crane Load Combinations

Crane Load combinations applicable to the design of the overhead bridge cranes are developed in accordance with ASME NOG-1 Section 4140. The design-basis seismic load (E) discussed above is considered in the safe-shutdown earthquake (SSE) load case in the ASME NOG-1 extreme environmental load combinations.

Static analysis is also performed for the operating thermal ($T\neg_o$) load case to evaluate forces induced in the CHB due to restraint of building temperature changes between ambient construction and winter or summer operating temperatures, as discussed in Section 7.5.3.2.1. Two load cases are developed to apply uniform temperature changes (ΔT) to all CHB framing equal to +34°F and -47□F, as previously defined. In accordance with ANSI/ANS 57.9, the resulting forces and moments are combined with gravity load cases within normal operating load combinations, but are not applied for extreme environmental conditions.

7.5.3.3.3 Seismic Analysis

The seismic response of the CHB is evaluated using modal response spectrum analysis, in accordance with ASCE 43-05 and ASCE 4-16. The input response spectra for the analysis are developed from the site-specific response spectra generated by the PSHA for the WCS CISF site (discussed in SAR Chapter 2).

Evaluation of Soil Structure Interaction Effects

Per ASCE 43-05 Section 3.1 and ASCE 4-16 Section 5.1(a), soil-structure interaction (SSI) effects must be considered. To evaluate the significance of SSI effects for the CHB, an assessment of site soil properties and dominant structural frequencies is performed in accordance with ASCE 4-16 Section 5.1.1. This evaluation entails calculation of soil frequencies based on a single degree-of-freedom system consisting of the lateral, vertical, torsional, or rocking soil spring and the relevant mass or mass moment of inertia for the overall CHB. The mass of the embedded CHB foundation is neglected in this calculation. Equivalent soil spring stiffness terms are calculated in accordance with ASCE 4-16 Table 5-2, using strain-compatible shear modulus determined from the site PSHA at the elevation of foundation bearing (9 feet below grade). A minimum strain-compatible shear wave velocity at the depth of foundation bearing equal to 1,500 ft/second is assumed. Equivalent rectangular foundation dimensions are calculated on the basis of the combined contact areas of the three primary strip mat foundations as preliminarily sized. As shown in Table 7-42, all soil/structure frequency ratios exceed 2, in which case the CHB seismic analysis is permitted by ASCE 4-16 to be performed assuming fixed-base supports. The minimum ratio shown in Table 7-42 (2.1) pertains to the vertical response. The response frequency considered for this ratio is not associated with a dominant mode involving overall structural response. The mode involves the response of the loaded crane runway girder and has a small overall mass participation of approximately 10% in the vertical direction. There are also other modes involving vertical response of the crane system with similar frequencies and mass participation ratios.

RAI NP-7-10

Seismic Mass

In accordance with ASCE 43-05 Section 3.4.2, the effective seismic mass of the CHB is taken as the sum of the weight of the structure, permanent equipment, and the expected live load, taken as 25% of the specified design live loads. Also per ASCE 43-05 Section 3.4.2, snow load need not be included in seismic mass since it is less than 30 psf (10 psf is the ground snow load; see Section 7.5.3.2.1). The overhead crane bridge and trolley mass are included for seismic mass in all directions, while the lifted load mass is only considered as seismic mass in the vertical direction. This is based on the assumption that the pendulum motion of the lifted load is of sufficiently low frequency to be considered as fully out-of-phase with the dynamic response of the supporting structure.

Damping

A constant modal damping ratio of 7% is used for CHB seismic analysis. This is based on ASCE 43-05 Table 3-2, considering welded or friction-bolted structures at Response Level 3. In accordance with AISC 341-16 Section D.2.2, all OCBF bolted connections will be classified as friction-bolted, as they are required to utilize fully pretensioned bolts with faying surfaces prepared to a slip coefficient of Class A or better. Per ASCE 43-05 Section 3.4.3, Response Level 3 damping may be used for evaluating seismic-induced forces and moments in structural members by elastic analysis, without consideration of the actual response level for Limit States A, B, or C. The CHB analysis considers Limit State C, corresponding to limited permanent distortion per ASCE 43-05 Table 1-4.

Modal Analysis

Modal response of the CHB for seismic response spectrum analysis is evaluated in STAAD using the Load-Dependent Ritz eigensolver. This solver is used because it is more efficient than other solvers in extracting modes of significance to the seismic response of the building. As a result, fewer overall modes are required to obtain sufficient mass participation. 500 modes are extracted, capturing more than 90% mass participation in all three global directions.

Response Spectrum Analysis Methodology

Response spectrum analyses for the CHB are performed using the Lindley-Yow method described in NRC Regulatory Guide 1.92 and endorsed by ASCE 4-16 Section 4.3.2. The Lindley-Yow method divides the total seismic response into two components: response in-phase with the ground motion (i.e., the "rigid" response) and response out-of-phase with the ground motion (i.e., the "periodic" response). A typical seismic response spectrum can be divided into three regions, as shown in Figure 7-63. Defining f_{SP} as the frequency corresponding to the peak spectral value on the response spectrum curve and f_{ZPA} as the frequency corresponding to the zero-period ground acceleration (ZPA), the regions may be categorized as follows:

All Indicated Changes are in response to RAI NP-7-10

- *Modes having a frequency less than f_{SP} (low-frequency range) are predominately out-of-phase with the ground motion and thus have no contribution to the in-phase response.*
- *Modes having a frequency between f_{SP} and f_{ZPA} (mid-frequency range) contribute to both the in-phase and out-of-phase responses.*
- *Modes having a frequency greater than f_{ZPA} (high-frequency range) are in-phase with the ground motion.*

The total in-phase response is calculated using the "Static ZPA Method" outlined in Regulatory Guide 1.92. This involves a static analysis in which the ZPA is applied to the total in-phase mass, equal to the total structure mass minus the sum of modal masses for modes with $f < f_{sp}$. Applying the ZPA to the in-phase mass automatically accounts for the so-called "missing mass," or that portion of the structural mass that does not participate in the amplified modal responses.

The out-of-phase response is determined by performing a response spectrum analysis combining the response of modes having a frequency less than or equal to the frequency corresponding to the ZPA (f_{ZPA}). Modified spectral accelerations, $S'_{ai} = S_{ai} [1- \alpha_i^2]^{1/2}$ are used in the analysis, where S_{ai} equals the unmodified spectral acceleration for mode "i". For modes that have a frequency less than f_{SP} (low-frequency range) and are predominately out-of-phase with the ground motion, $\alpha i = 0$. For modes having a frequency between f_{SP} and f_{ZPA} (mid-frequency range), $\alpha_i = ZPA/S_{ai}$.

Modal responses obtained using the modified spectra are combined in STAAD using the Complete Quadratic Combination (CQC) method, in accordance with ASCE 4-16 Section 4.3.2. The total seismic response in each direction is calculated as the square root of the sum of the squares (SRSS) of the in-phase and out-of-phase components, in accordance with the Lindley-Yow Method outlined in Regulatory Guide 1.92. Finally, the three directional responses (or spatial components) are combined by SRSS, in accordance with ASCE 4-16 Section 4.3.3.

Accidental Torsion

In accordance with ASCE 4-16 Section 3.1(i), the effect of accidental torsion is addressed in static analysis considering a torsional moment equal to the story shear at each level multiplied by 5% of the plan dimension perpendicular to the direction of motion. Two accidental torsion load cases are defined; one involving all story shears in the X direction with corresponding Z-direction eccentricity, and one with all story shears in the Z direction and corresponding X-direction eccentricity. In accordance with ASCE 4-16, the resulting forces must only be used to increase member design forces. Therefore, the magnitudes of the demands calculated in these two load cases are added to the corresponding demands obtained from the response spectrum analysis, which do not have signs as a result of CQC and SRSS squaring procedures.

7.5.3.3.4 Tornado Missile Impact Analysis

Refer to the discussion of Tornado Loads in Section 7.5.3.2.1 for an introduction to the Tornado Missile Impact Analysis.

The transient dynamic analysis performed in STAAD utilizes the mode superposition method of calculating structural response at each time step. Similar to the seismic response spectrum analysis, the Load-Dependent Ritz eigensolver is utilized, as it is more effective in capturing high frequency modes important to tornado missile response. A sufficient number of modes are extracted to capture more than 90% mass participation. A time step of 0.0001 seconds is considered for the transient analysis, which is well less than 1/20th of the shortest structural response period of interest, in accordance with industry practice. A constant modal damping ratio of 5% is assumed. The impulsive missile loading for the given impact location is applied as a nodal load with a rectangular load vs. time function that has a magnitude equal to that of the calculated impulsive force and a duration of 0.05 seconds. This duration is in accordance with guidance on automobile tornado missile impacts in UCRL-ID-115234, Title I Wind/Tornado Design Guidelines for New Production Reactors," Lawrence Livermore National Laboratory, September 1993. As maximum member forces are shown to occur within the first second of dynamic response, the total duration of the transient analysis is two seconds.

For each impact location of interest, a separate STAAD model is executed to perform static analyses for all other tornado wind, APC, and gravity load cases in the tornado load combinations, along with the mode superposition transient analysis for the single automobile impact case under consideration. Member demands are calculated in accordance with the design load combinations for each tornado missile impact model for all primary framing members in the STAAD model, and the envelope of all load combination demands from all models are considered in the member design checks.

RAI NP-7-9

7.5.3.4 CHB Steel Building Design

Design of the CHB steel framing is performed in accordance with the requirements of ANSI/AISC N690-18, which overlays additional requirements on the provisions of ANSI/AISC 360-16. This is in general accordance with the NUREG-1567 reference to ANSI/ANS 57.9, which in turn references ANSI/AISC N690-1984 for steel structure load combinations and design limits. ANSI/AISC N690 is considered for CHB design because it provides specific requirements for safety-related nuclear structures, including load combinations containing tornado loading. The 2018 version is utilized for compatibility with current national consensus codes and standards providing requirements for building structures (e.g., IBC 2016 and ASCE 7-16).

In accordance with ASME NOG-1-2015 Section 4150 [7-70], seismic demands on the cranes are determined from modal response spectrum analysis of a three-dimensional finite element model meeting all requirements of Section 4153, including requirements for model geometry, boundary conditions, and trolley and hook positions. Input to the response spectrum analysis consists of broadened in-structure response spectra (ISRS) computed in each of three directions at the crane support level of the CHB. The crane-level ISRS are developed from coupled analysis of the building and crane, in accordance with the requirements of ASCE 4-16 [7-71], Section 3.7. For response spectrum analysis of the crane in the vertical direction, the crane model includes the mass of the credible critical load, defined by NOG-1 as the lifted load with a probability of occurrence in conjunction with the Design Basis Earthquake (DBE) greater than or equal to 10-7. For analysis of CHB ITS structures, the DBE return period is 10,000 years (1x10-4 annual probability) and the expected number of rated load lifts per year, per crane is approximately 200, with an assumed duration of two hours per lift. As the combined probabilities of both cranes lifting a rated load in conjunction with the DBE exceeds 10-7, the rated load is considered as the credible critical load for seismic analysis of the cranes. For response spectrum analysis in the horizontal directions, response of the lifted load mass is addressed in accordance with NOG-1 Section 4153.3 criteria for separation between the frequency of pendulum motion and the fundamental horizontal frequencies of the crane. All operational hook positions are considered when calculating the pendulum frequency of the lifted load.

Normal operating crane loads, including dead loads of trolley and bridge, lifted loads, and crane impact/inertial forces, are developed in accordance with NOG-1 Section 4130. Combinations of normal operating loads and seismic loads are developed in accordance with NOG-1 Section 4140, with the DBE seismic loads discussed above considered in the Safe-Shutdown Earthquake (SSE) load case in the extreme environmental load combinations. As discussed above, the credible critical load for seismic load combinations is the rated load.

7.5.3.7 *Not Used.*

7.5.3.8 On-Site Accidents

WCS CISF-initiated explosions are not considered credible since insufficient explosive materials are present to initiate an event that would result in the destruction of the building. During operations, the amount of flammable liquids that are in the CHB will be administratively controlled to ensure the amount of flammable liquids is maintained below the fire load limits for the respective systems (e.g., 300 gallons of diesel fuel *equivalent* for NUHOMS® *and 50 gallons of diesel fuel equivalent for the NAC-MPC, NAC-UMS, and MAGNASTOR Systems*). In combination with fuel limitations and a fire suppression system, the fire hazard for the building is adequately mitigated (see WCS CISF SAR Section 3.3.6).

RAI TS-5

7.5.3.9 Off-Site Accidents

Off-site accidents are addressed in WCS CISF SAR Section 12.2.2.

7-58 Nuclear Energy Institute (NEI), "Consistent Site-Response/Soil-Structure Interaction Analysis and Evaluation," June 2009.

7-59 Deleted.

7-60 Deleted.

7-61 ANSI/AISC N690-06, "Specification for the Design, Fabrication, and Erection of Steel Safety-Related Structures in Nuclear Facilities."

7-62 ANSI/AISC 360-05, "Specification for Structural Steel Buildings."

7-63 APA Consulting Computer Code SASSI, Version 1.0.

7-64 ASCE 7-10, "Minimum Design Loads for Buildings and Other Structures."

7-65 ANSYS Computer Code and User's Manual, Version 16.0.

7-66 Calculation AREVATN00l-CALC-002, Rev. 0 "Soil Structure Interaction Analysis of TN Independent Spent Fuel Storage Installation (ISFSI) Concrete Pad at Andrews, TX."

7-67 Calculation AREVATN00l-CALC-001, Rev. 1 "ISFSI Pad Design for WCS at Andrews, Texas."

7-68 ACI 349-13, "Code Requirements for Nuclear Safety-Related Concrete Structures and 731Commentary."

RAI NP-7-11

7-69 ASCE 7-16, "Minimum Design Loads for Buildings and Other Structures."

RAI NP-7-9

7-70 ASME NOG-1-2015, "Rules for Construction of Overhead Gantry Cranes (Top Running Bridge, Multiple Girder)," The American Society of Mechanical Engineers, 2015.

7-71 ASCE/SEI 4-16, "Seismic Analysis of Safety-Related Nuclear Structures," American Society of Civil Engineers, 2016.

Table 7-1
WCS CISF Structures and QA Classification

Structure	QA Classification
Canisters, Storage Overpacks (VCCs and HSMs), Transfer Casks	Important-to-Safety
Cask Handling Building	Important-to-Safety
Cask Handling Building Overhead Cranes	Not important to safety
Overhead Crane Bridge Trucks and Trolley Seismic Clips	*Important-to-Safety*
Crane Runway Support Beams	*Important-to-Safety*
Canister Transfer System	Important-to-Safety
Storage pads, NUHOMS® Systems	Not important to safety
Storage pads, VCCs	Important-to-Safety
NUHOMS® Transfer Equipment (Except Transfer Cask)	Not important to safety
Vertical Cask Transporter	Important-to-Safety

All Indicated Changes are in response to RAI NP-3-5

The WCS CISF is designed and operated to provide radiation protection for workers in conformance with applicable regulatory criteria so that occupational radiation exposures are maintained ALARA.

Operation of the WCS CISF is in accordance with an ALARA policy that includes, as a minimum, the following criteria:

- Maintaining radiological releases and exposures to personnel below the applicable limits of 10 CFR Part 20.
- Ensuring that all exposures are kept ALARA, with technological, economic and social factors taken into consideration.
- Integrating appropriate radiation protection controls and ALARA program guidelines into all work activities, including those for design, operations, maintenance, and decommissioning.
- *Ensuring that all personnel understand that no practice involving radiation exposure will be undertaken unless its use produces a net benefit and that all personnel shall follow ALARA procedures at all times*.
- Restricting access to radiologically controlled areas.
- Tracking individual and collective doses to identify trends, causes, and take appropriate corrective actions for adverse trends.
- Conducting periodic training and exercises for management, radiation workers and other site personnel in radiation protection principles and procedures, individual and group protective measures, site procedures and emergency response.
- Integrating ALARA considerations into the WCS CISF design and procedure change activities, including appropriate experience gained during the loading and transfer operations at other ISFSIs relative to radiation control.

WCS CISF personnel including administration, security staff and railroad personnel involved in the delivery to and shipment from the WCS CISF of transport packages will be trained in accordance with 10 CFR Parts 19 and 20. These workers are considered “Radiation Workers” and the occupational radiation dose limits specified in 10 CFR Part 20 Subpart C apply. Individuals (visitors) not trained in accordance with 10 CFR Part 19 are considered members of the public and the dose limits specified in 10 CFR Part 20 Subpart D apply.

ISP minimizes radiation dose to non-radiation workers by the following means:

- ISP will control the number of non-radiation workers admitted to both the Owner Controlled Area (OCA) and to the WCS CISF.
- Commercial and industrial deliveries to ISP will be required to be accepted outside the OCA, for further transfer on site by radiation workers.
- Authorized visitors and other members of the public will be under escort while in the OCA and the WCS CISF.

The storage pads are sized to provide adequate spacing between storage casks or modules to permit workers to function efficiently during operations and maintenance. This helps minimize dose by limiting time spent by workers in the vicinity of storage casks.

The design of the storage systems includes a metal canister that is sealed by welding for SNF and GTCC waste confinement. This design precludes the release of radioactive effluents during normal operations, which fully satisfies the requirement of 10 CFR 72.126(d) to design the facility to provide means to limit the release of radioactive materials in effluents during normal operations to levels that are ALARA. This design also requires minimum maintenance and surveillance requirements by ISP personnel.

The *VCC* temperature monitoring system *installed on the outlet vents* enables data acquisition from remote readout of temperatures or inspection; this minimizes radiation dose to WCS CISF personnel by avoiding the need to perform daily walkdowns, or take measurements, or read instrumentation near the *VCCs. The NUHOMS® storage overpack vents are covered by screens which prevent internal blockage of the vents. The back-to-back array allows visual inspection of screens for debris to be performed from low dose areas on the storage pad*.

ALARA considerations have been incorporated into the WCS CISF design in accordance with 10 CFR 72.126(a) using guidance from Regulatory Guide 8.8, Regulatory Position 2 [9-16], as described below:

- Regulatory Position 2a on access control of radiation areas is satisfied by use of a security gate and a fence surrounding the WCS CISF Protected Area (PA) to prevent unauthorized access.
- Regulatory Position 2b on radiation shielding is satisfied by the shielding design for the transportation, storage, and transfer casks that minimizes personnel exposures during operations. The design of the storage cask air inlet and outlet ducts also prevents direct radiation streaming. The Security and Administration Building is located approximately 340 ft. (100 meters) from the nearest storage pad, and approximately 1130 ft. (345 meters) from the Cask Handling Building. Dose rates are sufficiently low at these distances such that shielding of the Security and Administration Building is unnecessary to assure dose rates are ALARA to personnel in the building.
- Regulatory Position 2c on process instrumentation and controls is satisfied since the cask temperature monitoring system will utilize a data acquisition system to record cask temperature instrumentation readings. This will avoid time spent by WCS CISF personnel near the storage casks to make daily cask vent blockage and temperature surveillances.

All Indicated Changes are in response to RAI NP-9-7

Cask System	Canister	Overpack	Operational Considerations
NUHOMS®-MP187 Cask System	FO-DSC	HSM (Model 80)	Section 7.1.3 of [9-3]
	FC-DSC		
	FF-DSC		
	GTCC Canister		
Standardized Advanced NUHOMS® System	NUHOMS® 24PT1	AHSM	Section 10.1.3 of [9-5]
Standardized NUHOMS® System	NUHOMS® 61BT	HSM Model 102	Section 7.1.3 of [9-4]
	NUHOMS® 61BTH Type 1		
NAC-MPC	Yankee Class	VCC	Appendix E.9
	Connecticut Yankee		
	LACBWR		
	GTCC-Canister-CY		
	GTCC-Canister-YR		
NAC-UMS	Classes 1 through 5	VCC	Appendix F.9
	GTCC-Canister-MY		
MAGNASTOR	TSC1 through TSC4	CC1 through CC4	Appendix G.9
	GTCC-Canister-ZN		

9.1.4 ISP ALARA Policy

The following sets forth ISP's policy on radiation protection principles and practices for maintaining occupational and public doses that are as low as reasonably achievable (ALARA) in the operation of its WCS Consolidated Interim Storage Facility (WCS CISF). This policy is based on three fundamental principles as described in International Commission on Radiological Protection (ICRP) Publication 103, "The 2007 Recommendations of the International Commission on Radiological Protection." Those principles are: (1) justification of exposure; (2) optimization of protection; and (3) limitation of individual dose. The policy also describes management's commitment to implement those principles.

Fundamental Principles of Radiation Protection and ALARA

The first principle, justification, states that "any decision that alters the radiation exposure situation should do more good than harm" (ICRP Publication 103). Decisions associated with justification do not simply take radiation doses into account, but should also encompass all of the possible benefits and detriments of the actions proposed. Thus, a decision may be justified by conclusions that the benefits of improved safety outweigh the detriment of occupational exposure and other detriments associated with taking the action.

All Indicated Changes are in response to RAI NP-9-2

The second principle, optimization, states that "the likelihood of incurring exposure, the number of people exposed, and the magnitude of their individual doses should be kept as low as reasonably achievable, taking into account economic and societal factors" (ICRP Publication 103). All exposures shall be kept ALARA, with technological, economic, and social factors considered. Once a particular exposure has been justified, it is necessary to take actions to reduce exposures to ALARA.

The third principle, limitation, states that "the total dose to any individual from regulated sources in planned exposure situations other than medical exposure of patients should not exceed the appropriate limits" (ICRP Publication 103). Individual dose limits shall be established that are appropriate for practices involving radiation exposure, and exposures to individuals shall not exceed these limits. Limits for occupational exposure are contained in 10 CFR 20.1201, "Occupational Dose Limits for Adults;" 10 CFR 20.1206, "Planned Special Exposures;" 10 CFR 20.1207, "Occupational Dose Limits for Minors;" and 10 CFR 20.1208, "Dose Equivalent to an Embryo/Fetus." Exceeding an occupational exposure limit is a significant violation and subject to enforcement.

Management Commitment

It will be a management priority that all personnel working with radioactive material be made aware of our commitment to the ALARA philosophy and that they be instructed in the procedures to be used to keep their exposures as low as possible. Supervisors and workers shall be appropriately instructed in the objectives and implementation of the ALARA program, with this information included in training modules.

It is management's direction that supervisors integrate appropriate radiation protection controls into all work activities. Management will make all reasonable modifications to procedures, equipment, and facilities to reduce exposures to ALARA.

Management has delegated authority to our RSO to ensure adherence to ALARA principles. The RSO shall emphasize the ALARA philosophy to all personnel working with radioactive material, and shall instruct workers to review current procedures and propose changes to reduce exposure levels. Management shall support the RSO in instances where this authority must be asserted. Strict compliance with all regulatory requirements and license conditions regarding procedures, radiation exposures, and releases of radioactive materials shall be met.

A comprehensive program shall be maintained, and periodically evaluated, to ensure that both individual and collective doses meet ALARA objectives and do not exceed acceptable levels.

Access to the PA is controlled through a single access point in the Security and Administration Building (see Figure 1-2). Personal dosimetry is issued and controlled in this building to individuals entering the PA. Provisions exist in this building for donning and doffing personal protective equipment, such as anti-contamination clothing and/or respirators, which could be necessary in the event of contamination in the Cask Handling Building as a result of off-normal or accident conditions. Provisions for personnel decontamination are also contained in the Security and Administration Building. The PA also includes the storage area and Cask Handling Building. In accordance with the WCS CISF Radiation Protection Program During Operation (Section 9.5), radiation protection personnel will monitor radiation levels in the PA and establish access requirements as needed.

9.3.2.1 Controlled Area

Within the OCA, a restricted area is established to control access to radiation areas in order to maintain worker exposures ALARA.

The WCS CISF PA boundary will be posted as "restricted area, radioactive material area, dosimetry and RWP required for entry." The WCS CISF Cask Handling Building will be posted as a Radiation Area or High Radiation Area per 10 CFR Part 20 limits. In posting contamination areas, ISP will use the limits in Waste Control Specialists State radioactive material license RML R04100 which can be found in 30 TAC 336.364 Appendix G [9-19].

ISP will establish access controls to ensure that unauthorized access inside the OCA and the PA *is prevented*. These controls will be established for radiation protection, security, and safeguards purposes. The site layout, including a description of barriers and gates that will be used to preclude ready access into the OCA of the WCS CISF is provided in the Physical Security Plan.

9.3.2.2 Restricted Area

The restricted area is located on the site such that a minimum distance from any stored SNF to the security boundaries is at least 330 feet in order to maintain exposures within regulatory limits.

9.3.3 Shielding

9.3.3.1 Cask Handling Building Shielding

The ALARA considerations for the CISF Cask Handling Building are the same as the transportation casks since the canisters will still be in the transportation cask. While shielding is provided by the Cask Handling Building, no credit is taken in the shielding/exposure analysis. Shielding from the radiation sources within the canisters is provided by the transportation/transfer casks, transfer casks and storage overpacks. Table 9-4 provides the cross reference to the applicable appendix and section for each canister/storage overpack where each system is discussed.

No credit is taken for the presence of any landscape features or site buildings, which would provide additional shielding. In addition to the HSMs, a number of vertical casks are adjacent to the HSM, as indicated in Figure 9-2. No credit is taken for any blocking provided by the vertical casks.

MCNP5 v1.40 is used in the analysis and all cross-sections utilized are provided with the computer program. All gamma cross-sections are from the ENDF/B-VI data set. The neutron cross sections are also from the ENDF/B-VI data set with the exception of iron (in the concrete) and gadolinium. Neutron cross-sections utilized are provided in Table 9-8.

NAC Systems

The WCS CISF is modeled explicitly. Shielding by NAC systems and NUHOMS® HSMs is included in the model. Dose rates are calculated using point detectors and superimposed mesh tallies. For the location specific dose rates, point detectors were used. Neutron, gamma, and neutron-induced gammas (N-Gamma) are accounted for in the shielding evaluation. Neutron induced gammas generated within the cask shielding are included in the imported gamma surface currents. N-Gamma cases and results for the VCCs only include gammas induced from neutron interactions in air surrounding the cask systems.

9.4.1.1 Dose Rate Results

Dose rates are computed at various locations around the WCS CISF using point detectors, as indicated on Figure 9-1 and Figure 9-2. Dose rates are computed for gamma radiation, neutron radiation and secondary gamma radiation created when neutrons are absorbed in air, soil or concrete. Fluxes are converted to dose rates using ANSI/ANS-6.1.1-1977 flux to dose rate conversion factors.

The total dose rate is computed as the sum of the gamma, neutron, and secondary gamma components. The gamma and neutron dose rate is approximately 90% and 10% of the total dose rate, respectively. The 1-sigma MCNP statistical uncertainty is also provided for the total dose rate. All reported dose rate results are well-converged. Coordinates of the detectors are given in the State Plane Coordinate System (SPCS).

Dose rate results for the general area around the WCS CISF are summarized in Table 9-5. Dose rate results for the locations around the facility and PA of the WCS CISF are summarized in Table 9-6. Coordinates of the detectors are given in the SPCS.

9.4.1.2 Direct Dose Rate

The point detector output provides both the total and uncollided dose rate. The uncollided dose rate is representative of the "direct" component of the dose rate. The direct dose rate is provided in Table 9-5 and Table 9-6 in the "Direct" column.

9.5 Radiation Protection Program During Operation

The major radiation protection functions of the Radiation Protection Program during operations of the Cask Handling Building are described in this section. The WCS CISF Radiation Protection Program is planned and organized in accordance with the criteria of NRC Regulatory Guides 8.8 and 8.10, and NUREG-0761.

9.5.1 Organization and Functions

The corporate structure of the applicant for the WCS CISF is addressed in Section 13.1.

The organizational structure of the WCS CISF, including the setting of the Radiation Safety Officer, is addressed in Section 13.1.1.2 and depicted in Figure 13-1.

The Personnel Functions, Responsibilities, and Authorities of those with responsibilities in the Radiation Protection Program are addressed in Section 13.1.2.2.

The Qualification requirements of those with responsibilities in the Radiation Protection Program are addressed in Section 13.1.3.1.

The WCS CISF training program is addressed in Section 13.3. It includes both technical and radiological training topics for the WCS CISF. Additionally, the Radiological Training Program topics are covered below in Section 9.5.4.

9.5.2 Equipment, Instrumentation and Facilities

A sufficient inventory and variety of operable and calibrated portable and fixed radiological instrumentation will be maintained to allow for effective measurement and control of radiation exposure and radioactive material and to provide back-up capability for inoperable equipment. Equipment will be able to assess sources of gamma, neutron, beta, and alpha radiation, including the capability to measure the range of dose rates and radioactivity concentrations expected. Radiation protection procedures will govern instrument calibration, instrument inventory and control, and instrument operation.

Facility requirements to support the WCS CISF radiation protection functions are shared between the WCS CISF and ISP joint venture member Waste Control Specialists and are as follows.

- Instrument calibration area LLRW
- Personnel change rooms, including lockers
- Access control stations for entrance to and exit from radiation areas and, if needed, temporary contamination control areas
- Office space to accommodate Radiation Protection staff
- Counting laboratory

All Indicated Changes are in response to RAI NP-9-6

- Counting laboratory locations are shown in Figure 9-6. Figure 9-7 shows building layouts and general equipment for each laboratory.

Equipment and instrumentation provided to support radiation protection functions are as follows:

- A proportional counter for contamination smears to define surface contamination and the need for decontamination *with detection capabilities ≤ 1.5 cpm.*
- Hand and foot contamination monitors stationed at building exits to prevent the spread of contamination
- Portable monitoring equipment to augment fixed detector systems *with detection capabilities as follows; 0.1 mR/hr to 999.9 mR/hr and/or 0.1 R/hr to 999.9 R/hr for GM detectors, 0.2 – 50,000 mR/hr with selectable range scales from x1 - x10k for Ion Chambers, 0 - 10,000 mrem/hr for Moderated Neutron Detectors with Gamma rejection up to 10R/hr.*
- Personnel protective equipment and clothing
- Personnel dosimetry instrumentation and equipment, including the following:
  - Optically stimulated luminescence monitoring for permanent exposure records
  - Self-reading dosimeters for instantaneous readout and personnel exposure control
  - Computer hardware/software to record and analyze radiological monitoring/sampling and personnel exposure data.

Radiological instrument storage and maintenance will also be located in the Security and Administration Building, along with a low-radiation background count room containing *calibrated* laboratory equipment for measuring radioactivity. *Count room instrumentation will be calibrated onsite using NIST traceable sources per the manufacturer's specifications. Portable monitoring instrumentation will be calibrated at an offsite vendor with the proper calibration qualifications to perform such calibrations per the manufacturer's specifications to NIST traceable standards applicable to the nuclides of interest at the WCS CISF.*

All Indicated Changes are in response to RAI NP-9-5

Access to the PA is controlled through a single access point in the Security and Administration Building (see Figure 1-2, the WCS CISF Site Boundary Layout). Personal dosimetry is issued and controlled in this building to individuals entering the PA. External radiation dose monitoring will be accomplished through the use of dosimeters (OSLs or equivalent) and self-reading dosimeters (SRDs) or digital alarming dosimeters (DADs). All operating personnel inside the Cask Handling Building and on the storage pads will utilize alarming dosimeters during the canister transfer process to warn of excessively high direct radiation and provide further assurance that occupation exposures will not exceed the limits of 10 CFR Part 20. The official dose of record of external dose to *beta, gamma, and neutron radiation* will be obtained from the personal dosimetry issued to each Radiation Worker (OSL or equivalent), with *calibrated* SRDs or DADs used as a means for tracking dose between dosimetry processing periods and as a backup to the dosimeters.

The Radiation Protection Program addresses the use of respiratory protection equipment, self-reading dosimetry, dose tracking and methods for data analysis and interpretation. Provisions exist in the Security and Administration Building for donning and doffing personal protective equipment, which could be necessary in the event of contamination in the Cask Handling Building.

Contamination of equipment or personnel is not expected to occur under normal conditions of operation. In accordance with the ISP policy of preventing generation of liquid radioactive waste, any necessary decontamination of equipment and personnel will be conducted using methods that produce only solid radioactive waste. Decontamination methods would typically include wiping the contaminated item with rags or paper wipes.

During routine storage operations at the WCS CISF, the only radiological instrumentation in use in the storage area will be the dosimeters, as described in Section 9.3.5. Routine radiological surveys will use instruments that are controlled by the Radiation Protection Program and governed by existing procedures. Portable instrumentation is calibrated at an approved certified offsite vendor. Procedures for radiological instrumentation will be established and applied to instruments used at the WCS CISF.

- Perform, monitor and record environmental monitoring of boundaries.

9.5.4 Radiological Worker Training

Radiation workers at the WCS CISF will receive Radiation Worker training under the Radiation Safety Program. Rad Worker Training includes the following topics:

- *Technical Topics*
  - *Sources of radiation (natural and man-made),*
  - *Basic atomic and nuclear physics,*
  - *Types of radiation and their characteristics (alpha, beta, gamma, x-ray, neutron),*
  - *Radiation units,*
  - *Biological effects,*
  - *Risks of occupational exposure (NRC Regulatory Guide 8.29),*
  - *Radiation measurement and survey instruments,*
  - *External dosimetry (TLD, OSL, SRD, extremity),*
  - *Time, distance, and shielding,*
  - *Internal dosimetry methods (whole-body counting, urinalysis, and fecal analysis), contamination control (sources of contamination, protective clothing/PPE, controlled areas and exiting, and personnel surveys),*
  - *Personnel and equipment decontamination,*
  - *Airborne radioactivity,*
  - *Respiratory protection and coordination with industrial/chemical hazards,*
  - *Prenatal radiation exposure (NRC Regulatory Guide 8.13),*
  - *First aid considerations,*
  - *Radiological waste reduction,*
  - *Introduction to mock-up training.*
- *Administrative Topics*
  - *ISP radiation safety policy,*
  - *Role of the RSO and RST,*
  - *Authority of radiation safety personnel,*
  - *ALARA philosophy and practices,*
  - *Regulatory and administrative limits; minimizing exposure,*
  - *Federal and State Regulations and License provisions for the protection of personnel from radiation and radioactive material,*

- *Radiological postings,*
- *Radiological surveys (purposes, methods),*
- *Control and removal of contaminated equipment,*
- *Introduction to WCS CISF operational procedures (additional, separate training is required for procedural qualification),*
- *Introduction to ISP quality assurance (additional, separate training is required for procedural qualification),*
- *Investigation and reporting of abnormal exposures,*
- *Obtaining exposure records,*
- *Responsibilities of individuals,*
- *Radiological emergencies,*
- *Respiratory protection program,*
- *Radiation work permits (RWPs).*

The training session is followed by a written test, which must be passed at the 80% level of competency before unescorted access is allowed into a Restricted Area.

The RSO/Director of Health and Radiation Safety may authorize individuals with documented radiation safety training and experience from other sites or utilities, such as the DOE, to challenge any training requirement and demonstrate the requisite level of knowledge in radiation safety by:

- *Successfully passing a written exam that includes basic radiation safety training principles and facility/WCS CISF specific information; and*
- *Successful discussion and performance of practical factors.*

9.6.2.4 Environmental Monitoring

NP-9-3

ISP will establish a Radiological Environmental Monitoring Program (REMP) that will demonstrate compliance with 10 CFR 72.104. Details of this program are described in *Chapter 4 of the ISP Environmental Report and Figure 4.12-7 through Figure 4.12-12 show the locations being monitored under the current REMP program*.

In establishing the environmental monitoring program for SNF storage, ISP will build upon ISP joint venture member, Waste Control Specialists current monitoring program for ISP joint venture member, Waste Control Specialists *SP&D Facilities*. This program will include the following monitoring parameters: perimeter dosimetry (Landauer Inlight® Environmental X9 (beta/X/gamma) or equivalent), soil, and air locations. This program will be implemented by the radiation safety department in accordance with written procedures.

NP-9-4 and NP-9-3

Waste Control Specialists uses the Luxel+ Ta (beta/photon/neutron) dosimeter for area monitoring under the radiation safety area monitoring program *(minimum of eight locations on the inner fence of the PA)* and the Landauer Inlight® Environmental X9 (beta/photon) dosimeter for perimeter environmental monitoring program *at the OCA boundary (for reference, see Figure 6.1-1 in Chapter 6 of the ISP Environmental Report). Data from the Luxel+ Ta (beta/photon/neutron) dosimeters on the inner fence of the PA will be used to extrapolate the neutron dose, using the inverse square law and distance from the source term, at the OCA boundary. All dosimeters will be analyzed on a quarterly basis*. Environmental boundary air *and soil* monitoring (i.e., Low Volume air sampling and High Volume air sampling) will be performed at a minimum of two locations *on the north OCA boundary (for reference, see Figure 4.12-7 and Figure 4.12-9 in Chapter 4 of the ISP Environmental Report),* in addition to the locations currently performed under the REMP. Analyses will be for gross alpha/beta and gamma spectrometry and performed by a certified offsite laboratory *on a quarterly basis*. *Air samples will be collected monthly for each location and composited for a quarterly analysis. Soil samples will be collected and analyzed annually unless air samples indicate the need to take additional samples.*

9.6.3 Maximum Off-Site Annual Dose

The nearest residence in Lea County, New Mexico is approximately 4 miles from the WCS CISF at SPCS coordinate (541732.42, 6873002.59). At this distance, the computed total dose rate is 4.83E-14 mrem/hr. With continuous occupancy of 8,760 hours per year, the total dose is 4.23E-10 mrem, which is essentially zero and less than the dose from natural background radiation.

9.6.4 Liquid Releases

As described in Section 6.1.2.1, there are no radioactive liquid radioactive wastes to monitor for the WCS CISF.

9.8 Supplemental Data

The following Instrumentation Specifications are enclosed as noted below:

1. *Mirion Technologies Series 5 XLB Automatic Low Background Alpha/Beta Counting System*

2. *Ludlum Measurements, Inc., Model 9-3 Ion Chamber*

3. *Ludlum Measurements, Inc., Model 12-4 Neutron Dose Ratemeter*

4. *Ludlum Measurements, Inc., Model 78 Stretch Scope Exposure Ratemeter*

5. *Ludlum Measurements, Inc., Model 79 Carbon Fiber Stretch Scope*

Table 9-8
MCNP Neutron Cross-Sections, NUHOMS® Systems

Isotope	Cross-Section Library Source
1001.62c	ENDF/B-VI
5010.66c	ENDF/B-VI
5011.66c	ENDF/B-VI
7014.62c	ENDF/B-VI
8016.62c	ENDF/B-VI
11023.62c	ENDF/B-VI
13027.62c	ENDF/B-VI
14000.60c	ENDF/B-VI
19000.62c	ENDF/B-VI
20000.62c	ENDF/B-VI
22000.62c	ENDF/B-VI
26056.62c (soil)	ENDF/B-VI
26000.55c (concrete)	LANL/T
64000.35c	LLNL

Model 9-3
Ion Chamber Survey Meter

Ludlum Measurements, Inc.

Features

- Five Range Ion Chamber
- 1000 mg/cm^2 Retractable Beta Shield
- Low Battery Warning
- High Background Zero Capability
- Audio Proportional to Reading
- Rugged Construction
- Adjustable Shoulder Strap Included

Model 9-3 Ion Chamber
(shoulder strap not shown)
Below: Retractable Beta Shield

Specifications
Part Number: 48-3633

DETECTOR

RANGE: typically 0.2–50000 mR/hr
LINEARITY: reading within 10% of true value
ENERGY RESPONSE: within 20% of true value from 40 keV to 2 MeV
RESPONSE TIME: approximately 5 seconds for 90% of final meter deflection on the x1 and x10 scales, and 2 seconds on the x100, x1k, and x10k scales
CHAMBER VOLUME: 220 cm^3 (13.4 in^3)
WINDOW: 7 mg/cm^2 metalized polyester; with slide open, allows gamma detection to 6 keV
WINDOW AREA: 40 cm^2 (6.2 in^2) (31.5 cm^2 [4.9 in^2] open with optional 79% open screen)
CHAMBER CONSTRUCTION: carbon coated acrylic
BETA SHIELD: retractable 1000 mg/cm^2 phenolic slide
SIDE WALL: 1000 mg/cm^2 aluminum and acrylic

INSTRUMENT CONTROLS

ZERO ADJUST: allows limited background subtract, and also used to compensate for electrometer drift
AUDIO: On/Off; when On, click rate relates to meter reading
BAT TEST: pushbutton used to check battery capacity
RESET: causes chamber discharge to re-establish a current reading
RANGE SELECTION: instrument Off, plus x10k, x1k, x100, x10, and x1
CALIBRATION CONTROLS: individual potentiometers for each range

METER

METER: 6.4 cm (2.5 in.) arc, 1 mA, pivot-and-jewel suspension
METER DIAL: 0–5 mR/hr, BAT TEST (others available)
AUDIO: built-in unimorph speaker with ON/OFF switch
POWER: 2 each "AA" cell batteries housed in a sealed externally-accessible compartment
BATTERY LIFE: x100 and higher ranges at full scale without display light, 1050 hours; at x 1 and x10 in low background without display light, 1500 hours
CONSTRUCTION: cast and drawn aluminum with beige powder coating
TEMPERATURE RANGE: -20 to 50 °C (-4 to 122 °F), temperature compensation maintains calibration within 15% of 25 °C reading
SIZE: 23.4 x 8.9 x 21.6 cm (9.2 x 3.5 x 8.5 in.) (H x W x L) including instrument handle
WEIGHT: 1.6 kg (3.6 lb) including batteries

Ludlum Measurements, Inc. P.O. Box 810, Sweetwater, Texas 79556
Web: http://www.ludlums.com **Tel**: 800-622-0828 / 325-235-5494 / **Fax**: 325-235-4672 / **Email**: sales@ludlums.com

Feb 2019

Supplemental Data added in response to RAI NP-9-5

Model 12-4
Neutron Dose Ratemeter

Ludlum Measurements, Inc.

Features

- Moderated Neutron Detector
- Range: 0–100 mSv/h (0–10,000 mrem/hr)
- Gamma Rejection up to 0.1 Sv/h (10 R/hr)
- Rugged
- 4-Range Analog Meter
- Complete Turn-Key System

Specifications
Part Number: 48-1200

INDICATED USE: neutron dose rate
MEASUREMENT RANGE: 0–100 mSv/h (0–10,000 mrem/hr)
DETECTOR: ^{3}He proportional detector, 1.6 x 2.5 cm (0.6 x 1.0 in.) (D x L), surrounded by a 22.9 cm (9.0 in.) diameter cadmium loaded polyethylene sphere
SENSITIVITY: typically 10 cpm per µSv/h (100 cpm per mrem/hr) (bare AmBe neutrons)
LINEARITY: reading within 10% of actual value
ENERGY RESPONSE: provides an appropriate inverse RPG curve for neutrons from thermal through 7 MeV, provides response up to 12 MeV
GAMMA REJECTION: < 10 cpm through 0.1 Sv/hr (10 R/hr) (^{137}Cs gamma)
OPERATING VOLTAGE: approximately 1200 Vdc
THRESHOLD: -2 mV
WORKING ENVIRONMENT: splashproof shields for outdoor use
METER DIAL: 0–10 mrem/hr, 0–2.5 kV, BAT TEST (other dials available)
HIGH VOLTAGE: adjustable from 400–2500 V (can be read on meter)
DISCRIMINATOR: adjustable from 1–50 mV
CONTROLS:

1. Multipliers: x1, x10, x100, x1000
2. Response: toggle switch for FAST (4 seconds) or SLOW (22 seconds) from 10% to 90% of final reading
3. Reset: pushbutton to zero meter
4. HV Test: pushbutton to display the high voltage on the meter
5. Audio: built-in unimorph speaker (greater than 60 dB at 61 cm [2 ft]) with ON/OFF switch

CALIBRATION: accessible from front of instrument (protective cover provided)
POWER: 2 "D" cell batteries (housed in sealed compartment that is externally accessible)
BATTERY LIFE: typically 600 hours with alkaline batteries (battery condition can be checked on meter)
CONSTRUCTION: cast and drawn aluminum with beige powder coat finish
TEMPERATURE RANGE: -20 to 50 °C (-4 to 122 °F)
SIZE: 43.2 x 22.9 x 26.7 cm (17.0 x 9.0 x 10.5 in.) (H x W x L)
TOTAL WEIGHT: 8.3 kg (18.3 lb); with batteries

Options

Lighted Handle: (PN 4464-154) meter-illuminating self-contained handle with 3-position rocker switch (On, Off, OnCall)
Shoulder Harness (PN 4363-413) nylon strap with wide comfort pad help ease task of carrying heavier instruments
Carrying Case: (PN 2310377) rugged, foam-padded, padlockable transport and storage case with hinged lid & trunk stay
Portable Scaler Option: (PN 4464-114) adds scaler counting capability with digital readout to analog ratemeter
Headphones: headphones provide superior audio in noisy or crowded environments. Several models are available.

Ludlum Measurements, Inc. P.O. Box 810, Sweetwater, Texas 79556
Web: http://www.ludlums.com **Tel**: 800-622-0828 / 325-235-5494 / **Fax**: 325-235-4672 / **Email**: sales@ludlums.com

Nov 2017

Supplemental Data added in response to RAI NP-9-5

Model 78
Stretch Scope Exposure Ratemeter

Features
- 0.1 mR/hr to 1000 R/hr
- (Sv version also available)
- 1 m (42 in.) to 3.8 m (12.4 ft) Telescoping Stainless Pole
- Dual Analog/Digital Display
- Splashproof Buttons
- Energy Compensated GM Detectors

Introduction

The Model 78 Stretch Scope keeps the user a safe distance from high rad areas, and reaches areas difficult to access with other probes. The wide detection range is accomplished using dual energy-compensated GM detectors. The backlit digital LCD delivers precise 4-digit measurement values, which can be programmed to display units of R or Counts, and is accompanied by icons and messages for operational status of the instrument. Rate changes are conveniently viewed on the accompanying analog meter. Clip-on shoulder strap is included.

(shown with optional headset)

Specifications
Part Number: 48-2832

WORKING ENVIRONMENT: splashproof shields for outdoor use (environmental rating of IP52)
DETECTORS: 2 energy-compensated GM tubes
ENERGY RESPONSE: within 25% of true value from 60 keV–3 MeV
DISPLAY: 4-digit LCD display with 1.3 cm (0.5 in.) digits, and 6.4 cm (2.5 in.) analog meter
DISPLAY RANGE: 000.0-999.9 with indicators of mR/hr and R/hr (Sv display also available)
MEASURED RANGE: 0.1 to 999.9 mR/hr or 0.1 to 999.9 R/hr
BACKLIGHT/RESET: temporary action 2-position toggle switch to turn backlight on for preset amount of time, or zero meter and display
METER DIAL: 0–1k 4-decade logarithmic
RANGE SELECTION: 2-position toggle switch to select between mR/hr and R/hr
LINEARITY: reading within 10% of true value
AUDIO: built-in click-per-event audio with ON/OFF switch
RESPONSE: dependent on number of counts present: typical times FAST 4–25 seconds, or SLOW 4–60 seconds, from 10% to 90% of final reading
POWER: 2 "D" cell batteries (housed in sealed handle)
BATTERY LIFE: typically 250 hours with alkaline batteries (low battery indicated on display)
METER: 6.4 cm (2.5 in.) arc, 1 mA analog type
CONSTRUCTION: aluminum housing with beige powder coat paint, and polished stainless steel telescope
TEMPERATURE RANGE: -20 to 50 °C (-4 to 122 °F)
SIZE: 12.2 x 10.9 x 105.9 cm retracted; 377.2 cm fully extended (4.8 x 4.3 x 41.7 in. retracted; 148.5 in. fully extended) (H x W x L, fully extended L)
WEIGHT: 2.9 kg (6.4 lb), including batteries

Options:
Case: water, crush- and dust proof wheeled case with custom foam pads protect & transport instrument PN 4272-444
Headphone: dual volume controls, padded ear cups, adjustable head strap, 3 m (10 ft) cord PN 47-3708

Also Available
Model 78-1: same as above, but in Sv units (1 µSv/h to 10,000 mSv/h), Part No. 48-3743

Ludlum Measurements, Inc.

Ludlum Measurements, Inc. P.O. Box 810, Sweetwater, Texas 79556
Web: http://www.ludlums.com **Tel**: 800-622-0828 / 325-235-5494 / **Fax**: 325-235-4672 / **Email**: sales@ludlums.com

April 2016

Supplemental Data added in response to RAI NP-9-5

Model 79
Carbon Fiber Stretch Scope

Ludlum Measurements, Inc.

Features

- Light Weight - Approximately 1/3 the Weight of Comparable Instruments
- 1.1 m (45 in.) to 4.5 m (177 in.) Telescoping Carbon Fiber Pole
- 10 µSv/h–10 Sv/h (1 mR/hr–1000 R/hr)
- 1 µSv/h (0.1 mR/hr) Display Resolution
- Backlit Auto-Ranging LCD with Adjustable Viewing Angle
- Simple Green, Yellow, and Red Status Indicators
- 3-Button Intuitive Interface for Easy Operation
- USB Port and All-Digital Calibration

Introduction

The Model 79 Stretch Scope provides the operator with the ability to investigate areas of suspected gamma contamination while remaining at a greater distance from potentially high fields of radioactivity. The 4.5 m telescoping pole allows the attached detector to reach areas difficult to access with other types of instruments.

A large, easy-to-read LCD display rotates to maximize ease of viewing. Padded shoulder strap (included), warning tone, and easy, intuitive design are also featured. The unit's body is made of durable,high-impact, plastic with splash-resistant construction allowing outdoor use.

The Model 79 has three modes of operation - RATE, MAX, and COUNT. Measurements can be collected in two sets of units (primary and secondary) for RATE and MAX modes in cps, cpm, Sv/h, mrem/hr, and R/hr units. The user can choose by simply pressing the Units button. An internal switch is used to enable or disable the front-panel setup feature to protect desired settings from inadvertent modification. Setup is also available via software from Ludlum Measurements.

Specifications

Part Number: 48-3966 (*an adjustable shoulder strap is included*)

DETECTOR: Geiger-Mueller (GM)
ENERGY RESPONSE: Within 25% of true value from 60 keV to 3 MeV
LINEARITY: Reading within 10% of true value
LCD DISPLAY: 3 digit LCD with large 13.4 mm (0.53 in.) digits, (k)cps, (k)cpm, (k)Bq, (k)dpm, (µ)(m)R(/h), (µ)(m)Sv(/h), (µ)(m)rem(/h), low-battery indicator, MAX, ALARM, MUTE
DISPLAY RANGE: 0.0 cps to 99.9 kcps; 0.00 cpm to 999 kcpm; 0.00 Bq to 99.9 kBq; 0.00 dpm to 999 kdpm; 0.00 µR/h to 999 R/h; 0.00 µSv/h to 999 Sv/h; 0.00 µrem/h to 999 rem/h. Display range can be set to limit display to calibrated range
BACKLIGHT: Built-in ambient light sensor automatically activates low-power LED backlight, unless internal dipswitch is set to continuous-On (will reduce battery life). Alarm light intensity varies based on ambient light levels.
USER CONTROLS:

- ON/OFF/ACK - Press to turn ON; Tap to acknowledge alarms and silence alarm tone; Press to reset Sigma Audio alarm; Turn "click" audio On/Off; Turn Sigma Audio beep On/Off; Hold for OFF
- MODE - Alternates between NORMAL (count rate), MAX (captures peak rate), and COUNT (user-selectable preset count time from 0 to 10 minutes). Number of modes can be reduced in setup.
- UNITS - Changes the units between primary or secondary units

RESPONSE TIME: User-selectable from 1 to 60 seconds, or Auto-Response Rate FAST or SLOW
WARM-UP TIME: Less than 2 minutes
ALARMS: Count rate, exposure/dose, and scaler alarm setpoints adjustable over the display range
OVERLOAD: High count rate saturation protection prevents false display of lower count rates
ZERO PROTECTION: After a user-settable time interval (default 60 seconds) of no pulses from detector, the instrument will flash zero reading and the alarm audio will be triggered
DEAD TIME CORRECTION: Employs first and second order corrections for extended performance
AUDIO: greater than 75 dB at 0.6 (2 ft), approximately 4 kHz
POWER: two alkaline or two rechargeable "AAA" batteries
BATTERY LIFE: approximately 100 hours of operation, 24-hour low battery warning
CONSTRUCTION: display unit: high-impact plastic with separate battery compartment; telescoping pole: carbon fiber
TEMPERATURE RANGE: -20 to 50 °C (-5 to 122 °F), may be certified for operation from -40 to 65 °C (-40 to 150 °F)
SIZE: 20.3 x 8.1 x 114 cm retracted; 4.5 m fully extended (8.0 x 3.2 x 45 in. retracted; 177 in. fully extended) (H x W x L; extended L)
WEIGHT: 1.4 kg (3 lb), including batteries and shoulder strap

Options:

Stereo Audio Option: Part Number 4498-697
Lumic Calibration Software Kit: Part Number 4498-1020
Case: (right) water-, crush- and dust-proof case with custom foam pads to protect and transport instrument (Part Number 2312979)

Ludlum Measurements, Inc. P.O. Box 810, Sweetwater, Texas 79556
Web: http://www.ludlums.com **Tel**: 800-622-0828 / 325-235-5494 / **Fax**: 325-235-4672 / **Email**: sales@ludlums.com

May 2019

Supplemental Data added in response to RAI NP-9-5

MIRION TECHNOLOGIES

Series 5 XLB™

Automatic Low Background Alpha/Beta Counting System

KEY FEATURES

- Automatic single detector, ultra-low background counting system
- Enhanced low background capability
- Gas Stat digital gas conservation and monitoring system
- Fifty planchet sample changer with 100 sample capacity optional
- Molded low background passive shielding with interlocking design
- Reduced system footprint and integrated cart
- High performance dual anode 5.7 cm (2.25 in.) gas flow detector with ultra-thin gold sputtered window; single anode one inch detector option available
- Advanced electronic diagnostics continuously monitor operating conditions
- Universal auto-sensing power supply
- Coded positive sample carrier identification
- External or sample changer based bar code reader
- CE compliant

DESCRIPTION

Superior Counting Performance, Unparalleled System Features

The Series 5 XLB low background alpha/beta counter offers a completely integrated, computer controlled system for maximum flexibility.

The Series 5 platform is designed to count samples the way they are prepared in a laboratory. Sensible and smart, Series 5 counters provide integrated intelligence to satisfy the most demanding applications and routine analysis.

Enhanced Low Background and Productivity

Due to increasing environmental regulations to reach lower detection limits, sample count times have increased reducing the overall sample throughput in the laboratory. The Series 5 system incorporates enhanced technology to reduce system background and increase sample throughput. Using an improved guard detector, the system sensitivity for high energy, cosmic background is increased, enabling the anti-coincidence circuitry to detect and reject more spurious background events.

The beta background for the Series 5 counter has been reduced by as much as 35% over older systems. Beta backgrounds as low as 0.5 cpm can be achieved. This means that the Series 5 family of low background counters can count twice as many samples for a given detection limit as a counter with a beta background of 1.0 cpm – impressive performance from an impressive system.

Custom Molded Shield

Using a graded shielding system, the Series 5 system counts samples with more accuracy than any other low background counter.

The molded shield system provides 10 cm (4 in.) of custom molded lead surrounding the detector. The shield comprises interlocking modules which weigh no more than 27 kg (60 lb) each for safety and ease of assembly.

Supplemental Data added in response to RAI NP-9-5

Time Proven Reliability

The sample changer of the Series 5 family is time and field proven. The highly reliable design of the automated sample changer transports and counts samples day after day providing worry free operation. When work counts and time is precious, count on a system to deliver results and reliability.

Ultra-Thin Detector Windows

The standard gas flow detector of the Series 5 family of systems incorporates a high performance pancake-style 5.7 cm (2.25 in.) detector. The entrance window of the detector is made with state-of-the-art technology and special materials to provide the highest counting efficiency and the lowest alpha background of any counter.

Positive Sample Identification and Bar Code – The Advantage

Today's changing requirements demand sample identification that is maintained through the counting data. Data defensibility is a priority. The Series 5 system incorporates a unique combination of carrier and sample identification systems to maintain chain-of-custody. Two methods of sample identification are linked to the final data report. The sample carrier is uniquely coded for routine analysis. The Series 5 counter can be configured with an automatic sample bar code reader. When present, the sample bar code is automatically captured by Apex-Alpha/Beta™ software and stored with the sample count data, forming the missing link in sample custody in the count room. Only Mirion sample carriers are washable for easy cleaning and decontamination.

Circuitry So Advanced, It Thinks for Itself

The electronics package of the Series 5 family of counting systems provides the most advanced control and monitoring system available to assure accurate results. The Series 5 incorporates hardware diagnostics which continuously monitor internal and external parameters including gas pressure and flow, system voltage, power distribution, and other system critical parameters. The user is alerted on the front panel if any of these parameters falls below normal operation thresholds.

Human Factor Engineering

Often computer controlled analytical equipment requires additional laboratory space for the computer system and peripherals. The Series 5 counter addresses that problem with an integrated mobile cart that provides all of the support necessary for the computer, monitor, keyboard, and pointing device. The optional S5-ACCKIT includes a monitor support shelf tray, printer support tray, and a gas tank bracket. The retractable printer shelf opens to hold printer and supplies. The Series 5 system is designed to be a completely integrated, self contained counting system with the industry's smallest footprint.

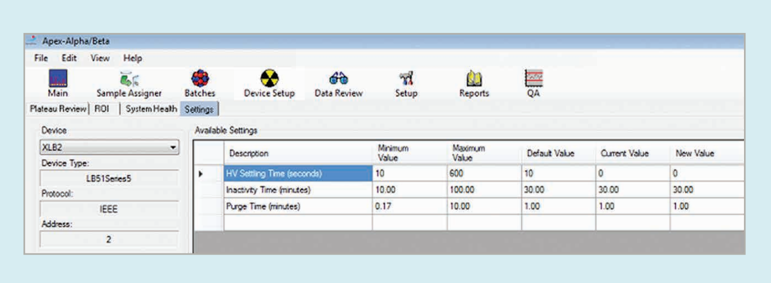
Gas Stat Gas Conservation System

Conventional low background counters have manual gas flow control and use the equivalent of a 1A gas cylinder on the average of once per six weeks. Changing gas supplies usually means re-verification of critical system calibrations which can be an unnecessary time consuming process. Not only time, but the impact on data quality can become significant issues when frequent re-calibrations must be performed, due to a change in gas quality.

The Series 5 system includes Gas Stat, the industry standard for gas management, which eliminates the high frequency of re-calibrations due to counting gas changes. Gas Stat is a microprocessor-controlled gas monitoring and control system that provides worry free operation by eliminating the need to adjust manual flow meters. The normal gas flow rate is set by the operator through software control, and flow rates are digitally displayed in real time on the computer screen.

The Series 5 hardware senses when the system is not counting samples, and automatically reduces the gas flow rate to a low quiescent flow to maintain detector gas quality. This prevents atmospheric impurities from diffusing into the detector and causing questionable results. When the user starts a count, Gas Stat automatically purges the detector and resets the flow rate to normal. Gas Stat uses a preset maximum flow rate for the detector purging; so, it is virtually impossible to cause window damage due to over pressurization.

Gas Stat effectively increases the useful life of the gas supply, thereby reducing the frequency of instrument re-verification, saving time and improving the quality of counting data.



Supplemental Data added in response to RAI NP-9-5

Software – Powerful and Flexible

The Series 5 counter has been designed to take full advantage of computer-based system integration. Series 5 XLB system can be operated with the legacy Eclipse™ software, or can use the state-of-the-art Apex-Alpha/Beta software to provide the optimum combination of power and ease of use for a low background system.

Apex-Alpha/Beta software includes a Microsoft SQL Server Express database for fast and efficient data storage. Custom reports can be easily developed for your application or presentation using an integrated reporting tool without the need for any third-party software. See the Apex-Alpha/Beta specification sheet for more detail on its advanced features.

Final activity results can be viewed on-screen for each sample as it is counted. An intuitive, symbolic icon tool bar provides access to functions at the push of a button.

No other counter can match the advanced automation capabilities and features of the Series 5 XLB counter and Apex-Alpha/Beta Software.

SPECIFICATIONS

*All specifications are based on measurements performed at a Mirion manufacturing facility with 5.7 cm (2.25 in.) detector with ultra-thin window, unless noted otherwise.

To achieve lower Beta background, the Gamma detector can be replaced with a Lead Plug (7081577).

PERFORMANCE

Background:

	WARRANTY	
	Standard system or Gamma system with lead plug installed	Gamma system with NaI detector installed
Gross (alpha+beta)	≤0.80 cpm	≤1.1 cpm
Alpha	≤0.1 cpm	≤0.1 cpm
Beta	≤0.75 cpm	≤1.0 cpm

Efficiency:

- 4π efficiency measured with a NIST traceable standard point source 5.08 x 0.3 cm (2 in. x 1/8 in.) planchet in 0.3 cm (1/8 in.) insert.

	Warranty
Alpha (^{210}Po)	≥38%
Beta (^{90}Sr/^{90}Y)	≥45%

- Counting efficiency is dependent on operating voltage, source thickness and distance from detector. Backscattering of high energy emitters produces higher than expected efficiency.

Spillover:

- ≤1.0% ^{210}Po alpha into beta channel with the system adjusted for a ≤0.1% spillover of ^{90}Sr beta into the alpha channel.

Detector Plateau:

- Alpha (^{210}Po) – ≤2.5% slope/100 V: ≥800 V plateau.
- Beta (^{90}Sr) – ≤2.5% slope/100 V: ≥200 V plateau.

Sample Count Rate:

- 500000 cpm with ≤1.5% deadtime loss.

Counting Time Preset:

- Adjustable between 0.2 and 9999 minutes.

PHYSICAL

Sample Changer Capacity:

- Standard – 50 samples.
- Optional – 100 samples.

Weight:

- Net weight less cart – standard system 324 kg (716 lb).
- Net weight cart with casters 54 kg (120 lb).

Dimensions:

(Height x Width x Depth)

- Table Top Model – 37 x 58 x 76 cm (14.5 x 23 x 30 in.).
- With 50 Sample Capacity – 75 x 58 x 76 cm (29.5 x 23 x 30 in.).
- With 100 Sample Capacity – 124 x 58 x 76 cm (49 x 23 x 30 in.).
- Cart With Casters – 76 x 58 x 76 cm (30 x 23 x 30 in.).

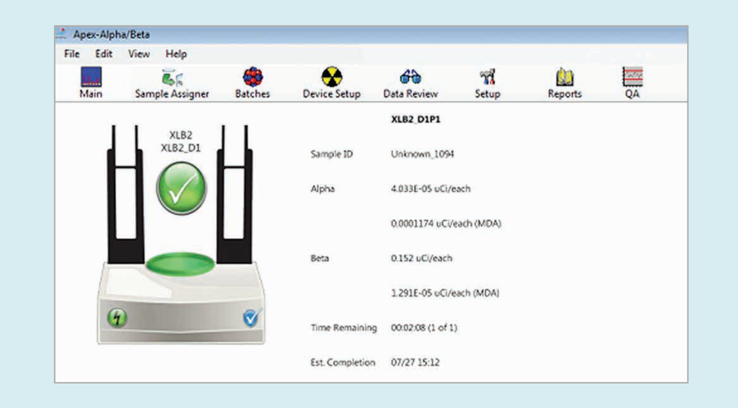
POWER REQUIREMENTS

The Series 5 counter is equipped with a universal power supply and automatically adapts to voltage and frequency.

- 100–240 V ac at 50/60 Hz.
- 100 W maximum.

ENVIRONMENTAL

- Operating Temperature – 0 to 50 °C (32 to 122 °F).
- Operating Humidity – 0 to 80% relative, non-condensing.
- Meets the environmental conditions specified by EN 61010, Installation Category I, Pollution Degree 2.



Software – Powerful and Flexible

Supplemental Data added in response to RAI NP-9-5

ORDERING INFORMATION

5XLB Models:

These models include on-site installation and one year on-site warranty. Requires computer, monitor, printer and Apex-Alpha/Beta (S556C) Software.

- S5X2050 – Includes basic S5XLB counter, 2.25 in. detector, 50 sample towers, carrier plates, carrier inserts (5/16 & 1/8 deep), planchets and cart.
- S5X2100 – Includes basic S5XLB counter, 2.25 in. detector, 100 sample towers, carrier plates, carrier inserts (5/16 & 1/8 deep), planchets and cart.
- S5XG2050 – Includes S5XLB counter with gamma option, 2.25 in. gas flow detector, 2X2 NAI, 50 sample towers, carrier plates, carrier inserts (5/16 & 1/8 deep), planchets and cart.
- S5XG2100 – Includes S5XLB counter with gamma option, 2.25 in. gas flow detector, 2X2 NAI, 100 sample towers, carrier plates, carrier inserts (5/16 & 1/8 deep), planchets and cart.

Export 5XLB Models:

Models with “E” do not include on-site installation. Requires computer, monitor, printer and Apex-Alpha/Beta Software.

- S5X2050E – Includes basic S5XLB counter, 2.25 in. detector, 50 sample towers, carrier plates, carrier inserts (5/16 & 1/8 deep), planchets and cart.
- S5X2100E – Includes basic S5XLB counter, 2.25 in. detector, 100 sample towers, carrier plates, carrier inserts (5/16 & 1/8 deep), planchets and cart.
- S5XG2050E – Includes S5XLB counter with gamma option, 5.7 cm gas flow detector, 50.8 x 50.8 mm NAI, 50 sample towers, carrier plates, carrier inserts (7.9 & 3.2 mm deep), planchets and cart.
- SXG2100E – Includes S5XLB counter with gamma option, 5.7 in. gas flow detector, 50.8 x 50.8 mm NAI, 100 sample towers, carrier plates, carrier inserts (7.9 & 3.2 mm deep), planchets and cart.

MISCELLANEOUS

- AB-CPU7 – Windows 7 PC with LCD monitor.
- AB-CPU10 – Windows 10 PC with LCD monitor.
- S556C – Apex-Alpha/Beta Software.
- S550C – Eclipse Software (Existing Eclipse Users Only).
- LB-Integ – Integration of customer supplied computer.
- 488PCI – IEEE-488 Card and Cable (PCI Bus).
- 488USB – IEEE-488 Interface (USB).
- S5-ACCKIT – S5 Mobile Cart Accessory Kit including Monitor Tray, Printer Tray, and Gas Tank Bracket.
- XLB-GR – Single Stage Gas Regulator.

ACCESSORIES

- 6200-12 – Carrier Inserts 2 x 1/16 in.
- 6200-13 – Carrier Inserts 2 x 1/8 in.
- 6200-14 – Carrier Inserts 2 x 1/4 in.
- 6200-09 – Carrier Inserts 2 x 5/16 in.
- 6200-21 – Carrier Inserts 1 x 1/16 in.
- 6200-22 – Carrier Inserts 1 x 1/8 in.
- 6200-23 – Carrier Inserts 1 x 1/4 in.
- 6200-24 – Carrier Inserts 1 x 5/16 in.
- 6200-137 – Plastic Carrier Inserts 2 x 1/4 in.
- 6200-96 – Carrier Plates Coded 1–50
- 6200-97 – Carrier Plates Coded 51–100
- 6200-88 – Carrier Plates Coded 101–150
- 1750-06 – Group Plates A – E
- 1750-07 – Group Plates F – J
- 1400-156 – Uncoded Carrier Plates
- 1750-475 – End Carrier Plates
- 1750-23 – Carrier Plate Cassette
- 6200-476 – 60 mm Carrier Insert Disk
- 6200-477 – 60 mm Carrier Insert Ring

Replacement Detectors and Windows

- S5-F2 – 2.25 in. detector for XLB, S5E and Solo
- WIND280 – Replacement premium 2.25 in. ultra-thin window
- WIND280AL – Replacement standard 2.25 in. thin window

ISO 9001 SYSTEM CERTIFIED — MERIDEN CT, SMYRNA GA, OAK RIDGE TN, CONCORD ON

CANBERRA

Supplemental Data added in response to RAI NP-9-5

11.5 Protection of Stored Materials from Degradation

The canister materials for the authorized design were selected such that degradation is not expected during normal conditions of transport to the WCS CISF and the storage period at the WCS CISF.

As described in Section 7.2, it is required that packages received at the WCS CISF are loaded in accordance with SAR and regulatory requirements applicable at the site where the SNF was originally loaded and stored. To provide assurance that the packages received at the WCS CISF are acceptable for storage, prior to receipt of a canister, a records review is performed to verify that the canister being received was fabricated, loaded, stored and maintained in accordance with the Site Specific or General License requirements and will comply with WCS CISF License Conditions and Technical Specifications. In addition, a receipt inspection of the canisters is performed upon arrival at the WCS CISF, which includes a post transport package evaluation in accordance with reference [11-2].

In order to assure that only conforming canisters are shipped to the WCS CISF, Section 1.2.4 of the SAR and Condition 9 of the proposed Materials License for the WCS CISF describe in detail the canisters that are acceptable for storage at the CISF. SAR Section 1.2.4.2 Pre-Shipment Review of Canisters, describes the process that ISP will use to verify that every spent fuel canister received at the WCS CISF complies with the terms, conditions of use, and technical specifications of one of the six storage systems listed in Section 2.1 of the Technical Specifications, when stored in the canister's approved overpack. ISP will not provide its permission to shipper to release a canister for shipment to the CISF until it has been confirmed that the canister meets the requirements. In accordance with 10 CFR 73.37(b)(1)(ii), the shipper must "coordinate shipment itineraries to ensure that the receiver at the final delivery point is present to accept the shipment."

In the highly unlikely event that a non-conforming canister is found as part of receipt inspection, the canister will be placed in a safe condition and the issue will be entered into the ISP Corrective Action Program and the corrective action would be subject to a reportability determination in accordance with 10 CFR Part 21, 10 CFR 72.242, 10 CFR Part 71.95, 49 CFR Part 171.15, and other regulations that may apply. The ISP reportability determination procedure provides the regulatory requirements for reporting to the appropriate agency, including deadlines for such notifications. The non-conforming canister will need to be evaluated on a case by case basis and depending on the specific conditions of the canister. The canister will be immediately placed in a safe condition and, following the applicable evaluations, the appropriate licensing actions will be initiated to resolve the situation. The corrective actions will include, but not be limited to the following:

1. *Notifying the NRC as required. Conferring with the NRC as needed.*

All Indicated Changes are in response to RAI NP-11-4

2. *Maintaining the canister inside the transportation cask in its transportation configuration until appropriate corrective actions are determined. The safety for temporary storage will be confirmed using Part 71 analysis as appropriate.*

3. *Developing an action plan with a timeframe which will include input from the NRC discussions.*

4. *Obtaining agency approvals as necessary.*

5. *Proceeding with corrective actions.*

The timeline by which a canister will be returned to the place of origin, or other facility licensed to perform fuel loading procedures, will depend on the specific corrective actions required to address the condition identified by the corrective action evaluation performed. As discussed above, this event will be extremely rare and will not result in a number of canisters with this condition.

The design and licensing basis for all of the canisters acceptable for storage at the CISF is that confinement is maintained for all normal, off-normal, and accident conditions of storage at the originating site and during storage at the WCS CISF. In addition, the design and licensing basis for the WCS CISF demonstrates that the canisters maintain confinement for all normal conditions of transport in the transportation cask used to transport the canister to the CISF. Therefore, there is no credible scenario under which a canister will fail the post-transportation leakage test. The post-transportation leakage test is not part of the design or licensing basis for the continued integrity of the confinement boundary for the canisters, rather, as described in SAR Section 5.1.3.1, it is a prudent measure being taken to confirm that a canister remains able to perform its safety function and is, therefore, acceptable for storage at the WCS CISF.

In addition, the License Condition 20 requires that the CoC 1004 aging management program (AMP) be incorporated in this WCS CISF license for the NUHOMS® Systems upon approval by the NRC. Similarly, License Condition 20 requires that as the AMPs for the NAC International systems are approved by the NRC, these also are incorporated into this WCS CISF license. The AMPs are applied based on the age of the canister when it was originally loaded under the applicable Site Specific or General License at the site of origin.

Fuel cladding integrity is ensured by maintaining the storage cladding temperatures below levels that are known to cause degradation of the cladding. In addition, the SNF is stored in an inert helium atmosphere to prevent degradation of the cladding, specifically cladding rupture due to oxidation and its resulting volumetric expansion of the SNF.

There is no significant degradation of any safety components caused by the effects of galvanic or chemical reactions or by the effects of the reactions combined with the effects of long-term exposure of the materials to neutron or gamma radiation, high temperatures or other possible conditions.

The Texas & New Mexico Railway at its closest point, is approximately 4.8 miles from the west OCA boundary of the WCS CISF. Using the methodology of Regulatory Guide 1.91, the maximum probable hazardous solid cargo for a single box car is 132,000 lbs, and detonation of this quantity of explosive could produce a 1 psi overpressure at a distance of approximately 2,300 ft (0.44 mile) from the detonation which does not approach the location of the WCS CISF. Considering for the possibility that multiple boxcars of explosive material are connected in a single train and multiple boxcars explode in the same event shows that ten completely full boxcars exploding in the same event produce 1 psi of overpressure at a distance of 5,000 feet from the detonation. This distance is much less than the distance to the WCS CISF. The weight of explosive material required to exceed 1 psi of overpressure at the WCS CISF makes the situation extremely unlikely under normal transportation conditions due to the configuration limitations (as the length of the train increases each successive rail car gets further away from the WCS CISF).

The Waste Control Specialists rail spur and loop exits the Texas & New Mexico Railway near Eunice, New Mexico as shown in updated SAR Figure 2-3. This spur continues east until it reaches the existing Waste Control Specialists facility where it forms a loop around the facility. The rail side track to the WCS CISF will begin by connecting to the northwest side of the existing loop and terminate by re-connecting at the north side of the loop. This rail line is completely controlled by ISP joint venture member Waste Control Specialists and limited to approved Waste Control Specialists waste shipments and transport casks. Railcars carrying contents with the potential to adversely affect the CISF will not be permitted on the Waste Control Specialists rail spur and loop. Fire and explosion precautions for the WCS CISF rail side track are discussed in Section 3.3.6 of the SAR.

The effects of explosions on the storage systems are discussed in the SAR Appendices, Sections A.12.2.5, B.12.2.5, C.12.2.5, D.12.2.5, E.12.1.2, E.12.2.2, F.12.1.2 and G.12.1.2, and it is determined that the canisters are protected from the effects of explosions. Overpressures of substantially greater than 1 psi would be required to cause damage to the cask storage systems.

Permian Basin Materials, LLC (PBM) operates an aggregates quarry and concrete ready mix facility in New Mexico near the CISF. PBM shares a property boundary with Waste Control Specialists and this boundary is approximately 4,000 feet from the CISF Protected Area. Actual blasting activities are further away but distances vary depending on exact locations.

All Indicated Changes are in response to RAI NP-12-3

PBM does not hold permits or licenses with the U.S. Bureau of Alcohol Tobacco and Firearms (BATF) or any other state or federal agency authorizing storage of explosives on their property. Blasting activities are conducted by PBM's blasting contractor, ORICA USA, who delivers the blasting agents to the quarry by truck. The blasting agents are delivered, placed, and detonated all in the same day so that no explosives are stored at the quarry. The fact that delivery, placement, and blasting must occur on the same day limits the amount of explosives that can be delivered in one day. The blasting contractor has indicated that blasting at the quarry occurs approximately once a month and up to 11,000 lbs of explosives are used in a typical single day blasting event. Any unused explosives are removed from the PBM site at the end of each day [12-8].

There are several types of explosives used in the mining and quarry industry and the type of explosive used is generally determined by the regional geology. PBM's contractor has been using Ammonium Nitrate/ Fuel Oil (ANFO) as their blasting agent. ANFO has the added safety benefit in that it is shipped on the same truck as a binary explosive with the Ammonium Nitrate in a separate compartment from the Fuel Oil. The truck drives to each individually pre-drilled hole, where the specific weight of explosive is mixed and poured into the hole.

Trucks that deliver explosives to PBM are regulated by U.S. Department of Transportation regulations [12-10] that establish maximum gross vehicle weights at 80,000 lbs resulting in a maximum cargo weight of under 50,000 lbs. This is consistent with guidance from Regulatory Guide 1.91 [12-11] which recommends using 50,000 lbs of equivalent weight TNT for a postulated accident involving a truck on a highway.

Based on the typical blasting activities and regulations precluding storage of explosives, the guidance in Regulatory Guide 1.91 provides a reasonable evaluation of the hazard associated with the PBM quarry to the CISF. This evaluation establishes that an acceptable safe distance for an explosion involving 50,000 lbs of equivalent weight TNT is approximately 1,660 feet from the point of detonation which is well short of the CISF.

If future operations require the storage of explosives on site, such storage will be limited by BATF regulation 27 CFR 555.218, "Table of Distances for Storage of Explosive Materials (High)" [12-9]. This table establishes that the minimum safe distance from an unbarricaded stockpile of 300,000 lbs of high explosives to inhabited buildings shall be 2,275 feet. This safe distance is well below the 4,000 feet between the CISF PA and the PBM property line providing assurance that future operations at the quarry will not impact the CISF.

Immediately south of the proposed WCS CISF is the currently operating Waste Control Specialists commercial waste disposal facility. This site has 12 fixed fuel tanks (Table 2-20) ranging in size from under 300 gallons to 8,000 gallons in size containing either diesel fuel, gasoline, or propane. Three of the twelve tanks are collocated in a cluster. These three tanks are the MWTF Diesel Tank (red), the MWTF Diesel Tank (green), and the MWTF Gasoline Tank. These three tanks consist of a total of 8,500 gallons of diesel fuel and 5,000 gallons of gasoline.

Regulatory Guide 1.91 [12-11] was established to determine acceptable distances from explosions at which no significant damage would be expected. The guidance establishes the safe distance where the overpressure from the explosion is less than 1.0 psi.

Gasoline and diesel fuel are not explosive compounds and only have explosive potential if they are allowed to vaporize and mix with oxygen. Potential vaporization would only be the result of a tank leak or tank collapse allowing the liquid fuel to be released and then to vaporize.

Utilizing the guidance [12-11] for vapor cloud explosions, an evaluation of the collocated tanks [12-12] determines that the safe distance from the cluster of fuel tanks is 454 feet. This distance is significantly less than the 4,400 feet that exists between the cluster of tanks and the CISF Protected Area (PA) boundary.

In addition to the three collocated tanks, the evaluation [12-12] uses similar methodology to model the potential Vapor Cloud Explosion that could result from failure of the 5,000 gallon propane tank. The model shows that the safe distance from the propane tank is 1,010 feet. This distance is significantly less than the 4,340 feet that exists between the propane tank and the CISF PA boundary.

As indicated in Table 2-20, these evaluated cases bound all of the fixed diesel/gasoline tanks and the propane tanks at the existing Waste Control Specialists facility. In addition to the fixed tanks, Waste Control Specialists has three 475 gallon mobile diesel tanks used for fueling heavy equipment in the field. Applying the results from the evaluation of the larger collocated tanks [12-12], the Owner Controlled Area boundary provides 660 feet of standoff distance from the Protected Area of the CISF. This is more than adequate to provide safe distance from an accident involving the mobile diesel tanks.

Oil industry pipelines are located near the facility. *A natural gas pipeline owned by Energy Transfer LP (previously owned by Sid Richardson Energy Services Company) runs parallel to Texas State Hwy 176 within an easement on Waste Control Specialists property. An evaluation assessing the hazards to the WCS CISF due to a pipeline leak and subsequent vapor cloud explosion following the guidance of Regulatory Guide 1.91 determined that the distance between the pipeline and the WCS CISF is sufficient to preclude any adverse impacts to the facility [12-7].*

All Indicated Changes are in response to RAI NP-12-4

12.3 References

12-1 NRC Regulatory Guide 3.48, "Standard Format and Content for the Safety Analysis Report for an Independent Spent Fuel Storage Installation or Monitored Retrievable Storage Installation (Dry Storage)," Rev. 1.

12-2 American National Standards Institute, American Nuclear Society, ANSI/ANS 57.9 1984, Design Criteria for an Independent Spent Fuel Storage Installation (Dry Storage Type).

12-3 Proposed SNM-1050, WCS Consolidated Interim Storage Facility Technical Specifications, Amendment 0.

12-4 *Emergency Response Guide 128, Emergency Response Guidebook (2016), U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration.*

12-5 NUREG-1567, "Standard Review Plan for Spent Fuel Dry Storage Facilities," Revision 0, U.S. Nuclear Regulatory Commission, Office of Nuclear Material Safety and Safeguards, March 2000.

12-6 NUREG-1536, "Standard Review Plan for Spent Fuel Dry Storage Systems at a General License Facility," Revision 1, U.S. Nuclear Regulatory Commission, Office of Nuclear Material Safety and Safeguards, July 2010.

12-7 ISP Calculation "Hazard Analysis of Gas Pipeline for WCS CISF," WCS01-0211, Revision 0.

12-8 Permian Basin Materials. Personal communications between M. Ulibari, Permian Basin Materials, D. Maggard, ORICA USA, C. Patterson, ORICA USA, A. Melton, ORICA USA, and B. Mason, Waste Control Specialists LLC, April 2019.

12-9 27 CFR Part 555, Commerce in Explosives, U.S. Bureau of Alcohol Tobacco and Firearms (BATF), U.S. Department of Justice.

12-10 23 CFR Part 655, Traffic Operations, Federal Highway Administration, U.S. Department of Transportation

12-11 Regulatory Guide 1.91, "Evaluation of Explosions Postulated to Occur at Nearby Facilities and Transportation Routes Near Nuclear Power Plants," Revision 2, Nuclear Regulatory Commission.

12-12 ISP Calculation "Fuel Tank Evaluation," WCS01-0212, Revision 0.

RAI NP-12-3

RAI NP-12-4

13.2.4 Operating Startup Plan

An operating startup plan will be prepared to implement the procedures necessary for the initial receipt of spent fuel and GTCC waste at the WCS CISF site, and the subsequent transfer of the spent fuel and GTCC waste to storage. The startup plan will be submitted to the NRC at 90 days prior to the initial receipt and storage of spent fuel and GTCC waste at WCS CISF. The plan will identify specific operations unique to the initial handling of spent fuel and GTCC waste to be placed into storage. The operating startup plan will also include reviews and tests of the operating procedures, confirmation of radiation exposure times and received doses, direct measurement of radiation dose rates from transportation and transfer casks and storage systems, evaluation of shielding methods, verification of heat removing features in accordance with the technical specifications, and notification to the NRC of the first loaded cask placed in storage.

The operating startup plan will be implemented for the initial receipt and transfer of spent fuel and GTCC waste and placement into storage. Upon completion of the plan, the effectiveness of procedures, actions, and equipment will be evaluated and documented to improve operations for subsequent spent fuel shipments.

All Indicated Changes are in response to RAI NP-13-2

A.4.4 Storage Module Thermal Monitoring System

As described in Section 5.1.3, HSM Thermal Monitoring Program of the Technical Specifications [A.4-3], *daily visual inspection of the inlet and outlet vents of the HSM and removing any identified debris* prevent*s* conditions that could lead to exceeding the concrete and SNF clad temperature criteria. *In addition, instrumentation that can be used for monitoring HSM roof concrete temperatures is also provided for each HSM.*

All Indicated Changes are in response to RAI TS-4

24. Replace the TC top cover plate and ram access cover plate. Secure the skid to the transfer vehicle.

25. Move the transfer vehicle and TC to the designated area. Return the remaining transfer equipment to the Storage Area.

A.5.1.3 Monitoring Operations

1. Perform routine security surveillance in accordance with the security plan.

2. Perform a daily visual surveillance of the HSM air inlets and outlets (bird screens) to verify that no debris is obstructing the HSM vents in accordance with Section 5.1.3(a) of the Technical Specification [A.5-2] requirements.

A.7. STRUCTURAL EVALUATION

This Appendix describes the structural evaluation of the NUHOMS®-MP187 Cask System components utilized for transfer and storage of canisterized spent nuclear fuel (SNF) and Greater Than Class C (GTCC) waste at the WCS Consolidated Interim Storage Facility (WCS CISF). As presented in Chapter 1, Table 1-1, the NUHOMS®-MP187 Cask System includes the FO-, FC-, FF- Dry Shielded Canisters (DSCs or canisters); GTCC waste canisters; and the HSM Model 80 storage overpack as the storage components, and the MP187 cask as the on-site cask for handling and transfer operations. The canisters and the MP187 cask are described in detail in Section 4.2, Volume I of the Rancho Seco Independent Spent Fuel Storage Installation Final Safety Analysis Report (ISFSI FSAR) [A.7-4]. The HSM Model 80 is described in detail in Section 4.2.3.2 of the Standardized NUHOMS® Updated Final Safety Analysis Report (UFSAR) [A.7-3]. All three components are NRC-approved [A.7-1] [A.7-6] for SNF and GTCC waste canister transfer and storage under the requirements of 10 CFR Part 72. This appendix is prepared to demonstrate that these licensed NUHOMS®-MP187 Cask System components are also qualified to safely transfer and store canisterized SNF and GTCC waste that is currently in storage at the Rancho Seco ISFSI at the WCS CISF in accordance with the requirements of 10 CFR Part 72.

The evaluation of the MP187 cask as the on-site transfer cask is contained in Volume I and Volume III of [A.7-4]. The evaluation of the canisters is contained in Volume I and Volume II of [A.7-4]. The evaluation of the HSM Model 80 is contained in Chapter 8 of [A.7-3].

Except for the seismic reconciliation evaluation presented in Section A.7.5, and the qualification of the canister confinement boundaries during Normal Conditions of Transport in Section A.7.7 *(to provide reasonable assurance that the confinement boundary is not adversely impacted by transport to the WCS CISF)*, no new structural analyses are presented in this appendix. This appendix demonstrates that (with the exception of the seismic reconciliation evaluation) the structural evaluations contained in [A.7-4] and, as applicable, in [A.7-3] are bounding for the WCS CISF.

All Indicated Changes are in response to RAI NP-A-3

The MP187 cask is a multi-purpose cask designed and evaluated as a transfer cask for use in loading HSMs under 10 CFR Part 72 [A.7-1] [A.7-4] and as a transportation cask for off-site shipments under the provisions of 10 CFR Part 71 [A.7-2] [A.7-7]. The evaluation of the MP187 cask as a transfer cask is based on Revision 13 of drawing NUH-05-4001 (Cask Main Assembly) and Revision 8 of NUH-05-4003 (Cask On-Site Transfer Arrangement), as shown in Volume IV of [A.7-4]. The current revision of NUH-05-4001 is Revision 15 as shown in Section 1.3.2 of [A.7-7]. *The changes between Revisions 13 and 14 and 14 and 15 of Drawing NUH-05-4001 update Bill of Material Quantities for some washers; allow for electroless nickel coating for washers a cap head screw and a pin; add some chamfer and radius details at the bottom end closure; and update company name in title block. These changes do not impact the design criteria related to loads and load combinations and do not impact structural performance margins. Therefore there* are no significant design differences in the cask main assembly configuration between these two revisions.

Furthermore, as described in Chapter 3 the design criteria for the Rancho Seco ISFSI envelops the design criteria for the WCS CISF, except for the site-specific seismic criteria, which are reconciled in Section A.7.5. Therefore, the 10CFR Part 72 evaluations of the MP187 cask performed in [A.7-4] are applicable and the current configuration of the MP187 cask is acceptable for use as a transfer cask at the WCS CISF.

Finally, bounding evaluations in Section A.7.7 are performed to demonstrate that the confinement boundaries for the FO-, FC-, FF-DSCs do not exceed ASME B&PV Subsection NB Article NB-3200 (Level A allowables) during normal conditions of transport to provide reasonable assurance that the confinement boundary is not adversely impacted by transport to the WCS CISF.

All Indicated Changes are in response to RAI NP-A-4

A.11.1 Confinement Boundary

The confinement boundary for the FO-, FC- and FF-DSCs is documented in Section 3.3.2.1 of [A.11-1]. Reference [A.11-1] does not include a figure showing the confinement boundary for the FO-, FC- and FF-DSCs. However, Figure 7.1-1 of reference [A.11-12] provides a figures that shows the component and welds that make up the confinement boundary for the 24PT1-DSC which is also applicable to the FO-, FC-, and FF-DSCs with one exception, the FO-, FC-, and FF-DSCs do not have a "helium Leak Test Plug" in the Outer Top Cover Plate. Drawings for the canisters, including the confinement boundary are referenced in Section A.4.6.

The canisters will not release radioactive contents under all normal, off-normal, and accident conditions; see Section 3.3.2 and Section 8.2.2 of [A.11-1]. However, during fabrication and closure operations the confinement boundary was leak tested to 10^{-5} *ref*-std cm^3/sec in accordance with ANSI N14.5 [A.11-2]. Therefore, for these canister designs, a non-mechanistic release is postulated based on a leakage rate of 10^{-5} *ref*-std cm^3/sec. In addition, bounding evaluations in Section A.7.7 are performed to demonstrate that the confinement boundaries for the FO-, FC-, FF-DSCs do not exceed ASME B&PV Subsection NB Article NB-3200 (Level A allowables) during normal conditions of transport to provide reasonable assurance that the confinement boundary is not adversely impacted by transport to the WCS CISF.

Section 4.3, Codes and Standards, of the Technical Specifications for the Rancho Seco ISFSI [A.11-11] cites the applicable ASME Code for the MP187 FO-, FC-, and FF-DSCs.

Section 3.1, "DSC Integrity," of the Technical Specifications for the Rancho Seco ISFSI; [A.11-11] includes limiting condition for operation (LCO) 3.1.1 for DSC vacuum pressure, LCO 3.1.2 for DSC helium leakage rate, and LCO 3.1.3 for DSC helium backfill pressure. These LCOs create dry, inert, leak tight atmosphere, which contributes to preventing the leakage of radioactive material.

All Indicated Changes are in response to RAI NP-A-2

A.11.2 Potential Release Source Term

As noted in Section A.11.1 the FO-, FC-, FF- DSCs, a non-mechanistic leakage rate of 10^{-5} *ref*-std cm^3/sec is postulated. The actinides and fission products for a B&W 15x15 fuel assembly are computed using SCALE6/ORIGEN-ARP. Two isotopic sets are considered, based on the design basis neutron and gamma sources. The design basis neutron source has a burnup of 38,268 MWd/MTU, enrichment of 3.18% U-235, and was discharged in 1983. The design basis gamma source has a burnup of 34,143 MWd/MTHM, enrichment of 3.21% U-235, and was discharged in 1989. The two source terms considered are decayed until June 2020, which corresponds to the placement of the first canisters at the WCS Consolidated Interim Storage Facility (WCS CISF). The reported source term in Table A.11-1 is the maximum value of the two isotopic sets considered. The design basis radioactive inventory for the confinement evaluation included in reference [A.11-1] was determined using these same bounding fuel assemblies as documented in Section 7.2.1 of Volume I of [A.11-1] (See also calculation 2069-0507, Revision 0 included in Volume IV of [A.11-1]).

The crud source is determined based on 140 μCi/cm^2 Co-60 on the surfaces of the SNF rods at the time of discharge [A.11-3]. The design basis gamma assembly was discharged in 1989, or 31 years decay until loading. Therefore, the crud source term in Table A.11-1 is decayed 31 years.

A.11.3 Confinement Analysis

Per Section A.11.1 the FO-, FC-, FF- DSCs, a non-mechanistic leakage rate of 10^{-5} *ref*-std cm^3/sec is postulated. A confinement analysis is performed for normal, off-normal, and accident conditions to determine the dose to an individual due to inhalation and ingestion. There is no credible mechanism that would produce a leak of this magnitude through the confinement boundary of the canister. All welds in the canister shell are volumetrically examined, as is the weld between the inner bottom cover plate and the shell. Because it is not feasible to volumetrically examine the inner top cover plate weld, this weld is leak tested in accordance with the stated criteria. However, no credit is taken for the presence of the outer top cover plate, which is welded to the canister shell with a 0.5 inch weld that receives no fewer than three levels of dye-penetrant testing. The releases postulated in this analysis, therefore, are several orders of magnitude greater than any expected release.

A.11.3.1 Methodology

1. Calculate the specific activity (Ci/cm^3) in the canister cavity for each radioactive isotope based on the rod breakage fractions, release fractions, isotopic inventory, and cavity free volume. It is conservatively assumed that every SNF assembly in every canister has the same radiological source as the design basis SNF assembly. This assumption is conservative because many SNF assemblies will have less activity than the design basis source. Two sets of release fractions are considered: fuel-to-canister release fractions and Canister-to-Environment release fractions. The fuel-to-canister release fractions are the fraction of isotopes released from the interior of the SNF rod to the internal void region of the canister upon failure of the SNF rods. The fuel-to-canister release fractions used in this analysis are those specified in NUREG-1536 [A.11-4, Table 5-2] or NUREG-1567 [A.11-5, Table 9.2] and are summarized in Table A.11-2. The Canister-to-Environment release fractions are the fraction of isotopes released from the canister to the environment. As the radioactive materials from the SNF assembly will not be released directly to the environment, there will be some release retention in the canister. The fraction of radioactive materials released from the canister to the environment is justified and provided in [A.11-6, Table 3-5] and reproduced in Table A.11-3. These additional factors account for material that may condense, plate out or be filtered out before escaping the canister due to leakage hole size. This accounting of canister retention is also documented in other NRC documents [A.11-7, Section 7.3.8]. The two sets of release fractions are combined to create the fuel-to-environment release fractions in Table A.11-4. No credit is taken for retention of material released from the canister and potentially retained in the Horizontal Storage Module (HSM).

2. Using the as-tested leak rate and adjusting for normal, off-normal, and accident conditions in the canister cavity, determine the adjusted maximum canister leak rate for each set of conditions. The guidance of ANSI N14.5 [A.11-2] is used to calculate the adjusted leak rates.

3. Calculate the isotope specific leak rates by multiplying the specific activities by the seal leak rate for each condition.

4. Determine the dose to the whole body, thyroid, lens of the eye, skin, and other critical organs from inhalation and immersion exposures at the controlled area boundary. Atmospheric dispersion factors are determined using Regulatory Guide 1.145 [A.11-8] and dose conversion factors are taken from EPA Guidance Reports No. 11 [A.11-9] and No. 12 [A.11-10].

A.11.3.2 Specific Activities for Release

Specific activities for release are computed for the canister based on SNF assembly activities in Table A.11-1 and normal, off-normal, and accident release fractions in Table A.11-4. The specific activities are based on 24 SNF design basis assemblies per canister and a cavity free volume of 5,592,315 cm^3. The specific activities for release are provided in Table A.11-5. The maximum number of fuel assemblies in any canister is 24 SNF assemblies; therefore, this assumption bounds all of the loaded FO-, FC- and FF-DSCs.

A.11.3.3 Leakage Rates

A leak rate in the units *ref*-std·cm^3/sec corresponds to a leak of dry air at a temperature of 25°C from a pressure of 1 atm (absolute) to a pressure of 0.01 atm (absolute). Because the canister contains an atmosphere that is primarily helium at various temperatures and pressures, the specified standard leak rate must be adjusted for the change in gas, temperature, and pressure. The design basis conditions for the canisters are provided in Table 8-2a of [A.11-1]. Using the method from ANSI N14.5 [A.11-2] and a leakage hole length assumed to be the size of the weld length (3/16 inches), the hole diameter is computed to be 4.7611×10^{-4} cm for a leakage rate of 10^{-5} *ref*-std cm^3/sec.

Based on ANSI N14.5, the computed leakage rates for the three operating conditions are:

- Normal condition leakage rate = 4.4914×10^{-6} cm^3/sec
- Off-normal condition leakage rate = 7.5892×10^{-6} cm^3/sec
- Accident condition leakage rate = 2.5413×10^{-5} cm^3/sec

The isotope specific leak rates (Q_i - Ci/sec) used in the exposure calculations are equal to the number of canisters, multiplied by the specific activity, multiplied by the leakage rate, or:

$$Q_i = N \cdot S_i \cdot L$$

where: N is the number of canisters

S_i is the specific activity of nuclide i (Ci/cm^3)

All Indicated Changes are in response to RAI NP-A-2

Corrective Action

Consistent with Section 8.2.1.4 of Volume I of [A.12-1], the canister shall be inspected for damage, for drop heights greater than fifteen inches, as necessary. Removal of the transfer cask top cover plate may require cutting of the bolts in the event of a corner drop onto the top end. These operations will take place in the Cask Handling Building. The extent of the damage will also be evaluated using calculations to demonstrate that there is no impact to the ability of the canister to continue to perform its intended design functions.

Following recovery of the transfer cask and transfer of the canister in the HSM, the transfer cask will be inspected, repaired, and tested as appropriate prior to reuse. For recovery of the cask and contents, it may be necessary to develop a special sling/lifting apparatus to move the transfer cask from the drop site to the Cask Handling Building. This may require several weeks of planning to ensure all steps are correctly organized. During this time, temporary shielding may be added to the transfer cask to minimize onsite exposure to WCS CISF operations personnel. The transfer cask would be roped off to ensure the safety of personnel.

A.12.2.3 Earthquakes

Cause of Accident

Site-specific ground-surface uniform hazard response spectra (UHRS) with 1E-4 annual frequency of exceedance (AFE) having peak ground acceleration (PGA) of 0.250 g horizontal and 0.175 g vertical are shown in Table 1-2, Table 1-5 and Figure 1-5. The site-specific response spectra are used in the WCS CISF SSI analysis to obtain the enveloped acceleration spectra at the HSM CG and base. Section A.7.5 demonstrates that the enveloping WCS CISF site-specific seismic forces remain below their applicable capacities for the NUHOMS® MP187 Cask System components.

Accident Analysis

The structural, thermal, and radiological consequences and the recovery measures required to mitigate an earthquake are addressed in Sections 8.3.2.2, 8.3.2.1 of Volume II and 8.3.2.1 of Volume III of [A.12-1]. In addition, Chapter A.8 demonstrates that the thermal analysis performed for the NUHOMS® MP187 Cask System in [A.12-1] is bounding for WCS CISF conditions.

A.12.2.4 Lightning

Cause of Accident

The likelihood of lightning striking the HSM Model 80 and causing an off-normal or accident condition is not considered a credible event. Simple lightning protection equipment for the HSM structures is considered a miscellaneous attachment acceptable per the HSM design.

All Indicated Changes are in response to RAI TS-8

Accident Analysis

Should lightning strike in the vicinity of the HSM the normal storage operations of the HSM will not be affected. The current discharged by the lightning will follow the low impedance path offered by the surrounding structures or the grounding system installed around each block of HSMs. The heat or mechanical forces generated by current passing through the higher impedance concrete will not damage the HSM. Since the HSM requires no equipment for its continued operation, the resulting current surge from the lightning will not affect the normal operation of the HSM.

Since no accident conditions will develop as the result of a lightning strike near the HSM, no corrective action would be necessary. In addition, there would be no radiological consequences

A.12.2.5 Fire and Explosion

Cause of Accident

Sections 3.3.6 and 8.2.5 of Volume I of [A.12-1] provide the potential sources of fire and explosion that may occur at the WCS CISF. *As described in Section 3.3.6, the CHB does not contain permanent flammable material other than some electrical and electronic components. The maximum amount of fuel in the CHB or on the Storage Pad(s) in the vicinity of the NUHOMS® Storage Overpacks is limited by administrative procedure in accordance with the Technical Specifications which provides a 300 gallon of diesel fuel limit for transfer and storage operations involving the NUHOMS®-MP187 System. Therefore, the fire evaluated in Section 8.2.5 of Volume I of [A.12-1] is the same as the worst case fire at the WCS CISF. Any fire involving a canister in a HSM would be bounded by the fire analyzed for the canister in a transfer cask. Direct engulfment of the HSM is not credible and the concrete HSM acts as a significant insulating firewall to protect the canister from the high temperatures of the fire. Explosions are not considered credible in the CHB since no explosive materials are present.*

Accident Analysis

The structural, thermal, and radiological consequences and the recovery measures required to mitigate a fire accident are addressed in Section 8.2.5 of Volume I of [A.12-1]. *Section 8.2.5 of Volume I of [A.12-1] also demonstrates that the MP187 cask performs its safety functions during and after the postulated fire/explosion accident.* Per Section 8.2.5.3 of Volume I of [A.12-1] the maximum flammable fuel either during the transfer operation or inside the WCS CISF is 300 gallons of diesel fuel.

All Indicated Changes are in response to RAI NP-12-1

B.3.3 Design Criteria for Environmental Conditions and Natural Phenomena

B.3.3.1 Tornado Wind and Tornado Missiles

The design basis tornado wind and tornado missiles for the Standardized Advanced NUHOMS® Horizontal Modular Storage System AHSM are provided in Section 2.2.1 of reference [B.3-1] and for the NUHOMS®-MP187 cask in Section 3.2.1 of Volume 1 of reference [B.3-2]. The Standardized Advanced NUHOMS® Horizontal Modular Storage System components are designed and conservatively evaluated for the most severe tornado and missiles anywhere within the United States (Region I as defined in NRC Regulatory Guide 1.76 [B.3-9]) while the WCS CISF is in Region II, a less severe location with respect to tornado and tornado missiles.

The AHSM protects the DSC from adverse environmental effects and is the principal structure exposed to tornado wind and missile loads. Furthermore, all components of the AHSM (regardless of their safety classification) are designed to withstand tornadoes and tornado-based missiles. The MP187 cask protects the DSC during transit to the Storage Pad from adverse environmental effects such as tornado winds and missiles.

B.3.3.2 Water Level (Flood) Design

The 24PT1 DSCs and AHSMs are designed for an enveloping design basis flood, postulated to result from natural phenomena as specified by 10 CFR 72.122(b). The system is evaluated for a flood height of 50 feet with a water velocity of 15 fps.

The DSCs are subjected to an external hydrostatic pressure equivalent to the 50 feet head of water. The AHSM is evaluated for the effects of a water current of 15 fps impinging on the sides of a submerged AHSM. For the flood case that submerges the AHSM, the inside of the AHSM will rapidly fill with water through the AHSM vents.

As documented in Sections 2.4.2.2 and 3.2.2, the WCS CISF is not in a floodplain and is above the Probable Maximum Flood elevation and, therefore, will remain dry in the event of a flood.

B.3.3.3 Seismic Design

The seismic criteria for the Standardized Advanced NUHOMS® Horizontal Modular Storage System AHSM are provided in Section 2.2.3 of reference [B.3-1]. This system was designed for very high seismic regions, such as the west coast, and as such the design basis earthquake shown in Figures 2.2-1 and 2.2-2 of reference [B.3-1] for the AHSM easily envelops the enveloping acceleration response spectra at the concrete pad base and HSM center of gravity obtained by the WCS CISF soil-structure interaction (SSI) analysis at all frequencies as demonstrated in Sections B.7.5 and B.7.8. *As Section 11.2.1 of reference [B.3-1] indicates, tipping/rocking and module-to-module separation is negligible when the AHSM row assembly consists of a minimum of three modules side-by-side with shield walls; configurations with additional modules back-to-back with this row remain bounded by this analysis.*

All Indicated Changes are in response to RAI NP-B-1

B.4.4 Storage Module Thermal Monitoring System

As described in Section 5.1.3, AHSM Thermal Monitoring Program of the Technical Specifications [B.4-3]*, daily visual inspection of the inlet and outlet vents of the HSM and removing any identified debris* prevent*s* conditions that could lead to exceeding the concrete and fuel clad temperature criteria. *In addition, instrumentation that can be used for monitoring HSM roof concrete temperatures is also provided for each HSM.*

23. The transfer vehicle can be moved, as necessary, to install the AHSM door. Install the AHSM door and secure it in place.

24. Replace the TC top cover plate and ram access cover plate. Secure the skid to the transfer vehicle.

25. Move the transfer vehicle and TC to the designated area. Return the remaining transfer equipment to the Storage Area.

26. Remove the AHSM Door and adjust the seismic restraints on the DSC one week following initial placement.

B.5.1.3 Monitoring Operations

27. Perform routine security surveillance in accordance with the security plan.

28. Perform a daily visual surveillance of the AHSM air inlet and outlet (bird screens) to verify that no debris is obstructing the AHSM vents in accordance with Section 5.1.3(a) of the Technical Specification [B.5-2] requirements.

B.7. STRUCTURAL EVALUATION

This Appendix describes the structural evaluation of the Standardized Advanced NUHOMS® System components utilized for storage of canisterized spent nuclear fuel (SNF) at the WCS Consolidated Interim Storage Facility (WCS CISF). As presented in Chapter 1, Table 1-1, the Standardized Advanced NUHOMS® System storage components include the 24PT1 Dry Shielded Canister (DSC or canister) and the AHSM concrete overpack.

The 24PT1 DSC is described in Section 3.1.1.1 of the Standardized Advanced NUHOMS® Updated Final Safety Analysis Report (UFSAR) [B.7-1]. The AHSM is described in Section 3.1.1.2 of [B.7-1]. Both of these components are approved by the NRC [B.7-6] for storage of SNF under the requirements of 10 CFR Part 72.

At the WCS CISF, the NUHOMS®-MP187 cask will be used for on-site transfer operations. The MP187 cask is a multi-purpose cask approved by the NRC for on-site transfer of the FO-, FC-, and FF- DSCs and Greater Than Class C (GTCC) waste canisters [B.7-2], and as a transportation cask for off-site shipments of the FO-, FC-, FF-, 24PT1 DSCs [B.7-3]. Volume I and Volume III of the Rancho Seco Independent Spent Fuel Storage Installation Final Safety Analysis Report (ISFSI FSAR) [B.7-4] describe the MP187 cask when used as on-site transfer cask under 10 CFR Part 72. Section 1.2 of the NUHOMS®-MP187 Multi-Purpose Transportation Package Safety Analysis Report (SAR) [B.7-5] describes the MP187 cask when used as a transportation cask under 10 CFR Part 71.

This appendix is prepared to demonstrate that the licensed canisters and AHSM storage components are qualified to safely transfer and store SNF and GTCC waste at the WCS CISF. Additionally, this appendix provides the justification to allow use of the MP187 cask for on-site transfer of the canister, consistent with the cask's allowable payloads in the MP187 cask's transportation license.

The structural evaluations presented herein are based on existing analyses as documented in [B.7-1] for the 24PT1 DSC and the AHSM and [B.7-4] for the MP187 cask except for the qualification of the 24PT1-DSC confinement boundary during Normal Conditions of Transport in Section B.7.9 *(to provide reasonable assurance that the confinement boundary is not adversely impacted by transport to the WCS CISF)* which points to the evaluation documented in Section A.7.7.2.

<u>MP187 Cask</u>

The design basis design criteria for the MP187 cask as an on-site transfer cask for the canisters is provided in [B.7-4] Volume I Table 3-4, Table 3-8, Table 3-9, and Table 3-10. The loading criteria summary shown in [B.7-4] Table 3-4 bounds the loading criteria for the WCS CISF as specified in Appendix B.3, Table B.3-1 (with the exception of seismic loading which is addressed in Section B.7.5).

All Indicated Changes are in response to RAI NP-A-3

B.7.1 Discussion

As discussed in Chapter 1, the 24PT1 DSCs, currently stored inside AHSMs at the San Onofre Nuclear Generating Station (SONGS) ISFSI, will be transported to the WCS CISF utilizing the NUHOMS®-MP187 Transportation Cask. The canisters and the AHSM are Standardized Advanced NUHOMS® System components for the storage of SNF under NRC Certificate of Compliance No. 1029 [B.7-6] and are described in Chapter 1 of [B.7-1]. The MP187 transportation cask is licensed under NRC Certificate of Compliance (CoC) No. 9255 [B.7-3].

At the WCS CISF, the canisters will be stored inside newly fabricated AHSMs utilizing the MP187 cask for on-site transfer operations. The MP187 cask is a multi-purpose cask licensed as an on-site transfer cask [B.7-2] under 10 CFR Part 72 as described in [B.7-4].

As described in [B.7-1] the canister and the AHSM utilize the OS197 transfer cask for on-site transfer operations. The OS197 transfer cask is licensed under CoC No. 1004 and is described in the Standardized NUHOMS® UFSAR [B.7-7]. This appendix reconciles the design basis analyses of the 24PT1 DSC in the OS197 transfer cask (that will not be used at the WCS CISF) to justify use of the MP187 cask for transfer of the 24PT1 DSC at the WCS CISF.

The design basis seismic criteria for the canister and AHSM significantly exceed the seismic criteria for the WCS CISF (see Figure B.7-2). Hence, no reconciliation for seismic loads for the canister and AHSM need to be performed in this appendix.

The qualification of the MP187 cask for use as the on-site transfer cask at WCS CISF is based on the design basis analysis as documented in [B.7-4]. *The cask stability evaluations in [B.7-4] consider the MP187 cask in the transfer horizontal configuration, the only configuration for the MP187 cask.*

Finally, a bounding evaluation in Section B.7.9 is performed to demonstrate that the confinement boundaries for the 24PT1-DSC does not exceed ASME B&PV Subsection NB Article NB-3200 (Level A allowables) during normal conditions of transport to provide reasonable assurance that the confinement boundary is not adversely impacted by transport to the WCS CISF.

All Indicated Changes are in response to RAI NP-B-2

B.7.3 Structural Evaluation of MP187 Transfer Cask with Canister (Transfer Configuration at WCS CISF)

This section reconciles the use of the MP187 cask for transfer of the canister at the WCS CISF. This section also evaluates the 24PT1 DSC as a payload in the MP187 cask.

B.7.3.1 Evaluation of MP187 Cask Loaded with a Canister

The 10 CFR Part 71 evaluation of the canister in the MP187 cask is contained in Appendix A of the NUHOMS®-MP187 Multi-Purpose Transportation Package Safety Analysis Report (SAR) [B.7-5]. This section presents the evaluation of the canister in the MP187 cask for transfer operations under 10CFR Part 72. As in the 10 CFR Part 71 evaluations in Appendix A of [B.7-5], the evaluation presented herein is based on the design similarities between the FO- and FC- DSCs and the 24PT1 DSC.

As shown in Table A2.1-1 of [B.7-5], reproduced here as Table B.7-1, the 24PT1 DSC in [B.7-1] is the same as the FO DSC in [B.7-4], except that the 24PT1 DSC has a modified spacer disc spacing and support rod configuration. Sections A2.6.11.A and A2.6.11.B of [B.7-5] addressed these differences and concluded that the FO- and FC- DSCs configuration bounds the 24PT1 DSC configuration.

Table A2.2-1 of [B.7-5], reproduced here as Table B.7-2, shows that the 24PT1 DSC weight, center of gravity (cg) and weight moment of inertia (MOI) are bounded by those of the FO-, FC-, and FF- DSCs. As shown in this table, the 24PT1 DSC weight (78,400 lbs) is between the weight of the heaviest DSC (the FC- DSC with a weight of 81,120 lbs) and the lightest DSC (the FF- DSC with a weight of 74,900 lbs). This ensures that the effect of the lighter canister (increasing g-loads during postulated drop) and a heavier canister (higher stresses for non-drop loading conditions) envelop the 24PT1 DSC.

The total weight of the loaded MP187 cask (on-site transfer configuration) ranges from 239,700 lbs (with FC- DSC) to 233,500 lbs (with FF- DSC). This range bounds the total weight of 237,200 lbs (with 24PT1 DSC). Thus, the MP187 cask loaded with a FO- and FC- DSC configuration bounds the MP187 loaded with a 24PT1 DSC configuration [B.7-5, Table A2.2-2].

Section B.7.8 presents an evaluation of the MP187 cask in the transfer configuration at the WCS CISF.

Based on the evaluation above, the structural evaluation of the MP187 cask documented in [B.7-4] for the MP187 cask loaded with the FO- and FC- DSCs is applicable to the MP187 cask loaded with a 24PT DSC.

All Indicated Changes are in response to RAI NP-B-2

B.7.8 Cask Stability and Missile Penetration Evaluation of the MP187 Cask (On-Site Transfer Configuration)

This section presents *a* structural evaluation of the MP187 cask for tornado, seismic, and missile impact loads. The evaluation encompasses stability, stress, and missile penetration effects, as applicable.

The following evaluation considers the MP187 cask loaded with an FO-, FC-, FF-DSC. The MP187 cask with 24PT1 DSC configuration is bounded by the MP187 cask with an FO-, FC-, or FF-DSC (Section B.7.3).

B.7.8.1 Assumptions

1. The gust factor, G, value for wind loading of 0.85 is taken from Section 6.5.8.1 of ASCE 7-05 standard [B.7-8].

2. The stability calculations use a weight of the MP187 cask with transfer skid and transfer trailer of W_c = 270 kips. Per Table B.7-6, the minimum weight of the loaded cask for the analyzed configurations is 221.98 kips. The weight for the MP187 cask transfer trailer is 40 kips, and for the transfer skid is 21 kips. Therefore, the total weight of the cask with transfer trailer and skid is expected to be at minimum 221.98+40+21 = 282.98 kips. Thus, assuming a minimum weight of 270 kips to calculate the resisting moment is conservative.

3. The MP187 transfer trailer length, width, and height dimensions are 264 inches, 10.5 feet and 42 inches, respectively. The length, width, and height of the transfer skid are 186 inches, 10.5 feet, and 15 inches, respectively (refer to Figure B.7-3). These dimensions are representative dimensions for NUHOMS® Systems' transfer equipment.

B.7.8.2 Material Properties

Material properties of the cask outer shell, top cover plate, and ram access cover plate at 400 °F are taken from [B.7-5]. The material properties for the analyzed components are summarized in Table B.7-7.

B.7.8.3 Design Criteria

For stability analyses, the permissible angle of rotation is considered to be equal to one third of the critical angle of rotation – i.e. the angle of tilt at which the center of gravity of the configuration is directly over the configuration's edge (tip-over angle).

Stress allowables are based on ASME Code, Section III, Division 1, Appendix F, [B.7-9].

For missile penetration analyses, the required material thickness is calculated using Nelms' formula from [B.7-10] and the Ballistic Research Laboratory methodology contained in [B.7-11].

Accident Analysis

The structural, thermal, and radiological consequences and the recovery measures required to mitigate the effects of a drop accident are addressed in Section 8.2.1.3 of Volume I of [B.12-5] for the MP187 cask in the transfer configuration. Section 3.6 of [B.12-1] demonstrates that the canister remains leak tight and the basket maintains its configuration following the drop event. In addition, Chapter B.8 demonstrates that the thermal analysis performed for the NUHOMS® MP187 Cask System in [B.12-1] is bounding for WCS CISF conditions.

Corrective Action

Consistent with Section 11.2.5.4 of [B.12-1], the canister will be inspected for damage *for drop heights greater than fifteen inches*, as necessary. Removal of the transfer cask top cover plate may require cutting of the bolts in the event of a corner drop onto the top end. These operations will take place in the Cask Handling Building. *The extent of the damage will also be evaluated using calculations to demonstrate that there is no impact to the ability of the canister to continue to perform its intended design functions.*

Following recovery of the transfer cask and transfer of the canister in the AHSM, the transfer cask will be inspected, repaired and tested as appropriate prior to reuse.

For recovery of the cask and contents, it may be necessary to develop a special sling/lifting apparatus to move the transfer cask from the drop site to the Cask Handling Building. This may require several weeks of planning to ensure all steps are correctly organized. During this time, temporary shielding may be added to the transfer cask to minimize on-site exposure to WCS CISF operations personnel. The transfer cask would be roped off to ensure the safety of personnel.

B.12.2.3 Earthquakes

Cause of Accident

Site-specific ground-surface uniform hazard response spectra (UHRS) with 1E-4 annual frequency of exceedance (AFE) having peak ground acceleration (PGA) of 0.250 g horizontal and 0.175 g vertical are shown in Table 1-2, Table 1-5 and Figure 1-5. The site-specific response spectra are used in the WCS CISF SSI analysis to obtain the enveloped acceleration spectra at the HSM CG and base. Section B.7.5 demonstrates that the enveloping WCS CISF site-specific seismic forces remain below their applicable capacities for the MP187 cask and Standardized Advanced NUHOMS® System components.

All Indicated Changes are in response to RAI TS-8

C.3.4 Safety Protection Systems

The safety protection systems of the NUHOMS®-61BT System are discussed in Section K.2.3 of the "Standardized NUHOMS® Horizontal Modular Storage System Safety Analysis Report" [C.3-1].

C.3.4.1 General

The NUHOMS®-61BT System is designed for safe confinement during dry storage of SFAs. The components, structures, and equipment that are designed to assure that this safety objective is met are summarized in Table C.3-2. The key elements of the NUHOMS®-61BT System and its operation at the WCS CISF that require special design consideration are:

1. Minimizing the contamination of the DSC exterior.
2. The double closure seal welds on the DSC shell to form a pressure retaining confinement boundary and to maintain a helium atmosphere.
3. Minimizing personnel radiation exposure during DSC transfer operations.
4. Design of the cask and DSC for postulated accidents.
5. Design of the HSM passive ventilation system for effective decay heat removal to ensure the integrity of the fuel cladding.
6. Design of the DSC basket assembly to ensure subcriticality.

RAI NP-C-2

C.3.4.2 Structural

The principal design criteria for the DSCs are presented in Section*s K.2.2.5.1, K.3.1.2, and* K.2.3.2 of the "Standardized NUHOMS® Horizontal Modular Storage System Safety Analysis Report" [C.3-1]. The DSCs are designed to store intact and failed *BWR* FAs with or without channels. The fuel cladding integrity is assured by limiting fuel cladding temperature and maintaining a nonoxidizing environment in the DSC cavity.

RAI NP-C-1

The principal design criteria for the MP197HB cask are presented in Section 3.2.5.3 of the "NUHOMS®-MP197 Transportation Package Safety Analysis Report" [C.3-10]. The cask is designed to transfer the loaded DSCs to the HSM.

C.3.4.3 Thermal

The HSM relies on natural convection through the air space in the HSM to cool the DSC. This passive convective ventilation system is driven by the pressure difference due to the stack effect (ΔP_s) provided by the height difference between the bottom of the DSC and the HSM air outlet. This pressure difference is greater than the flow pressure drop (ΔP_f) at the design air inlet and outlet temperatures.

C.4.4 Storage Module Thermal Monitoring System

As described in Section 5.1.3, HSM Thermal Monitoring Program of the Technical Specifications [C.4-3], *daily visual inspection of the inlet and outlet vents of the HSM and removing any identified debris* prevent*s* conditions that could lead to exceeding the concrete and fuel clad temperature criteria. *In addition, instrumentation that can be used for monitoring HSM roof concrete temperatures is also provided for each HSM.*

All Indicated Changes are in response to RAI TS-4

26. Replace the TC top cover plate and ram access cover plate. Secure the skid to the transfer vehicle.

27. Move the transfer vehicle and TC to the designated area. Return the remaining transfer equipment to the Storage Area.

C.5.1.3 Monitoring Operations

1. Perform routine security surveillance in accordance with the security plan.

2. Perform a daily visual surveillance of the EOS-HSM air inlets and outlets (bird screens) to verify that no debris is obstructing the HSM vents in accordance with Section 5.1.3(a) of the Technical Specification [C.5-2] requirements.

All Indicated Changes are in response to RAI TS-4

C.7. STRUCTURAL EVALUATION

This Appendix describes the structural evaluation of the Standardized NUHOMS®-61BT System components utilized for transfer and storage of canisterized spent nuclear fuel (SNF) at the WCS Consolidated Interim Storage Facility (WCS CISF). As presented in Chapter 1, Table 1-1, the Standardized NUHOMS®-61BT System storage components include the 61BT Dry Shielded Canister (DSC or canister) and the HSM Model 102 concrete overpack. At the WCS CISF, the MP197HB transportation cask is used for on-site transfer activities.

The HSM Model 102 is described in detail in Section 4.2.3.2 of the Standardized NUHOMS® Updated Final Safety Analysis Report (UFSAR) [C.7-13]. The 61BT DSC is described in detail in Section K.1.2 of [C.7-13]. Both of these components are approved by the NRC [C.7-13] for transfer and storage of SNF under the requirements of 10 CFR Part 72.

The MP197HB cask is described in detail in Section A.1.2 of the NUHOMS®-MP197 Transportation Package Safety Analysis Report (SAR) [C.7-1]. The MP197HB cask is approved by the NRC for off-site transport of canisters under the requirements of 10 CFR Part 71. This SAR presents the analyses required for approval of the MP197HB cask as the on-site transfer cask at the WCS CISF under the requirements of 10 CFR Part 72. The structural evaluation of the MP197HB cask as the on-site transfer cask is contained in this appendix. The evaluation of the canisters for transfer and storage is contained in Appendix K of [C.7-13] for the Standardized NUHOMS®-61BT System [C.7-13]. The evaluation of the HSM Model 102 is contained in Chapter 8 of [C.7-13].

This appendix is prepared to demonstrate that these licensed Standardized NUHOMS®-61BT System components are also qualified to safely transfer and store SNF at the WCS CISF. In addition to the seismic reconciliation evaluation presented in Section C.7.3, this appendix presents the analyses required to qualify the MP197HB cask for on-site transfer activities per 10 CFR Part 72 for the 61BT and 61BTH Type 1 canisters. These analyses, in combination with existing evaluations in [C.7-13], demonstrate that the MP197HB / Canisters / HSM Model 102 transfer and storage system satisfies all of the 10 CFR Part 72 requirements for storage at the WCS CISF. Qualification of the 61BT DSC confinement boundary during Normal Conditions of Transport is addressed in Section C.7.8 *(to provide reasonable assurance that the confinement boundary is not adversely impacted by transport to the WCS CISF)*.

MP197HB Cask

The principal design criteria for the MP197HB cask for service at the WCS CISF are described in Table C.7-1 and below in Section C.7.7.1. The design approach, design criteria and loading combinations for the MP197HB cask are also described in Section C.7.7.1.

C.7.7.3 Accident Conditions

C.7.7.3.1 Loads

Structural integrity of the MP197HB cask for accident conditions is established by addressing the following events:

a. Horizontal side drop from a height of 80 inches (via 75g static evaluation of horizontal drop).

b. Vertical end drops onto top or bottom of the cask with a deceleration of 75g. These end drops are not postulated or credible events for the on-site transfer operations in the WCS CISF since the cask remains in the horizontal position during all anticipated operations at the facility. However, 75g vertical end drop analyses are conducted (in conjunction with the 75g horizontal drop) to obtain the stress envelope for the postulated 25g corner drop.

c. An oblique corner drop from a height of 80 inches onto the top or bottom corner of the cask, occurring at an angle of 30° to the horizontal. This case is not specifically evaluated since the side drop and the end drop evaluations are deemed to bound the consequences of the corner drop.

The 75g cask decelerations have been approved as a conservative basis for the accident drop evaluations of site-specific (MP187 cask) and general license (OS197 and OS200) transfer casks to verify the structural integrity of NUHOMS® system casks ([C.7-12] and [C.7-13]).

The key design parameters for the MP197HB cask, OS197 transfer cask and MP187 cask are compared in Table C.7-9. The comparison includes the outer shell length, diameter and thickness, cask length, cask weight and cask cavity length, and other crucial design parameters. The comparison of the NUHOMS® System casks confirms the similarity of the cask designs and components. It is also noted that the MP197HB cask is heavier than MP187 cask and OS197 transfer casks. Based on the similarity of the cask designs, the 75g inertia acceleration criteria are considered to be bounding for the accident drop stress evaluations for the MP197HB cask design. *Evaluation of the MP197HB cask loaded with a 61BT or 61BTH DSC for 75g drop loads is performed in [C.7-21].*

All Indicated Changes are in response to RAI NP-C-3

C.7.7.3.4 Stress Analysis Methodology

For purposes of reporting stress results, the cask body is divided into the following seven components: Outer Shell, Inner Shell, Top Cover Plate (Lid), Top Flange, Bottom Flange, Bottom Plate, and Ram (Access) Closure Plate. For each component, the stresses are categorized according to the rules of the ASME Code Section III, Appendix F, [C.7-8].

The methods of extraction and interpretation of stress results from the ANSYS model (e.g. stress classification path selection, stress component qualification, and stress linearization method) remain the same as described in [C.7-1], Appendix A.2.13.1.10, for plastic analysis methodology.

For the plastic analysis methodology, stress path evaluation in ANSYS brings the information about average stress intensity across the path, P_M, as well as maximum stress intensity at the path surface, labeled as $P_M + P_B$. Conservatively no distinction is made between paths located at gross or local discontinuities and areas remote from these discontinuities and all path averaged stresses (including general primary stress intensities, P_M, and local primary stress intensities, P_L) are classified and reported as P_M stresses and assessed against the P_M stress allowable.

Table C.7-10 lists the maximum values of reported results for the side drop load, while Table C.7-11 lists the maximum values of reported results for both the top and bottom end drop load.

The extent of lead slump in the MP197HB cask is assessed only for the vertical end drop scenario. The side drop induces only negligible amounts of slump in the lead shielding.

C.7.7.3.5 Summary of Results

The maximum stress intensity and the deformation plots for the 75g side drop are shown in Figure C.7-15 and Figure C.7-16, respectively. As shown in Table C.7-10 all stresses are within allowable limits for the side drop load.

The maximum stress intensity for the 75g top and bottom end drop are shown in Figure C.7-19 and Figure C.7-20, respectively. As shown in Table C.7-11 all stresses are within allowable limits for both the top and bottom end drop load.

The buckling analysis reveals commencement of buckling for the inner shell at 230g loads for both the bottom and top end drops. The buckling load for the MP197HB cask is well above the ASME Code required $3/2 \times 75g = 112.5g$ load. An illustration of the top end drop buckling deformation at the buckling location is presented in Figure C.7-21.

At 75g there is a lead slump of 0.545 inches and 0.543 inches for the bottom and top end drops, respectively.

All Indicated Changes are in response to RAI NP-C-4

C.7-17 US NRC Document NUREG/CR-6007 "Stress Analysis of Closure Bolts for Shipping Casks."

C.7-18 ANSI N14.6-1993 American National Standard for Radioactive Materials – "Special Lifting Devices for Shipping Containers Weighing 10,000 Pounds (4500 kg) or More," 1993.

C.7-19 Blevins, Robert D. Formulas for Natural Frequency and Mode Shape. 2001.

C.7-20 Regulatory Guide 1.61, "Damping Values for Seismic Design of Nuclear Power Plants," U.S. Nuclear Regulatory Commission, Revision 1, March 2007.

C.7-21 *AREVA TN Calculation, WCS01-0201 Rev. 0, "NUHOMS® MP197HB Cask Structural Qualification for Accident Conditions."*

All Indicated Changes are in response to RAI NP-C-3

Table C.7-9
MP197HB, MP187 and *OS197* Casks – Comparison of Basic Design Parameter

Parameter	MP197HB Cask	MP187 Cask	OS197 Cask
Outer Shell Thickness (*in*)	2.75	2.49	1.50
Inner Shell Thickness *(in)*	1.25	1.25	0.50
Bottom End Closure Thickness *(in)*	6.50	8.00	2.00
Top Lid Thickness (*in*)	4.50	6.50	5.25
Lead Gamma Shield Thickness *(in)*	3.00	4.00	3.56
Cask Body Outer Diameter (*in*)	84.50	83.50	79.12
Cask Cavity Diameter *(in)*	70.50	68.00	68.00
Overall Length of Cask Body (*in*)	210.25	201.50	207.20
Overall Length of Outer Shell *(in)*	190.25	183.50	183.35
Overall Length of Inner Shell *(in)*	185.25	173.75	191.25
Overall Length of Lead *(in)*	194.50	182.44	189.25
Cavity Length (*in*)	199.25	187.00	196.75
Cask Weight (Dry, Empty) (*kips*)	163.31	158.58	111.25
Cask Loaded (Dry, Loaded) (*kips*)	251.70	239.70	204.37

Note: Comparison of design parameters of the MP197HB Cask with the MP187 and OS197 casks, licensed under [C.7-12] and [C.7-13] respectively, is solely to justify that 75g load magnitude remains bounding for the MP197HB cask design in the cask accident drop, by comparison with the design parameters of these casks already approved for that load magnitude.

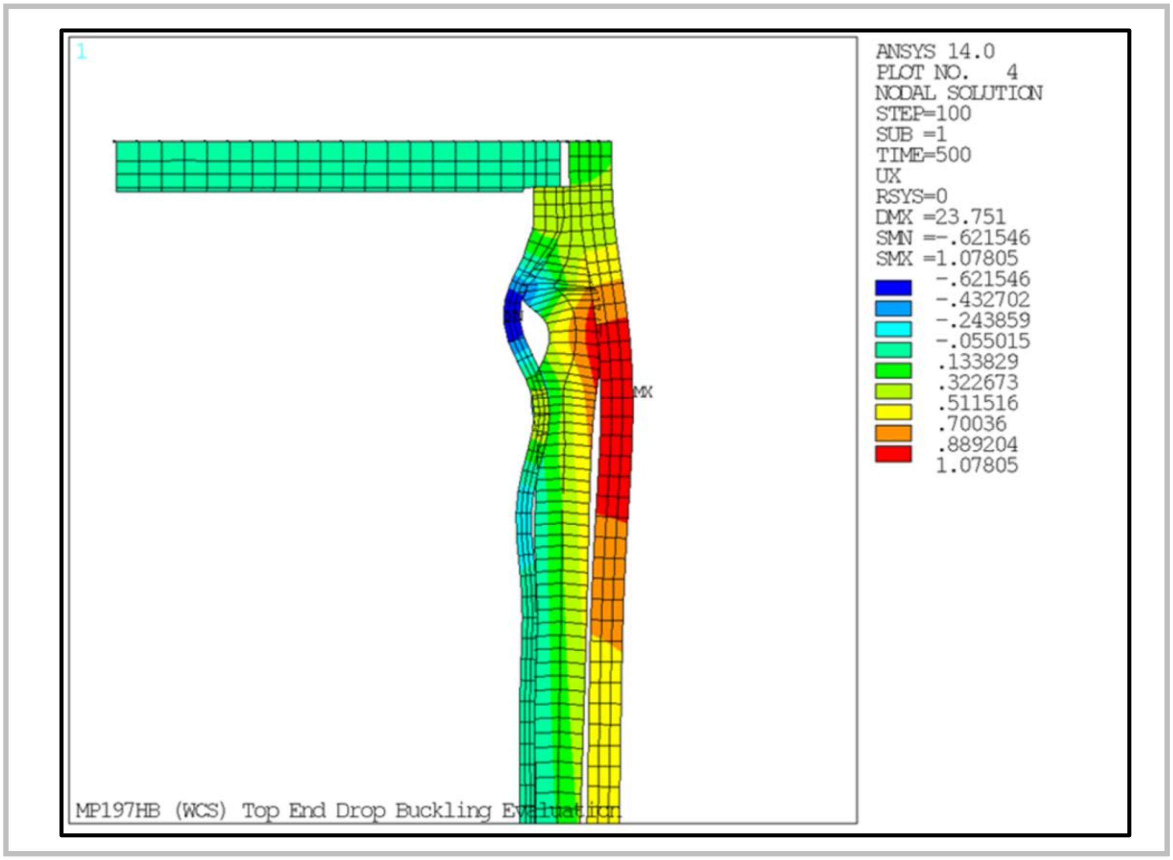


Figure C.7-21
Top End Drop Buckling

All Indicated Changes are in response to RAI NP-C-4

C.12.2.2 Drop Accidents

Cause of Accident

Sections K.11.2.5.1 and K.3.7.5.1 of [C.12-1] discusses the cask drop for the MP197HB cask in the transfer configuration when it contains the canister.

Accident Analysis

The structural and thermal consequences for the effect of a drop accident are addressed in Section K.11.2.5.2 for the canister and in Appendix C.8 for the MP197HB cask in the transfer configuration. This analysis demonstrates that the canister remains leak tight and the basket maintains its configuration following the drop event. In addition, Chapter C.8 presents the thermal analysis performed for the MP197HB cask for WCS CISF conditions.

Accident Dose Calculations

The accident dose calculations presented in Section K.11.2.5.3 of [C.12-1], are very conservative because the MP197HB cask consists of a solid neutron shield, the source terms for the contents of the canister have significantly decayed prior to transportation to the WCS CISF and the boundary is approximately 0.75 miles from the WCS CISF.

Corrective Action

Consistent with Sections K.11.2.5.4 and 8.2.5.4 of [C.12-1], the canister will be inspected for damage *for drop heights greater than fifteen inches*, as necessary. Removal of the transfer cask top cover plate may require cutting of the bolts in the event of a corner drop onto the top end. These operations will take place in the Cask Handling Building. *The extent of the damage will also be evaluated using calculations to demonstrate that there is no impact to the ability of the canister to continue to perform its intended design functions.*

Following recovery of the transfer cask and transfer of the canister in the HSM, the transfer cask will be inspected, repaired and tested as appropriate prior to reuse.

For recovery of the cask and contents, it may be necessary to develop a special sling/lifting apparatus to move the transfer cask from the drop site to the cask handling building. This may require several weeks of planning to ensure all steps are correctly organized. During this time, temporary shielding may be added to the transfer cask to minimize on-site exposure to WCS CISF operations personnel. The transfer cask would be roped off to ensure the safety of the personnel.

D.3.4 Safety Protection Systems

The safety protection systems of the NUHOMS®-61BTH Type 1 System are discussed in Section T.2.3 of the "Standardized NUHOMS® Horizontal Modular Storage System Safety Analysis Report" [D.3-1].

D.3.4.1 General

The NUHOMS®-61BTH Type 1 System is designed for safe confinement during dry storage of SFAs. The components, structures, and equipment that are designed to assure that this safety objective is met are summarized in Table D.3-2. The key elements of the NUHOMS®-61BTH Type 1 System and its operation at the WCS CISF that require special design consideration are:

1. Minimizing the contamination of the DSC exterior.

2. The double closure seal welds on the DSC shell to form a pressure retaining confinement boundary and to maintain a helium atmosphere.

3. Minimizing personnel radiation exposure during DSC transfer operations.

4. Design of the cask and DSC for postulated accidents.

5. Design of the HSM passive ventilation system for effective decay heat removal to ensure the integrity of the fuel cladding.

6. Design of the DSC basket assembly to ensure subcriticality.

D.3.4.2 Structural

The principal design criteria for the DSCs are presented in Section T.2.5 of the "Standardized NUHOMS® Horizontal Modular Storage System Safety Analysis Report" [D.3-1]. The DSCs are designed to store intact and failed *BWR* FAs with or without channels. The fuel cladding integrity is assured by limiting fuel cladding temperature and maintaining a nonoxidizing environment in the DSC cavity.

The principal design criteria for the MP197HB cask are presented in Section 3.2.5.3 of the "NUHOMS® -MP197 Transportation Package Safety Analysis Report" [D.3-10]. The cask is designed to transfer the loaded DSCs to the HSM.

D.3.4.3 Thermal

The HSM relies on natural convection through the air space in the HSM to cool the DSC. This passive convective ventilation system is driven by the pressure difference due to the stack effect (ΔP_s) provided by the height difference between the bottom of the DSC and the HSM air outlet. This pressure difference is greater than the flow pressure drop (ΔP_f) at the design air inlet and outlet temperatures.

D.4.4 Storage Module Thermal Monitoring System

As described in Section 5.1.3, HSM Thermal Monitoring Program of the Technical Specifications [D.4-3]*, daily visual inspection of the inlet and outlet vents of the HSM and removing any identified debris* prevent*s* conditions that could lead to exceeding the concrete and fuel clad temperature criteria. *In addition, instrumentation that can be used for monitoring HSM roof concrete temperatures is also provided for each HSM.*

24. The transfer vehicle can be moved, as necessary, to install the HSM door. Install the HSM door and secure it in place. The door may be welded for security.

25. Remove the unloading flange and replace the cask spacer ring.

26. Replace the TC top cover plate and ram access cover plate. Secure the skid to the transfer vehicle.

27. Move the transfer vehicle and TC to the designated area. Return the remaining transfer equipment to the Storage Area.

D.5.1.3 Monitoring Operations

1. Perform routine security surveillance in accordance with the security plan.

2. Perform a daily visual surveillance of the HSM air inlets and outlets (bird screens) to verify that no debris is obstructing the HSM vents in accordance with Section 5.1.3(a) of the Technical Specification [D.5-2] requirements.

D.7. STRUCTURAL EVALUATION

This Appendix describes the structural evaluation of the Standardized NUHOMS®-61BTH Type 1 System components utilized for transfer and storage of the 61BTH Type 1 canister at the WCS Consolidated Interim Storage Facility (WCS CISF). As presented in Chapter 1, Table 1-1, the Standardized NUHOMS® System storage components include the 61BTH Type 1 Dry Shielded Canister (DSC or canister) and the HSM Model 102 storage overpack. At the WCS CISF, the MP197HB transportation cask will be used for on-site transfer activities.

The HSM Model 102 is described in detail in Section 4.2.3.2 of the Standardized NUHOMS® Updated Final Safety Analysis Report (UFSAR) [D.7-2]. The 61BTH Type 1 DSC is described in detail in Section T.1.2 of [D.7-2]. Both of these components are approved by the NRC in Certificate of compliance (CoC) No. 1004 for transfer and storage of spent nuclear fuel (SNF) under the requirements of 10 CFR Part 72.

The MP197HB cask is described in Section A.1.2 of the NUHOMS®-MP197 Transportation Package Safety Analysis Report (SAR) [D.7-1]. The MP197HB cask is approved by the NRC in CoC No. 9302 for off-site transportation of SNF under the requirements of 10 CFR Part 71. The evaluation of the MP197HB cask for on-site transfer operations under 10 CFR Part 72 is contained in Appendix C.7.

The evaluation of the 61BTH Type 1 DSC for transfer and storage of SNF is contained in Appendix T of [D.7-2]. The evaluation of the HSM Model 102 is contained in Chapter 8 of the Standardized NUHOMS® Updated Final Safety Analysis Report [D.7-2].

Section D.7.3 presents a seismic reconciliation evaluation for the HSM Model 80/102 and for the 61BTH Type 1 DSC. This reconciliation, in combination with evaluations in the Standardized NUHOMS® Updated Final Safety Analysis Report [D.7-2] and evaluations of the MP197HB cask in Appendix C.7 demonstrate that the MP197HB cask / 61BTH Type 1 / HSM Model 102 transfer and storage system components satisfy all of the 10 CFR Part 72 requirements for storage at the WCS CISF.

Qualification of the 61BTH Type 1 DSC confinement boundary during Normal Conditions of Transport is addressed in Section D.7.8 *(to provide reasonable assurance that the confinement boundary is not adversely impacted by transport to the WCS CISF).*

Transfer Cask

The principal design criteria for the MP197HB cask for service at the WCS CISF are described in Table D.3-1 of Appendix D.3 and in Section C.7.7.1. The design approach, design criteria and loading combinations for the MP197HB cask are also described in Section C.7.7.1.

All Indicated Changes are in response to RAI NP-A-3

D.7.3 Seismic Reconciliation of the Canister, HSM Model 102, and MP197HB Cask

The WCS CISF site-specific seismic ground motion developed for the WCS CISF in the form of the 10,000-year return period uniform hazard response spectra for the horizontal and vertical directions is described in Chapter 2. A comparison of the WCS CISF site-specific response spectra and the Regulatory Guide 1.60 response spectra is shown in Figure D.7-1 for 3%, 5%, and 7% damping values. This comparison indicates that for system frequencies above about 10 Hz (horizontal direction) and 9 Hz (vertical direction), the WCS CISF spectral accelerations are higher than the design basis spectral accelerations. The ZPA values of 0.25g (horizontal) and 0.175g (vertical) for the WCS CISF ground motion are essentially the same as those for the Standardized NUHOMS® System as documented in Section 3.2.3 of [D.7-2].

This section describes the reconciliation evaluations of the 61BTH Type 1 DSC and the HSM Model 102 using the enveloping response spectra at the HSM CG and base, which are obtained from the soil-structure interaction (SSI) analysis of the WCS CISF. Comparisons of the 7%-damped WCS CISF 10,000-year return period uniform hazard response spectra and +/-15% peak-broadened HSM center of gravity (CG) response spectra from the WCS CISF SSI analysis in the HSM's transverse, longitudinal, and vertical directions are shown in Figure D.7-4, Figure D.7-5, and Figure D.7-6, respectively. The +/-15% peak-broadened HSM CG response spectra for damping values of 7%, 3%, and 2% are shown in Figure D.7-7 through Figure D.7-9. Section C.7.3.2 presents the reconciliation evaluation of the MP197HB cask as a transfer cask.

Section D.7.3.1 discusses the seismic analysis of the HSM Model 80 and Model 102 [D.7-5], Section D.7.3.2 discusses the seismic analysis of the MP197HB Cask [D.7-6], and Section D.7.3.3 discusses the seismic analysis of the 61BTH Type 1 DSC [D.7-7].

D.7.3.1 HSM Model 80 and Model 102

The seismic analysis of the HSM (Model 80 and Model 102, herein referred to as "HSM") is described in Section 8.2.3 of [D.7-2]. This analysis is reconciled in consideration of the enveloping response spectra at the HSM CG obtained from the WCS CISF SSI analysis, which are shown in Figure D.7-7 through Figure D.7-9. The same analysis methodology as used for the seismic evaluation of the HSM in Section 8.2.3.2.B in [D.7-2] is used for this reconciliation evaluation.

A dynamic response spectrum analysis is performed using the HSM ANSYS model shown in Figure 8.1-22 of [D.7-2] and the 7% damped response spectra at the HSM CG obtained from the WCS CISF SSI analysis. The ANSYS code Release 10.0 [D.7-4] is used for the analysis. The model includes an 88.7 kips canister, which is the weight of the 61BTH Type 1 DSC and also the bounding weight of the canister types considered in this application. The forces and moments in the various HSM concrete and steel components of the HSM are evaluated and compared to previous results as applicable.

All Indicated Changes are in response to RAI NP-D-1

D.7.3.1.5 Evaluation of Miscellaneous Components

D.7.3.1.5.1 Evaluation of the DSC Axial Retainer

The evaluation of the DSC axial retainer is described in Section 8.2.3.2(C)(iii) of [D.7-2]. The seismic load on the retainer is calculated below for the WCS CISF site-specific seismic loading.

[ ]

The maximum shear and bending stresses in the DSC axial retainer are 19.8 ksi and 25.8 ksi, respectively. The allowable shear and bending stresses are 23.5 ksi and 44.3 ksi, respectively. Therefore, the DSC axial retainer stresses are within allowable values.

D.7.3.1.5.2 Evaluation of the Heat Shields

The heat shield studs are evaluated for the axial, shear, and bending forces due to the WCS CISF site-specific loading, Reference [D.7-5].

[ ]

The stiffness of the 3/8" diameter studs is calculated and used to determine the natural frequency of the heat shield panels in the in-plane directions. The corresponding seismic accelerations are combined with deadweight loading to determine the maximum loads on the studs. The maximum axial and bending stresses in the studs are 1.59 ksi and 14.05 ksi, which give an interaction ratio of 0.43. The maximum shear stress in the studs is 0.40 ksi, which is less than the allowable shear stress of 18 ksi.

Therefore, the heat shield plates and studs are acceptable for the WCS CISF seismic loading.

D.7.3.1.6 Evaluation of HSM Seismic Stability and Sliding

The HSM is evaluated for seismic sliding and overturning stability due to the WCS CISF site-specific loading. The maximum sliding distance, rocking angle, and uplift height from the WCS CISF SSI analysis are 0.19", 0.05°, and 0.08", respectively. Therefore, the sliding and overturning stability characteristics of the HSM are acceptable for the WCS CISF seismic loading.

All Indicated Changes are in response to RAI NP-D-2

D.7.9 References

D.7-1 TN Document, NUH09.101 Rev. 17, "NUHOMS® -MP197 Transportation Package Safety Analysis Report." (Basis for NRC CoC 71-9302).

D.7-2 TN Document NUH-003, Revision 14, "Updated Final Safety Analysis Report for the Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Nuclear Fuel." (Basis for NRC CoC 72-1004).

D.7-3 Blevins, Robert D. Formulas for Natural Frequency and Mode Shape. 2001.

D.7-4 ANSYS Computer Code and User's Manual, Version 10.0 A1.

D.7-5 TN Americas LLC Calculation, WCS01-0208, Rev. 0, "Evaluation of HSM 80/102 Modules for WCS SSI Loading."

D.7-6 TN Americas LLC Calculation, WCS01-0202, Rev. 1, "NUHOMS® MP197HB Cask Structural qualification for Normal/Off-Normal conditions."

D.7-7 TN Americas LLC Calculation, WCS01-0209, Rev. 0, "FO, FC, FF, 61BT, and 61BTH Type 1 DSC Seismic Reconciliation."

All Indicated Changes are in response to RAI NP-D-1

D.12.2.2 Drop Accidents

Cause of Accident

Sections T.11.2.5.1 and T.3.7.4.1 of [D.12-1] discusses the cask drop for the MP197HB cask in the transfer configuration when it contains the canister.

Accident Analysis

The structural thermal consequences for the effects of a drop accident are addressed in Section T.11.2.5.2 of [D.12-1] for the canister and in Appendix D.8 for the MP197HB cask in the transfer configuration. This analysis demonstrates that the canister remains leak tight and the basket maintains its configuration following the drop event. In addition, Chapter D.8 presents the thermal analysis performed for the MP197HB cask for WCS CISF conditions.

Accident Dose Calculations

The accident dose calculations presented in Section T.11.2.5.3 of [D.12-1], are very conservative because the MP197HB cask consists of a solid neutron shield, the source terms for the contents of the canister have significantly decayed prior to transportation to the WCS CISF and the boundary is approximately 0.75 miles from the WCS CISF.

Corrective Action

Consistent with Sections T.11.2.5.4 and 8.2.5.4 of [D.12-1], the canister will be inspected for damage *for drop heights greater than fifteen inches*, as necessary. Removal of the transfer cask top cover plate may require cutting of the bolts in the event of a corner drop onto the top end. These operations will take place in the Cask Handling Building. *The extent of the damage will also be evaluated using calculations to demonstrate that there is no impact to the ability of the canister to continue to perform its intended design functions.*

Following recovery of the transfer cask and transfer of the canister in the HSM, the transfer cask will be inspected, repaired and tested as appropriate prior to reuse.

For recovery of the cask and contents, it may be necessary to develop a special sling/lifting apparatus to move the transfer cask from the drop site to the cask handling building. This may require several weeks of planning to ensure all steps are correctly organized. During this time, temporary shielding may be added to the transfer cask to minimize on-site exposure to WCS CISF operations personnel. The transfer cask would be roped off to ensure the safety of personnel.

E.3.1.2 Safety Protection Systems

The NAC-MPC relies upon passive systems to ensure the protection of public health and safety, except in the case of fire or explosion. As discussed in Section 2.3.6 of Reference E.3-1, fire and explosion events are effectively precluded by site administrative controls that prevent the introduction of flammable and explosive materials into areas where an explosion or fire could damage installed NAC-MPC systems. The use of passive systems provides protection from mechanical or equipment failure.

E.3.1.2.1 General

The NAC-MPC is designed for safe, long-term storage of spent nuclear fuel. The NAC-MPC will survive all of the evaluated normal, off-normal, and postulated accident conditions without release of radioactive material or excessive radiation exposure to workers or the general public. The major design considerations that have been incorporated in the NAC-MPC system to assure safe long-term fuel storage are:

1. Continued confinement in postulated accidents
2. Thick concrete and steel biological shield
3. Passive systems that ensure reliability
4. Inert atmosphere to provide corrosion protection for stored fuel cladding

Each NAC-MPC system storage component is classified with respect to its function and corresponding effect on public safety. In accordance with Regulatory Guide 7.10, each system component is assigned a safety classification into Category A, B or C, as shown in Tables 2.3-1 and 2.3-2 of Reference E.3-1. *Table E.3-2 provides the safety classifications for the Auxiliary Equipment referenced in Sections E.4.1.4 of this SAR.* The safety classification is based on review of each component's function and the assessment of the consequences of component failure following the guidelines of NUREG/CR-6407, "Classification of Transportation Packaging and Dry Spent Fuel Storage System Components According to Importance to Safety."

Category A - Components critical to safe operations whose failure or malfunction could directly result in conditions adverse to safe operations, integrity of spent fuel or public health and safety.

Category B - Components with major impact on safe operations whose failure or malfunction could indirectly result in conditions adverse to safe operations, integrity of spent fuel or public health and safety.

Category C - Components whose failure would not significantly reduce the packaging effectiveness and would not likely result in conditions adverse to safe operations, integrity of spent fuel, or public health and safety.

As discussed in Section 2.3 of Reference E.3-1, the NAC-MPC design incorporates features addressing the above design considerations to assure safe operation during fuel loading, handling, and storage. This section addresses the following:

All Indicated Changes are in response to RAI NP-E-4

E.3.2.2 Safety Protection Systems

The MPC-LACBWR relies upon passive systems to ensure the protection of public health and safety, except in the case of fire or explosion. As discussed in Section 2.3.6 of Reference E.3-1, fire and explosion events are effectively precluded by site administrative controls that prevent the introduction of flammable and explosive materials into areas where an explosion or fire could damage installed MPC-LACBWR systems. The use of passive systems provides protection from mechanical or equipment failure.

E.3.2.2.1 General

The MPC-LACBWR is designed for safe, long-term storage of spent nuclear fuel. The MPC-LACBWR will survive all of the evaluated normal, off-normal, and postulated accident conditions without release of radioactive material or excessive radiation exposure to workers or the general public. The major design considerations that have been incorporated in the MPC-LACBWR system to assure safe long-term fuel storage are:

6. Continued confinement in postulated accidents
7. Thick concrete and steel biological shield
8. Passive systems that ensure reliability
9. Inert atmosphere to provide corrosion protection for stored fuel cladding

Each MPC-LACBWR system storage component is classified with respect to its function and corresponding effect on public safety. In accordance with Regulatory Guide 7.10, each system component is assigned a safety classification into Category A, B or C, as shown in Table 2.A.3-1 of Reference E.3-1. *Table E.3-2 provides the safety classifications for the Auxiliary Equipment referenced in Sections E.4.2.4 of this SAR.* The safety classification is based on review of each component's function and the assessment of the consequences of component failure following the guidelines of NUREG/CR-6407, "Classification of Transportation Packaging and Dry Spent Fuel Storage System Components According to Importance to Safety."

Category A - Components critical to safe operations whose failure or malfunction could directly result in conditions adverse to safe operations, integrity of spent fuel or public health and safety.

Category B - Components with major impact on safe operations whose failure or malfunction could indirectly result in conditions adverse to safe operations, integrity of spent fuel or public health and safety.

Category C - Components whose failure would not significantly reduce the packaging effectiveness and would not likely result in conditions adverse to safe operations, integrity of spent fuel, or public health and safety.

All Indicated Changes are in response to RAI NP-E-4

Table* E.3-*2
Safety Classification of Auxiliary Equipment
(3 pages)

Assembly/ Component Name	***Safety Function/Description***	***Q-Category***
Auxiliary Equipment	*Systems and components not normally addressed or defined with cask system SARs that are normally utilized for the handling, loading, transfer, storage, and/or unloading multi-purpose, storage and transport cask system.*	*Itemized As Follows*
Cask Lifting Yoke (CLY) Assembly	*The lifting yoke assembly provides for the lifting and handling of a cask body (i.e., transfer cask, transport cask, etc.) by connection to lifting points/features on the cask during loading, unloading and/or transfer operations of radioactive materials at user facilities.*	*B*
- Lifting Yoke Load Bearing Components	*The load carrying components of the lifting yokes used to lift and handle transport and transfer casks during loading and unloading operations. Components include lift yoke arms, crossbeams, lift pins, etc., that transmit the load of the cask to the facility crane hook*	*B*
- Lifting Yoke Components for Non-Critical Lifts	*Load carrying components of the lifting yoke used for non-critical lifts only, allowing the use of reduced design factors of safety.*	*C*
- Lifting Yoke Operational Components	*The operational components provide operational support for the Yoke Assembly, including components that assist in the guiding or aligning of the yoke to the cask, arm actuation components, bolting, washers, screws, etc.*	*NQ*
- Lifting Yoke Auxiliary Components	*The Lifting Yoke Auxiliary Components, such as the yoke counterweight, are non-load bearing components utilized during normal operations to assist in the engagement of the lifting yoke to the lifting attachments on the cask.*	*B*
Cask Ancillary Systems (CAS)	*Cask ancillary systems are the various operational systems that are used at the loading and unloading facility to prepare TSCs, transport casks and other auxiliary equipment for storage and/or transport in accordance with the Certificate of Compliance (CoC). These systems do not provide a safety function for the cask performance. They provide operational support and monitor or modify operational conditions for final compliance with the CoC. These systems include H2 Monitoring, Vacuum Drying, Cask Cool Down, Cask Draining, etc. Failure of any of these systems would not have an adverse affect to cask final CoC condition.*	*NQ-OS*
Auxiliary Lifting Components for Critical Lifts	*The lifting slings and associated hardware, designed and tested to comply with the requirements of ASME B30.9 and ANSI N14.6 for use on critical lifts (e.g. lowering the loaded canister into the VCC).*	*B*

All Indicated Changes are in response to RAI NP-E-4

Table* E.3-*2
Safety Classification of Auxiliary Equipment
(3 pages)

Assembly/ Component Name	***Safety Function/Description***	***Q-Category***
Auxiliary Lifting Components for Non-Critical Lifts	*The lifting slings and associated hardware for use on non-critical lifts (e.g. lifting of an empty canister).*	*NQ*
Welding and Cutting Equipment	*Welding, cutting, and weld inspection systems required to perform the necessary canister field welds during loading or unloading operations.*	*NQ*
Weld Mock-up	*Weld mock-ups, representative of the canister certified design configuration, used to demonstrate and qualify the canister closure welding operation sequences and performance.*	*NQ-OS*
Ancillary Shielding	*Additional shielding components used during operational procedures to ensure doses to workers are maintained ALARA.*	*NQ*
Cask Maneuvering Equipment	*Systems used for the onsite transport of loaded concrete casks to the ISFSI pad*	*NQ-OS*
Auxiliary Transfer Equipment	*Components and systems designed to facilitate the loading, handling, testing, and/or other dry transfer operations during transfer from a facility to the shipping cask.*	*NQ*
Single Failure Proof Cask Lifting Systems	*Systems such as overhead gantry cranes or chain hoist systems designed to handle a critical load. These systems are designed and constructed with single failure proof features and are capable of retaining control of a critical load during and after a seismic event.*	*B*
Equipment Storage and Handling Systems	*Systems such as the Lift Yoke Stand designed to facilitate equipment handling and storage at the facility.*	*NQ*
Transfer Cask Leveling Pad	*A site-specific transfer cask leveling pad designed to ensure the proper levelness of the transfer cask during TSC insertion, welding and preparation for transfer in the decontamination/cask preparation area.*	*NQ-OS*
Personnel Barrier	*Components used as a physical barrier to prevent access to, or contact with, the package by persons during routine transport.*	*NQ-OS*

All Indicated Changes are in response to RAI NP-E-4

***Table* E.3-2**
Safety Classification of Auxiliary Equipment
(3 pages)

Assembly/ Component Name	***Safety Function/Description***	***Q-Category***
Adapter Plate Components and Assembly	*The Adapter Plate is utilized to appropriately position the loaded Transfer Cask (TFR) on the VCC Assembly for transfer of the loaded TSC assembly into or from the VCC, and to remotely open and close the TFR shield doors to access the TFR cavity. The Adapter Plate is also designed to interface with the appropriate Transport Cask for loading and unloading of the TSC Assembly.*	*NQ*
Seismic Restraint System (SRS)	*A structural assembly of components designed to limit the motion of the Transfer Cask, Concrete Cask, and/or Transport Cask during a seismic event.*	*B*
- SRS Primary Structural Components	*The primary structural components of the SRS include all components important to maintain the cask system in a safe condition during a seismic event (i.e. beam structures, foundations, bolted/welded connections, bracketry, struts, cables, etc. in the primary load path between the cask system and ground or other qualified structure).*	*B*
- SRS Miscellaneous Components	*The miscellaneous components of the SRS include items such as structural components used only for installation or operation of the Seismic Restraint System and non-structural components such as nameplates, coatings, etc. which are not relied upon to carry any load during a seismic event.*	*NQ*

All Indicated Changes are in response to RAI NP-E-4

The storage cask has an annular air passage to allow the natural circulation of air around the canister to remove the decay heat from the spent fuel. The decay heat is transferred from the fuel assemblies to the fuel tubes or damaged fuel can in the fuel basket and through the heat transfer disks to the canister wall. Heat flows by radiation and convection from the canister wall to the air circulating through the concrete cask annular air passage and is exhausted through the air outlet vents. This passive cooling system is designed to maintain the peak cladding temperature of both stainless steel and Zircaloy clad fuel well below acceptable limits during long-term storage. This design also maintains the bulk concrete temperature below 150°F and localized concrete temperatures below 200°F in normal operating conditions.

The top of the storage cask is closed by a shield plug and lid. The shield plug for the Yankee MPC is approximately 5 inches thick and incorporates carbon steel plate as gamma radiation shielding and NS-4-FR as neutron radiation shielding. A carbon steel lid that provides additional gamma radiation shielding is installed above the shield plug. For the CY-MPC, the shield plug is similar to the Yankee-MPC except the neutron shielding may be either NS-4-FR or NS-3. The shield plug and lid reduce skyshine radiation and provide a cover and seal to protect the canister from the environment and postulated tornado missiles. At the option of the user, a tamper-indicating seal may be installed on two of the concrete cask lid bolts.

To facility movement of the storage cask at the WCS CISF, embedded lift lugs are placed in the concrete. This provides a place for the vertical cask transporter to engage the storage cask in order to lift and subsequently move the storage cask whether there is a loaded TSC in it or not.

Existing Yankee-MPC and CY-MPC storage casks will not be used at the WCS CISF. New storage casks will be constructed on site at the WCS CISF. Fabrication of the storage cask involves no unique or unusual forming, concrete placement, or reinforcement requirements. The concrete portion of the storage cask is constructed by placing concrete between a reusable, exterior form and the inner metal liner. Reinforcing bars are placed near the inner and outer concrete surfaces to provide structural integrity. The inner liner and base of the storage cask are shop fabricated. An optional supplemental shielding fixture may be installed in the air inlets of the Yankee-MPC to reduce the radiation dose rate at the base of the cask. The principal fabrication specifications for the storage cask are shown in Table E.4-2.

E.4.1.3 Transfer Cask

The transfer cask, with its lifting yoke, is primarily a lifting device used to move the canister assembly. *The transfer cask is designed, fabricated, and tested to meet the requirements of ANSI N14.6 as a special lifting device. The transfer cask* provides biological shielding *and structural protection for a loaded TSC*. The transfer cask is used for the vertical transfer of the canister between work stations and the storage cask, or transport cask.

All Indicated Changes are in response to RAI NP-E-3

The general arrangement of the transfer cask and canister is shown in Figure E.4-4 and Figure E.4-5, and the arrangement of the transfer cask and concrete cask is shown in Figure E.4-6. The configuration of the transfer cask, canister and concrete cask during loading of the concrete cask is shown in Figure E.4-7.

Table 1.2-5 of Reference E.4-1 shows the principal design parameters of the transfer cask used for the Yankee-MPC and CY-MPC configurations. As shown, the basic design of the transfer cask is similar, with the CY-MPC transfer cask being approximately 30 inches longer and 2.5 inches larger in diameter than the Yankee-MPC transfer cask.

The transfer cask is a multiwall (steel/lead/NS-4-FR neutron shield/steel) design, which limits the average contact radiation dose rate to less than 300 mrem/hr. The transfer cask design incorporates a top retaining ring, which is bolted in place preventing a loaded canister from being inadvertently removed through the top of the transfer cask. The transfer cask has retractable bottom shield doors. During loading operations, the doors are closed and secured by lock bolts/lock pins, so they cannot inadvertently open. During unloading, the doors are retracted using hydraulic cylinders to allow the canister to be lowered into the storage or transport casks. The transfer cask is shown in Figure E.4-4.

To qualify the transfer cask as a heavy lifting device, it is designed, fabricated, and proof load tested to the requirements of NUREG-0612 and ANSI N14.6. Maintenance is to be performed in accordance with WCS CISF procedures that meet the requirements of NUREG-0612.

RAI NP-E-3

Lifting and handling of the transfer cask is performed using the Canister Transfer System (CTS), which is described in Section 7.5.1.

E.4.1.4 Ancillary Equipment

RAI NP-E-4

This section presents a brief description of the principal ancillary equipment needed to operate the NAC-MPC in accordance with its design. *Sections 7.5.1 and 7.5.2 of this SAR contain descriptions, design criteria, load cases, and analysis for the Cask Transfer System (CTS) and Vertical Cask Transporter (VCT) respectively.*

E.4.1.4.1 Adapter Plate

The adapter plate is a carbon steel table that mates the transfer cask to either the vertical concrete (storage) cask or the NAC-STC transport cask. It has a large center hole that allows the transportable storage canister to be raised or lowered through the plate into or out of the transfer cask. Rails are incorporated in the adapter plate to guide and support the bottom shield doors of the transfer cask when they are in the open position. The adapter plate also supports the hydraulic system and the actuators that open and close the transfer cask bottom doors.

E.4.1.4.2 Vertical Cask Transporter

The vertical cask transporter is mobile lifting device that allows for the movement of the vertical concrete storage cask. The transporter engages the storage cask via the embedded lift lugs. After the transporter has engaged the storage cask, it can lift the storage cask and move it to the desired location. When the storage cask has a loaded TSC, the transporter shall not lift the storage higher than the allowed lift limit.

E.4.1.4.3 Rigging and Slings

Several lifting rig assemblies are required to handle various NAC-MPC (Yankee-Rowe and Connecticut Yankee) components during transfer operations at the CISF. Each lifting rig assembly may consist of a combination of slings, shackles, swivel hoist rings, turnbuckles, master links, connecting links, and chains. The lifting rig assemblies are designed to meet the guidance of NUREG/CR-0612 with the following considerations made:

- *Lifting requirements consider dynamic loading (i.e., 1.1 dynamic load factor).*
- *Components meet the requirements of ASME B30 (i.e., ASME B30.9 – Slings, B30.10 – Hooks, and B30.26 – Rigging Hardware).*
- *Single-failure-proof lifting devices have enhanced safety features for handling critical loads without the need to consider drop conditions.*

Enhanced safety features include double the safety factor required for handling non-critical loads or redundant load paths, with each qualified to the safety factor required for handling non-critical loads. Note that handling of critical loads may be performed with non-single-failure proof rigging if drop conditions have been analyzed and shown to be acceptable.

Typical rigging and slings include a concrete cask lid sling, concrete cask shield plug sling, canister shield lid sling, loaded canister transfer sling (also used to handle the structural lid), and canister retaining ring sling.

E.4.1.4.4 Temperature Instrumentation

The concrete casks may be equipped with temperature-monitoring equipment to measure the outlet air temperature. The Technical Specification requires either daily temperature measurements or daily visual inspection for inlet and outlet screen blockage to ensure the cask heat removal system remains operable.

All Indicated Changes are in response to RAI NP-E-5

The top of the storage cask is closed by a lid with integral radiation shield. The radiation shield is approximately 8-inch thick concrete encased in a carbon steel shell extending into the cask cavity from the bottom surface of the 1.5-inch-thick carbon steel lid. The specification summary for the encased concrete is shown in Table E.4-3.

To facility movement of the storage cask at the WCS CISF, embedded lift lugs are placed in the concrete. This provides a place for the vertical cask transporter to engage the storage cask in order to lift and subsequently move the storage cask whether there is a loaded TSC in it or not.

Existing MPC-LACBWR storage casks will not be used at the WCS CISF. New storage casks will be constructed on site at the WCS CISF. Fabrication of the storage cask involves no unique or unusual forming, concrete placement, or reinforcement requirements. The concrete portion of the storage cask is constructed by placing concrete between a reusable, exterior form and the inner metal liner. Reinforcing bars are placed near the inner and outer concrete surfaces to provide structural integrity. The inner liner and base of the storage cask are shop fabricated. Radiation shielding is installed in the air inlets to reduce the radiation dose rates local to the air inlets at the base of the cask. The principal fabrication specifications for the storage cask are shown in Table E.4-2.

E.4.2.3 Transfer Cask

The transfer cask for the MPC-LACBWR is the same transfer cask used for the Yankee-MPC as described in WCS CISF SAR Appendix E, Section E.4.1.3. The transfer cask, with its lifting yoke, is primarily a lifting device used to move the canister assembly. *The transfer cask is designed, fabricated, and tested to meet the requirements of ANSI N14.6 as a special lifting device. The transfer cask* provides biological shielding *and structural protection for a loaded TSC*. The transfer cask is used for the vertical transfer of the canister between work stations and the storage cask, or transport cask.

The general arrangement of the transfer cask and canister is shown in Figure E.4-11 and Figure E.4-12, and the arrangement of the transfer cask and concrete cask is shown in Figure E.4-13. The configuration of the transfer cask, canister and concrete cask during loading of the concrete cask is shown in Figure E.4-14.

Table 1.A.2-5 of Reference E.4-1 shows the principal design parameters of the transfer cask used for the Yankee-MPC and MPC-LACBWR configurations.

All Indicated Changes are in response to RAI NP-E-3

The transfer cask is a multiwall (steel/lead/NS-4-FR neutron shield/steel) design, which limits the average contact radiation dose rate to less than 100 mrem/hr. The transfer cask design incorporates a top retaining ring, which is bolted in place preventing a loaded canister from being inadvertently removed through the top of the transfer cask. The transfer cask has retractable bottom shield doors. During loading operations, the doors are closed and secured by door stops, so they cannot inadvertently open. During unloading, the doors are retracted using hydraulic cylinders to allow the canister to be lowered into the storage or transport casks. The transfer cask is shown in Figure E.4-11.

To qualify the transfer cask as a heavy lifting device, it is designed, fabricated, and proof load tested to the requirements of NUREG-0612 and ANSI N14.6. Maintenance is to be performed in accordance with WCS CISF procedures that meet the requirements of NUREG-0612.

RAI NP-E-3

Lifting and handling of the transfer cask is performed using the Canister Transfer System (CTS), which is described in Section 7.5.1.

E.4.2.4 Ancillary Equipment

RAI NP-E-4

This section presents a brief description of the principal ancillary equipment needed to operate the MPC-LACBWR in accordance with its design. *Sections 7.5.1 and 7.5.2 of this SAR contain descriptions, design criteria, load cases, and analysis for the Cask Transfer System (CTS) and Vertical Cask Transporter (VCT) respectively.*

E.4.2.4.1 Adapter Plate

The adapter plate is a carbon steel table that mates the transfer cask to either the vertical concrete (storage) cask or the NAC-STC transport cask. It has a large center hole that allows the transportable storage canister to be raised or lowered through the plate into or out of the transfer cask. Rails are incorporated in the adapter plate to guide and support the bottom shield doors of the transfer cask when they are in the open position. The adapter plate also supports the hydraulic system and the actuators that open and close the transfer cask bottom doors.

E.4.2.4.2 Vertical Cask Transporter

The vertical cask transporter is mobile lifting device that allows for the movement of the vertical concrete storage cask. The transporter engages the storage cask via the embedded lift lugs. After the transporter has engaged the storage cask, it can lift the storage cask and move it to the desired location. When the storage cask has a loaded TSC, the transporter shall not lift the storage higher than the allowed lift limit.

E.4.2.4.3 Rigging and Slings

Several lifting rig assemblies are required to handle various MPC-LACBWR components during transfer operations at the CISF. Each lifting rig assembly may consist of a combination of slings, shackles, swivel hoist rings, turnbuckles, master links, connecting links, and chains. The lifting rig assemblies are designed to meet the guidance of NUREG/CR-0612 with the following considerations made:

- *Lifting requirements consider dynamic loading (i.e., 1.1 dynamic load factor).*
- *Components meet the requirements of ASME B30 (i.e., ASME B30.9 – Slings, B30.10 – Hooks, and B30.26 – Rigging Hardware).*
- *Single-failure-proof lifting devices have enhanced safety features for handling critical loads without the need to consider drop conditions.*

Enhanced safety features include double the safety factor required for handling non-critical loads or redundant load paths, with each qualified to the safety factor required for handling non-critical loads. Note that handling of critical loads may be performed with non-single-failure proof rigging if drop conditions have been analyzed and shown to be acceptable.

Typical rigging and slings include a concrete cask lid sling, concrete cask shield plug sling, canister shield lid sling, loaded canister transfer sling (also used to handle the structural lid), and canister retaining ring sling.

E.4.2.4.4 Temperature Instrumentation

The concrete casks may be equipped with temperature-monitoring equipment to measure the outlet air temperature. The Technical Specification requires either daily temperature measurements or daily visual inspection for inlet and outlet screen blockage to ensure the cask heat removal system remains operable.

E.4.2.5 Storage Pad

The MPC-LACBWR is designed for long-term storage at an ISFSI. At the ISFSI site, the loaded concrete storage casks are placed in the vertical position on a concrete pad in a linear array. The reinforced concrete foundation of the ISFSI pad is capable of sustaining the transient loads from the vertical cask transporter and the general loads of the stored casks. The pad design meets the NAC-MPC pad requirements listed in Reference E.4-1.

All Indicated Changes are in response to RAI NP-E-5

E.7.1.8 Cold

As described in Section 3.4.5 of Reference E.7-1, the evaluation for severe cold environments for the NAC-MPC system for the Yankee-MPC and CY-MPC are provided in Section 11.1.4 of Reference E.7-1. Stress intensities corresponding to thermal loads in the canister are evaluated by using a finite element model as described in Section 3.4.4 of Reference E.7-1. The thermal stresses that occur in the canister as a results of the maximum off-normal temperature gradients in the canister are bounded by the analysis of extreme cold in Section 11.1.4 of Reference E.7-1. The canister and basket are fabricated from stainless steel an aluminum, which are not subject to a ductile-to-brittle transition in the temperature range of interest.

E.7.1.9 Fuel Rods

The evaluations of the Yankee-MPC and CY-MPC fuel rods are provided in Section 3.5 of Reference E.7-1.

E.7.1.10 Coating Specifications

The coating specifications for the NAC-MPC vertical concrete cask and transfer cask exposed carbon steel surfaces associated with the Yankee-MPC and CY-MPC are provided in Section 3.8 of Reference E.7-1.

E.7.1.11 Structural Evaluation of Yankee-MPC and CY-MPC Canister Confinement Boundaries under Normal Conditions of Transport

The Yankee-MPC and CY-MPC canister primary confinement boundaries consist of a canister shell, bottom closure plate, shield lid, the two (2) port covers, and the welds that join these components. Redundant closure is provided by a structural lid and adjoining canister weld. Additional details, geometry and shell and plate thicknesses are provided on the drawings in Section E.4.4. The confinement boundary is addressed in Section E.11.1.1. The Yankee-MPC and CY-MPC canister shells are evaluated for Normal Conditions of Transport in the NAC-STC Transport cask in Sections 2.6.13 and 2.6.15 of [E.7-9] *(to provide reasonable assurance that the confinement boundary is not adversely impacted by transport to the WCS CISF)*.

The result of the structural analysis is acceptable for the loads and combinations described in Sections 2.6.13 and 2.6.15 of [E.7-9] and hence structurally adequate for normal conditions of transport loading conditions.

All Indicated Changes are in response to RAI NP-E-6

E.7.2.8 Fuel Rods

The evaluations of the MPC-LACBWR fuel rods is provided in Section 3.A.5 of Reference E.7-1.

E.7.2.9 Canister Closure Weld Evaluation

The evaluations of the MPC-LACBWR closure weld is provided in Section 3.A.6 of Reference E.7-1.

E.7.2.10 Coating Specifications

The coating specifications for the MPC-LACBWR vertical concrete cask and transfer cask exposed carbon steel surfaces are provided in Section 3.A.8 of Reference E.7-1.

E.7.2.11 Structural Evaluation of MPC-LACBWR Canister Confinement Boundaries under Normal Conditions of Transport

The MPC-LACBWR canister primary confinement boundaries consist of a canister shell, bottom closure plate, closure lid, the two (2) port covers, and the welds that join these components. Redundant closure is provided by two (2) outer port covers and a closure ring. Additional details, geometry and shell and plate thicknesses are provided on the drawings in Section E.4.4. The confinement boundary is addressed in Section E.11.2.1. The MPC-LACBWR canister shell is evaluated for Normal Conditions of Transport in the NAC-STC Transport cask in Section 2.11.6.13 of [E.7-9] *(to provide reasonable assurance that the confinement boundary is not adversely impacted by transport to the WCS CISF)*.

The result of the structural analysis is acceptable for the loads and combinations described in Section 2.11.6.13 of [E.7-9] and hence structurally adequate for normal conditions of transport loading conditions.

All Indicated Changes are in response to RAI NP-E-6

E.9 RADIATION PROTECTION

Chapter 5 of Reference E.9.3-1 provides the shielding evaluation of the NAC-MPC storage system. The system is provided in three configurations. The Yankee Class NAC-MPC is designed to store up to 36 Yankee Class spent fuel assemblies or Yankee Class reconfigured fuel assemblies and is referred to as the Yankee-MPC. The Connecticut Yankee-MPC, referred to as the CY-MPC, is designed to store up to 26 Connecticut Yankee spent fuel assemblies, CY-MPC reconfigured fuel assemblies or CY-MPC damaged fuel cans. The analysis of the Yankee Class spent fuel is performed using the SAS4 code series. The analysis of the Connecticut Yankee spent fuel is performed using the MCBEND code. Separate models are used for each of the fuel types.

The Dairyland Power Cooperative (DPC) La Crosse Boiling Water Reactor (LACBWR) MPC, referred to as MPC-LACBWR, is designed to store up to 68 LACBWR spent fuel assemblies, including up to 32 LACBWR damaged fuel cans. The shielding evaluation of the MPC-LACBWR system is presented in Appendix 5.A of Chapter 5 to Reference E.9.3-1.

The regulation governing spent fuel storage, 10 CFR 72, does not establish specific cask dose rate limits. However, 10 CFR 72.104 and 10 CFR 72.106 specify that for an array of casks in an Independent Spent Fuel Storage Installation (ISFSI), the annual dose to an individual outside the controlled area boundary must not exceed 25 mrem to the whole body, 75 mrem to the thyroid and 25 mrem to any other organ during normal operations. In the case of a design basis accident, the dose to an individual outside the area boundary must not exceed 5 rem to the whole body or any organ. The ISFSI must be at least 100 meters from the owner controlled area boundary. In addition, the occupational dose limits and radiation dose limits for individual members of the public in 10 CFR Part 20 (Subparts C and D) must be met. Reference E.9.3-1, Chapter 10, Section 10.3, demonstrates NAC-MPC compliance with the requirements of 10 CFR 72 with regard to annual and occupational doses at the owner controlled area boundary. Chapter 5 of Reference E.9.3-1 presents the shielding evaluations of the NAC-MPC storage system. Dose rate profiles are calculated as a function of distance from the side, top and bottom of the NAC-MPC storage and transfer casks. Shielded source terms from the NAC-MPC storage cask are calculated to establish owner controlled area boundary dose estimates due to the presence of the ISFSI.

Table E.9-1 provides estimated occupational exposures for receipt and handling of the YR-MPC, CY-MPC, and MPC-LACBWR at the WCS CISF. For each procedural step, the number of workers, occupancy time, worker distance, dose rates, and total dose are estimated. Dose rates used were obtained and estimated via the listed references in the table. The total occupational exposure for receiving, transferring and placing these canisters on the storage pad in their storage overpack (VCC) is *864* person-mrem each. The total collective dose for unloading a YR-MPC, CY-MPC or MPC-LACBWR canister from its VCC and preparing it for transport off-site is bounded by the loading operations (*864* person-mrem). Operations for retrieving these canisters from the VCC and off-site shipment are identical to loading operations, except in reverse order.

All Indicated Changes are in response to RAI NP-9-10

Table E.9-1
Estimated Occupational Collective Dose for Receipt of NAC-STC Cask Loaded with YR-MPC, CY-MPC, or MPC-LACBWR TSC and Transfer to MPC VCC

8 Sheets

Process Step	Number of Workers	Occupancy Time (hours)	Worker Location Around Cask	Worker Distance (m)	Total Dose Rate (mrem/hr)	Total Dose (person-mrem)[1]	Reference SAR/FSAR Section/Table/Figure
Perform radiation and contamination survey of STC Cask.	2	0.5	All Around	2	4	2	SAR Figure 5.1-6, Figure 5.1-11, and Table 5.1-10
Inspect top impact limiter security seal and verify it is intact and correct ID.	1	0.25	Surface of Top Impact Limiter	<1	<1	1	SAR Figure 5.1-6, Figure 5.1-11, and Table 5.1-10
Remove Personnel Barrier and complete surveys.	2	0.5	Center of cask	1.5	15	15	SAR Figure 5.1-6, Figure 5.1-11, Figure 5.4-10, and Table 5.1-10
Remove Security Seal	*1*	*0.1*	*Top Impact Limiter Periphery*	*> 1*	*< 1*	*1*	*SAR Figure 5.1-6, Figure 5.1-11, Figure 5.4-10, and Table 5.1-10*
Visually inspect Cask surface for transport/road damage and record.	1	0.25	All Around	2	<4	1	SAR Figure 5.1-6, Figure 5.1-11, Figure 5.4-10, and Table 5.1-10
Attach slings to top Impact Limiter and remove attachment nuts/rods. Remove and store Impact Limiter.	2	0.5	Surface of Top Impact Limiter	1	< 1	1	SAR Figure 5.1-6, Figure 5.1-11, and Table 5.1-10

All Indicated Changes are in response to RAI NP-9-10

Table E.9-1
Estimated Occupational Collective Dose for Receipt of NAC-STC Cask Loaded with YR-MPC, CY-MPC, or MPC-LACBWR TSC and Transfer to MPC VCC

8 Sheets

Process Step	Number of Workers	Occupancy Time (hours)	Worker Location Around Cask	Worker Distance (m)	Total Dose Rate (mrem/hr)	Total Dose (person-mrem)[1]	Reference SAR/FSAR Section/Table/Figure
Attach slings to bottom Impact Limiter and remove attachment nots/rods. Remove and store Impact Limiter.	2	0.5	Surface of Bottom Impact Limiter	1	< 1	1	SAR Figure 5.1-6, Figure 5.1-11, and Table 5.1-10
Perform contamination survey of cask surfaces. If necessary, decontaminate the cask until acceptable smearable contamination levels are achieved.	*2*	*0.5*	*All Around*	*> 1*	*< 20*	*20*	*SAR Figure 5.1-16, Figure 5.1-11, and Table 5.1-10*
Release Front Tie-Down Assembly.	2	1	Top Side STC Cask Surface	1	25	50	SAR Figure 5.1-6, Figure 5.1-11, Figure 5.4-10, and Table 5.1-10
Engage Vertical Cask Transporter (VCT) Lift Arms to Front Trunnions and rotate cask to vertical orientation.	2	1	Top Side STC Cask Surface	>2	5	10	SAR Figure 5.1-6, Figure 5.1-11, Figure 5.4-10, and Table 5.1-10

All Indicated Changes are in response to RAI NP-9-10

Table E.9-1
Estimated Occupational Collective Dose for Receipt of NAC-STC Cask Loaded with YR-MPC, CY-MPC, or MPC-LACBWR TSC and Transfer to MPC VCC

8 Sheets

Process Step	Number of Workers	Occupancy Time (hours)	Worker Location Around Cask	Worker Distance (m)	Total Dose Rate (mrem/hr)	Total Dose (person-mrem)[1]	Reference SAR/FSAR Section/Table/Figure
Using the VCT, lift and move loaded MPC VCC and position it in the designated storage location.	2	1	VCT Platform	>2	10	20	Operation performed from VCT and FSAR Figure 5.4.2-7
Prepare empty STC cask for empty return transport.	2	4	CTF	1	0	0	Empty cask preparation activities
Total (person-mrem)						*864*	

Note:
1. Rounded up to the nearest whole number

All Indicated Changes are in response to RAI NP-9-10

Each NAC-UMS component is classified with respect to its function and corresponding effect on public safety. In accordance with Regulatory Guide 7.10, each system component is assigned a safety classification into Category A, B or C, as shown in Table 2.3-1 of Reference F.3-1. *Table E.3-2 provides the safety classifications for the Auxiliary Equipment referenced in Sections F.4.1.4 of this SAR.* The safety classification is based on review of each component's function and the assessment of the consequences of component failure following the guidelines of NUREG/CR-6407, "Classification of Transportation Packaging and Dry Spent Fuel Storage System Components According to Importance to Safety." The safety classification categories are defined as follows:

Category A - Components critical to safe operations whose failure or malfunction could directly result in conditions adverse to safe operations, integrity of spent fuel or public health and safety.

Category B - Components with major impact on safe operations whose failure or malfunction could indirectly result in conditions adverse to safe operations, integrity of spent fuel or public health and safety.

Category C - Components whose failure would not significantly reduce the packaging effectiveness and would not likely result in conditions adverse to safe operations, integrity of spent fuel, or public health and safety.

As discussed in Section 2.3 of Reference F.3-1, the NAC-UMS design incorporates features addressing the above design considerations to assure safe operation during fuel loading, handling, and storage. The section addresses the following:

1. Protection by multiple confinement barriers and systems.
2. Protection by equipment and instrumentation selection
3. Nuclear criticality safety
4. Radiological protection
5. Fire and explosion protection
6. Ancillary Structure (Canister Handling Facility)

The confinement performance requirements for the NAC-UMS System are described in Chapter 7, Section 7.1.1.2 of Reference F.3-1 for storage conditions. In addition, "NAC-UMS Universal Transport Cask Safety Analysis Report" [F.3-2] demonstrates that the confinement boundary is not adversely affected by normal conditions of transport. Specifically, Chapter 2, Section 2.6.12 for the PWR canister. Therefore, transport to the WCS CISF will not adversely impacted confinement integrity of the NAC-UMS canister.

All Indicated Changes are in response to RAI NP-F-4

F.4.1.4 Auxiliary Equipment

This section presents a brief description of the principal auxiliary equipment needed to operate the NAC-UMS Universal Storage System in accordance with its design.

F.4.1.4.1 Transfer Adapter

The transfer adapter is a carbon steel table that is positioned on the top of the vertical concrete cask or the transport cask and mates the transfer cask to either of those casks. It has a large center hole that allows the transportable storage canister to be raised or lowered through the plate into or out of the transfer cask. Rails are incorporated in the transfer adapter to guide and support the bottom shield doors of the transfer cask when they are in the open position. The transfer adapter also supports the hydraulic system and the actuators that open and close the bottom doors of the transfer cask.

F.4.1.4.2 Vertical Cask Transporter

The vertical cask transporter is a mobile lifting device that allows for the movement of the vertical concrete cask. The transporter engages the storage cask via the embedded lift lugs on the top of the cask. After the transporter has engaged the storage cask, it can lift the storage cask and move it to the desired location. When the storage cask has a loaded TSC, the transporter shall not lift the storage cask higher than the lift height limit in Table A5-1 of the NAC-UMS Technical Specifications, Reference F.4.2-2.

F.4.1.4.3 Rigging and Slings

Several lifting rig assemblies are required to handle various NAC-UMS components during transfer operations at the CISF. Each lifting rig assembly may consist of a combination of slings, shackles, swivel hoist rings, turnbuckles, master links, connecting links, and chains. The lifting rig assemblies are designed to meet the guidance of NUREG/CR-0612 with the following considerations made:

- *Lifting requirements consider dynamic loading (i.e., 1.1 dynamic load factor).*
- *Components meet the requirements of ASME B30 (i.e., ASME B30.9 – Slings, B30.10 – Hooks, and B30.26 – Rigging Hardware).*
- *Single-failure-proof lifting devices have enhanced safety features for handling critical loads without the need to consider drop conditions.*

Enhanced safety features include double the safety factor required for handling non-critical loads or redundant load paths, with each qualified to the safety factor required for handling non-critical loads. Note that handling of critical loads may be performed with non-single-failure proof rigging if drop conditions have been analyzed and shown to be acceptable.

Typical rigging and slings include a concrete cask lid sling, concrete cask shield plug sling, canister shield lid sling, loaded canister transfer sling (also used to handle the structural lid), and canister retaining ring sling.

All Indicated Changes are in response to RAI NP-F-3

F.7.1.10 Coating Specifications

Coatings are applied to the exposed carbon steel surfaces associated with the NAC-UMS vertical concrete cask and transfer cask to protect those surfaces in their service environment. The coating specifications are provided in Section 3.8 of the NAC-UMS FSAR, Reference F.7.2-1.

Each coating meets the service and performance requirements that are established for the coating by the design and service environment of the component to be covered.

F.7.1.11 Structural Evaluation of NAC-UMS Canister Confinement Boundaries under Normal Conditions of Transport

The NAC-UMS canister primary confinement boundaries consist of a canister shell, bottom closure plate, shield lid, the two (2) port covers, and the welds that join these components. Redundant closure is provided by a structural lid and adjoining canister weld. Additional details, geometry and shell and plate thicknesses are provided on the drawings in Section F.4.3. The confinement boundary is addressed in Section F.11.1.1. NAC-UMS canister shell is evaluated for Normal Conditions of Transport in the NAC-UMS Transport cask in Section 2.6.12 of [F.7.2-3] *(to provide reasonable assurance that the confinement boundary is not adversely impacted by transport to the WCS CISF)*.

The result of the structural analysis is acceptable for the loads and combinations described in Section 2.6.12 of [F.7.2-3] and hence structurally adequate for normal conditions of transport loading conditions.

All Indicated Changes are in response to RAI NP-F-5

Maximum dose rates for the standard or advanced transfer cask with a wet and dry canister cavity are shown in Table 5.1-3 of Reference F.9.2-1, for design basis PWR fuel. Under wet canister conditions, the maximum surface dose rates with design basis PWR fuel are 259 (<1%) mrem/hr on the cask side and 579 (<1%) mrem/hr on the cask bottom. The cask side average surface dose rate under wet conditions is 137 (<1%) mrem/hr, and the bottom average surface dose rate is 258 (<1%) mrem/hr. Under dry conditions, the maximum surface dose rates are 410 (<1%) mrem/hr on the cask side and 819 (<1%) mrem/hr on the cask bottom. Cask average surface dose rates are 306 (<1%) mrem/hr on the side and 374 (<1%) mrem/hr on the bottom. In normal operation, the bottom of the transfer cask is inaccessible during welding of the canister lids.

Maine Yankee Site-Specific fuel assembly configurations are either shown to be bounded by the analysis of the standard design basis fuel assembly configuration of the same type (PWR or BWR), or are shown to be acceptable contents by specific evaluation of the configuration.

Table F.9-1 provides estimated occupational exposures for receipt and handling of the NAC-UMS system loaded with PWR fuel at the WCS CISF. For each procedural step the number of workers, occupancy time, worker distance, dose rates, and total dose are estimated. Dose rates used were obtained and estimated via the listed references in the table. The total occupational exposure for receiving, transferring and placing these canisters on the storage pad in their storage overpack (VCC) is *883* person-mrem each.

The total collective dose for unloading a NAC-UMS PWR canister from its VCC and preparing it for transport off-site is bounded by the loading operations (*883* person-mrem). Operations for retrieving these canisters from the VCC and off-site shipment are identical to loading operations, except in reverse order. The collective dose for unloading is bounded because during storage at the WCS CISF the source terms will have decayed reducing surface dose rates. The total collective dose is the sum of the receipt, transfer, retrieval, and shipment is 1,728 person-mrem.

All Indicated Changes are in response to RAI NP-9-10

Table F.9-1
Estimated Occupational Collective Dose for Receipt of NAC Universal Transport Cask Loaded with PWR SNF in Class 1 or 2 TSC and Transfer to UMS Class 1 or Class 2 VCC
6 Sheets

Process Step	Number of Workers	Occupancy Time (hours)	Worker Location Around Cask	Worker Distance (m)	Total Dose Rate (mrem/hr)	Total Dose (person-mrem)[1]	Reference SAR/FSAR Section/Table/Figure
Perform radiation and contamination survey of UTC	2	0.25	All Around UTC Cask	>2	10	5	SAR Figure 5.1-1 and Table 5.1-1
Inspect top and bottom impact limiter security seals and verify they are intact and correct IDs.	1	0.5	Top and Bottom Impact Limiters	>1	<6	3	SAR Figure 5.1-1 and Table 5.1-1
Remove Security Seal	*1*	*0.1*	*Top Impact Limiter Periphery*	*>1*	*<1*	*1*	*SAR Figure 5.1-1 and Table 5.1-1*
Remove Personnel Barrier and complete surveys	2	0.5	Center of cask	>1	<20	20	SAR Figure 5.1-1 and Table 5.1-1
Visually inspect UTC Cask surface for transport/road damage and record	1	0.25	All Around UTC Cask	2	10	3	SAR Figure 5.1-1 and Table 5.1-1
Attach slings to top Impact Limiter and remove attachment nuts/rods. Remove and store Impact Limiter. Remove and store front impact limiter positioner and screws.	2	1	Top Impact Limiter Surface of UTC	1	< 1	2	SAR Figure 5.1-1 and Table 5.1-1
Attach slings to bottom Impact Limiter and remove attachment nots/rods. Remove and store Impact Limiter. Remove and store bottom impact limiter positioner and screws.	2	1	Bottom Impact Limiter Surface of UTC	1	6	12	SAR Figure 5.1-1 and Table 5.1-1
Release Front Tie-Down Assembly	2	1	Top Side UTC Surface	>1	50	100	SAR Figure 5.1-1 and Table 5.1-1

All Indicated Changes are in response to RAI NP-9-10

Table F.9-1
Estimated Occupational Collective Dose for Receipt of NAC Universal Transport Cask Loaded with PWR SNF in Class 1 or 2 TSC and Transfer to UMS Class 1 or Class 2 VCC
6 Sheets

Process Step	Number of Workers	Occupancy Time (hours)	Worker Location Around Cask	Worker Distance (m)	Total Dose Rate (mrem/hr)	Total Dose (person-mrem)[1]	Reference SAR/FSAR Section/Table/Figure
Perform contamination survey of cask surfaces. If necessary, decontaminate the cask until acceptable smearable contamination levels are achieved.	*2*	*0.5*	*All Around UTC Cask*	*>1*	*<20*	*20*	*SAR Figure 5.1-1 and Table 5.1-1*
Engage Vertical Cask Transporter (VCT) Lift Arms to Primary Front Trunnions and rotate cask to vertical orientation	2	1	Top Side UTC Surface	>2	10	20	SAR Figure 5.1-1 and Table 5.1-1
Lift and Remove UTC from the Transport Skid Rear Rotation Trunnions and move cask to gantry Canister Transfer Facility (CTF), set cask down and release VCT Lift Arms. Establish Radiation Control boundaries.	2	2	Top Side UTC Surface	>2	10	40	SAR Figure 5.1-1 and Table 5.1-1
Using VCT, move empty UMS VCC (Class 1 or 2, as required) to transfer position in CTF and set down adjacent to UTC cask. Set up appropriate work platforms/man lifts for access to top of VCC and UTC.	2	1	Top of Empty VCC	>2	0	0	Empty VCC
Remove VCC Lid and bolts, and VCC Shield Plug.	2	1	Top of Empty VCC	1	0	0	Empty VCC

All Indicated Changes are in response to RAI NP-9-10

Table F.9-1
Estimated Occupational Collective Dose for Receipt of NAC Universal Transport Cask Loaded with PWR SNF in Class 1 or 2 TSC and Transfer to UMS Class 1 or Class 2 VCC
6 Sheets

Process Step	Number of Workers	Occupancy Time (hours)	Worker Location Around Cask	Worker Distance (m)	Total Dose Rate (mrem/hr)	Total Dose (person-mrem)[1]	Reference SAR/FSAR Section/Table/Figure
Install the VCC Shield Plug.	2	0.5	Top of VCC	1	25	35	Operation performed on top of VCC Figure 5.4-5
Install and bolt in place the VCC lid.	2	1	Top of VCC	1	25	50	Operation performed on top of VCC Figure 5.4-5
Using the VCT, lift and move loaded UMS VCC and position it in the designated storage location.	2	1	VCT Platform	>4	10	20	Operation performed from VCT and FSAR Figure 5.4-2
Remove installed transport cavity spacer and place in approved IP-1 container. Prepare empty UTC cask for empty return transport. Transfer and rotate UTC on the transport/shipping frame. Install transport tie-downs and impact limiters.	3	9	CTF/VCT/Rail Car	1 to 4	0	0	Empty cask preparation activities
					Total (person-mrem)	*883*	

Note:
1. Rounded up to the nearest whole number

All Indicated Changes are in response to RAI NP-9-10

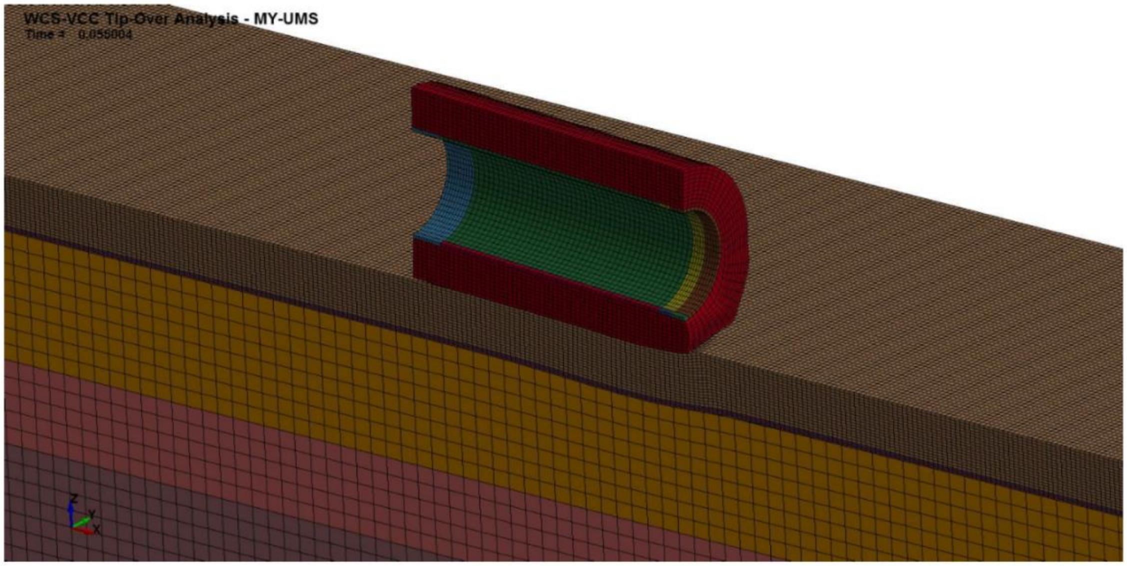


Figure F.12-5
Deformed Shape of UMS VCC, Concrete Pad, Mudmat and Soil

The canister lid and attached canister shell peak acceleration is determined to be 26.6g, which would also correspond to the static acceleration to be applied to the model for the canister stress evaluation.

For the amplification of the accelerations during the short pulse, the maximum possible DLF for the triangular pulse is 1.52 regardless of the basket fundamental modal frequency and pulse duration. Likewise, for the accelerations during the long pulse, the maximum DLF for the sine pulse is 1.76. The Table F.12-3 shows the basket acceleration obtained from the analysis, the maximum DLF, and the amplified accelerations. The acceleration used in the basket and canister evaluations for the UMS system in Reference *F.12.2-1* was 40g's. The peak basket amplified accelerations shown below is 37.7, which bounds the peak canister acceleration. Both accelerations are bounded by the design basis acceleration. Therefore, the basket and canister evaluations contained in Reference F.12.2-1 are bounding for the conditions at the CISF.

Table F.12-3
Peak Accelerations and DLF for UMS VCC Systems

Pulse	Peak Basket Analysis Acceleration (A_p) (g)	DLF	Amplified Acceleration (g) (A_p)×DLF
Short Pulse	24.8	1.52	37.7
Long Pulse	19.8	1.76	34.8

G.3.1.2 Safety Protection Systems

MAGNASTOR relies upon passive systems to ensure the protection of public health and safety, except in the case of fire or explosion. As previously discussed, fire and explosion events are effectively precluded by site administrative controls that prevent the introduction of flammable and explosive materials. The use of passive systems provides protection from mechanical or equipment failure.

G.3.1.2.1 General

MAGNASTOR is designed for safe, long-term storage of spent fuel. The system will withstand all of the evaluated normal conditions and off-normal and postulated accident events without release of radioactive material or excessive radiation exposure to workers or the general public. The major design considerations to assure safe, long-term fuel storage and retrievability for ultimate disposal by the Department of Energy in accordance with the requirements of 10 CFR 72 and ISG-2 are as follows.

- Continued radioactive material confinement in postulated accidents.
- Thick steel and concrete biological shield.
- Passive systems that ensure reliability.
- Pressurized inert helium atmosphere to provide corrosion protection for fuel cladding and enhanced heat transfer for the stored fuel.

Retrievability is defined as: “maintaining spent fuel in substantially the same physical condition as it was when originally loaded into the storage cask, which enables any future transportation, unloading and ultimate disposal activities to be performed using the same general type of equipment and procedures as were used for the initial loading.”

Each major component of the system is classified with respect to its function and corresponding potential effect on public safety. In accordance with Regulatory Guide 7.10, each major system component is assigned a safety classification as shown in Table 2.4-1 or Reference G.3-1. *Table E.3-2 provides the safety classifications for the Auxiliary Equipment referenced in Sections G.4.1.7 of this SAR.* The safety classification is based on review of the component’s function and the assessment of the consequences of its failure following the guidelines of NUREG/CR-6407. The safety classification categories are defined in the following list.

Category A - Components critical to safe operations whose failure or malfunction could directly result in conditions adverse to safe operations, integrity of spent fuel, or public health and safety.

Category B - Components with major impact on safe operations whose failure or malfunction could indirectly result in conditions adverse to safe operations, integrity of spent fuel, or public health and safety.

All Indicated Changes are in response to RAI NP-G-2

G.7.1.8 Fuel Rods

The structural evaluations of PWR fuel rods for the storage conditions of the MAGNASTOR system are provided in Section 3.8 of Reference G.7-1.

G.7.1.9 Structural Evaluation of NAC-MAGNASTOR Canister Confinement Boundaries under Normal Conditions of Transport

The NAC-MAGNASTOR canister primary confinement boundaries consist of a canister shell, bottom closure plate, closure lid, the two port covers, and the welds that join these components. Redundant closure is provided by two outer port covers and a closure ring. Additional details, geometry, and shell and plate thicknesses are provided on the figures in Section G.4. The confinement boundary is addressed in Section G.11.1.1. The evaluation findings for the NAC-MAGNASTOR canister shell for normal conditions of transport are provided in Section 2.6.12 of [G.7-2] *(to provide reasonable assurance that the confinement boundary is not adversely impacted by transport to the WCS CISF)*.

The result of the structural analysis is acceptable for the loads and combinations described in Section 2.6.12 of [G.7-2], and is therefore structurally adequate for normal conditions of transport loading conditions.

PWR fuel assemblies may contain nonfuel hardware – i.e., reactor control components (RCCs), burnable poison rod assemblies (BPRAs), guide tube plug devices (GTPDs), neutron sources/neutron source assemblies (NSAs), hafnium absorber assemblies (HFRAs), instrument tube tie components, in-core instrument thimbles, and steel rod inserts (used to displace water from the lower section of guide tubes), and components of these devices, such as individual rods. The analysis shows that for the design basis fuel, the system meets the requirements of 10 CFR 72.104 and 10 CFR 72.106 and complies with the requirements of 10 CFR 20 with regard to annual and occupational doses at the owner-controlled area boundary.

Minimum cool times prior to fuel transfer and storage are specified as a function of minimum assembly average fuel enrichment and maximum assembly average burnup (MWd/MTU). To minimize the number of loading tables, PWR and BWR fuel assemblies are grouped by bounding fuel and hardware mass. Key characteristics of each assembly grouping are shown in Section 5.2 of Reference G.9-1. Refer to Section 5.8.9 of Reference G.9-1 for detailed loading tables meeting the system heat load limits.

Source terms for the various vendor-supplied fuel types are generated using the SCALE 4.4 sequence as discussed in Section 5.2 of Reference G.9-1. Three-dimensional MCNP shielding evaluations provide dose rates for transfer and concrete casks at distances up to four meters. NAC-CASC, a modified version of the SKYSHINE-III code, calculates site boundary dose rates for either a single cask or cask array. See Section 5.6 of Reference G.9-1 for more detail on the shielding codes.

Table G.9-1 provides estimated occupational exposures for receipt and handling of the NAC-MAGNASTOR system loaded with PWR fuel at the WCS CISF facility. For each procedural step the number of workers, occupancy time, worker distance, dose rates, and total dose are estimated. Dose rates used were obtained and estimated via the listed references in the table. The total occupational exposure for receiving, transferring and placing these canisters on the storage pad in their storage overpack (VCC) is *1,035* person-mrem each.

The total collective dose for unloading a NAC-MAGNASTOR PWR canister from its VCC and preparing it for transport off-site is bounded by the loading operations (*1,035* person-mrem). Operations for retrieving these canisters from the VCC and off-site shipment are identical to loading operations, except in reverse order. The collective dose for unloading is bounded because during storage at the WCS CISF the source terms will have decayed reducing surface dose rates. The total collective dose is the sum of the receipt, transfer, retrieval, and shipment is 2,046 person-mrem.

Table G.9-1
Estimated Occupational Collective Dose for Receipt of NAC MAGNATRAN Cask Loaded with PWR SNF in MAGNASTOR TSC and Transfer to MAGNASTOR VCC
7 Sheets

Process Step	Number of Workers	Occupancy Time (hours)	Worker Location Around Cask	Worker Distance (m)	Total Dose Rate (mrem/hr)	Total Dose (person-mrem)[1]	Reference SAR/FSAR Table/Figure
Perform radiation and contamination survey of MAGNATRAN Cask.	*1*	0.5	All Around MAGNATRAN Cask	>2	10	*5*	SAR Figure 5.1-1, Table. 5.1-3, Figure 5.8-7, Figure 5.8-11, Figure 5.8-14, Figure 5.8-15
Inspect top impact limiter security seal and verify it is intact and correct ID.	1	*0.1*	Top Impact Limiter *Periphery*	>1	*<1*	1	SAR Figure 5.1-1, Table. 5.1-3, Figure 5.8-7, Figure 5.8-11, Figure 5.8-14, Figure 5.8-15
Remove Security Seal	*1*	*0.1*	*Top Impact Limiter Periphery*	*>1*	*<1*	*1*	*SAR Figure 5.1-1, Table 5.1-3, Figure 5.8-7, Figure 5.8-11, Figure 5.8-14,and Figure 5.8-15*
Remove Personnel Barrier.	2	0.5	Center of MAGNATRAN Cask	1	<20	*20*	SAR Figure 5.1-1, Table. 5.1-3, Figure 5.8-7, Figure 5.8-11, Figure 5.8-14, Figure 5.8-15
Attach slings to top Impact Limiter and remove 32 retention nuts/rods. Remove and store Impact Limiter.	2	1	Top of MAGNATRAN Cask	>1	< 5	10	SAR Figure 5.1-1, Table. 5.1-3, Figure 5.8-7, Figure 5.8-11, Figure 5.8-14, Figure 5.8-15
Attach slings to bottom Impact Limiter and remove 32 retention nuts/rods. Remove and store Impact Limiter.	2	1	Bottom of MAGNATRAN Cask	>1	< 5	10	SAR Figure 5.1-1, Table. 5.1-3, Figure 5.8-7, Figure 5.8-11, Figure 5.8-14, Figure 5.8-15

All Indicated Changes are in response to RAI NP-9-10

Table G.9-1
Estimated Occupational Collective Dose for Receipt of NAC MAGNATRAN Cask Loaded with PWR SNF in MAGNASTOR TSC and Transfer to MAGNASTOR VCC
7 Sheets

Process Step	Number of Workers	Occupancy Time (hours)	Worker Location Around Cask	Worker Distance (m)	Total Dose Rate (mrem/hr)	Total Dose (person-mrem)[1]	Reference SAR/FSAR Table/Figure
Perform contamination survey of cask surfaces. If necessary, decontaminate the cask until acceptable smearable contamination levels are achieved.	*2*	*0.5*	*Top, side, and bottom of MAGNATRAN*	*>1*	*<20*	*20*	*SAR Figure 5.1-1, Table 5.1-3, Figure 5.8-7, Figure 5.8-11, Figure 5.8-14,and Figure 5.8-15*
Visually inspect MAGNATRAN Cask surface for transport/road damage and record.	*1*	*0.25*	*All Around Cask*	*>4*	*2.5*	*1*	*SAR Figure 5.1-1, Table. 5.1-3, Figure 5.8-7, Figure 5.8-11, Figure 5.8-14, Figure 5.8-15*
Release Front Tie-Down Assembly.	2	1	Top Side MAGNATRAN Cask Surface	1	50	100	SAR Figure 5.1-1, Table. 5.1-3, Figure 5.8-7, Figure 5.8-11, Figure 5.8-14, Figure 5.8-15
Remove front trunnion plugs and bolts, and ring segments, and store.	2	0.5	Top Side MAGNATRAN Cask Surface	1	50	50	SAR Figure 5.1-1, Table. 5.1-3, Figure 5.8-7, Figure 5.8-11, Figure 5.8-14, Figure 5.8-15
Install front trunnions and bolts and torque to specified value.	2	1	Top Side MAGNATRAN Cask Surface	1	50	100	SAR Figure 5.1-1, Table. 5.1-3, Figure 5.8-7, Figure 5.8-11, Figure 5.8-14, Figure 5.8-15
Engage Vertical Cask Transporter (VCT) Lift Arms to Front Trunnions and rotate cask to vertical orientation on rear rotation trunnions.	2	1	Top Side MAGNATRAN Cask Surface	>2	10	20	SAR Figure 5.1-1, Table. 5.1-3, Figure 5.8-7, Figure 5.8-11, Figure 5.8-14, Figure 5.8-15

All Indicated Changes are in response to RAI NP-9-10

Table G.9-1
Estimated Occupational Collective Dose for Receipt of NAC MAGNATRAN Cask Loaded with PWR SNF in MAGNASTOR TSC and Transfer to MAGNASTOR VCC
7 Sheets

Process Step	Number of Workers	Occupancy Time (hours)	Worker Location Around Cask	Worker Distance (m)	Total Dose Rate (mrem/hr)	Total Dose (person-mrem)[1]	Reference SAR/FSAR Table/Figure
Lift and Remove MAGNATRAN from the Transport Skid Rear supports and move cask to gantry Canister Transfer Facility (CTF), set cask down and release VCT Lift Arms. Establish Radiation Control boundaries.	2	2	Top Side MAGNATRAN Cask Surface	>2	10	40	SAR Figure 5.1-1, Table. 5.1-3, Figure 5.8-7, Figure 5.8-11, Figure 5.8-14, Figure 5.8-15
Using VCT, move empty MAGNASTOR VCC to transfer position in CTF and set down adjacent to MAGNATRAN cask. Set up appropriate work platforms/man lifts for access to top of VCC and MAGNATRAN.	2	1	Top Of Empty MAGNASTOR VCC	*>4*	*2.5*	*5*	Empty VCC */ Loaded MAGNATRAN*
Remove VCC Lid and bolts, and VCC Shield Plug.	2	1	Top Of Empty MAGNASTOR VCC	1	0	0	Empty VCC
Install Transfer Adapter on VCC and connect hydraulic system.	2	1	Top Of Empty MAGNASTOR VCC	1	0	0	Empty VCC

All Indicated Changes are in response to RAI NP-9-10

Table G.9-1
Estimated Occupational Collective Dose for Receipt of NAC MAGNATRAN Cask Loaded with PWR SNF in MAGNASTOR TSC and Transfer to MAGNASTOR VCC
7 Sheets

Process Step	Number of Workers	Occupancy Time (hours)	Worker Location Around Cask	Worker Distance (m)	Total Dose Rate (mrem/hr)	Total Dose (person-mrem)[1]	Reference SAR/FSAR Table/Figure
Remove vent port cover and connect pressure test system to vent port to check for excessive pressure. If pressure is high, take sample and check. If clean vent to HEPA filter.	1	0.5	Top of Cask	0.5	50	25	FSAR Table *5.1.3-1*, FSAR Section 5.8.3.3.2 + MAGNATRAN Closure Lid Thickness 7.75 in.
Remove 48 MAGNATRAN lid bolts, install alignment pins and lid lifting hoist rings/slings and remove inner lid and store. Remove alignment pins.	2	1	Top of Cask	0.5	30	60	FSAR Table *5.1.3-1*, FSAR Section 5.8.3.3.2 + MAGNATRAN Closure Lid Thickness 7.75 in.
Install adapter ring to inner lid recess and torque captured bolts.	2	0.5	Top of Cask	0.5	30	30	FSAR Table *5.1.3-1*, FSAR Section 5.8.3.3.2 Remote operation from side of MAGNATRAN
Install transfer adapter plate on adapter ring and install and torque the four transfer adapter plate bolts.	2	1	Top of Cask	1	15	30	FSAR Table *5.1.3-1*, FSAR Section 5.8.3.3.2 Remote operation from side of MAGNATRAN
Install TSC Lid Lifting Adapter Plate and bolts on the MAGNASTOR Closure Lid, and torque to specified value.	2	1	Top of Cask	0.5	75	150	FSAR Table *5.1.3-1*, FSAR Section 5.8.3.3.2 Remote operation from side of MAGNATRAN

All Indicated Changes are in response to RAI NP-9-10

Table G.9-1
Estimated Occupational Collective Dose for Receipt of NAC MAGNATRAN Cask Loaded with PWR SNF in MAGNASTOR TSC and Transfer to MAGNASTOR VCC
7 Sheets

Process Step	Number of Workers	Occupancy Time (hours)	Worker Location Around Cask	Worker Distance (m)	Total Dose Rate (mrem/hr)	Total Dose (person-mrem)[1]	Reference SAR/FSAR Table/Figure
Using the CTF crane, lower the appropriate MAGNASTOR Transfer Cask (MTC) and set it down on the transfer adapter on the MAGNATRAN Cask.	2	1.5	Top of Cask	>4	<1	3	Remote handling operation
Remove lock pins and open shield doors with hydraulic system.	1	0.5	Top of Cask	1	15	8	FSAR Table *5.1.3-1*, FSAR Section 5.8.3.3.2 + 2 inch TSC Lid Lift Adapter Plate Remote operation from side of MTC/MAGNATRAN
Using the CTF, lower the Air-Powered Chain Hoist hook through the MTC and engage to the TSC Lift Adapter Plate.	2	1.5	Remote Operating Location	>4	<5	15	Remote operation using CTF mounted cameras
Using the Chain Hoist System slowly lift the TSC into the MTC.	2	1	Remote Operating Location	>4	<5	10	Remote operation using CTF mounted cameras
Close the MTC shield doors and install lock pins.	1	0.5	Bottom of MTC	0.5	30	15	Operation from side of MTC FSAR Section 5.8.3.3.2 and Figure 5.8.3-17
Lower the TSC onto the shield doors and using the CTF, lift the MTC off of the MAGNATRAN transfer adapter plate.	2	1	Remote Operating Location	>4	<5	10	Remote operation using CTF mounted cameras

All Indicated Changes are in response to RAI NP-9-10

Table G.9-1
Estimated Occupational Collective Dose for Receipt of NAC MAGNATRAN Cask Loaded with PWR SNF in MAGNASTOR TSC and Transfer to MAGNASTOR VCC
7 Sheets

Process Step	Number of Workers	Occupancy Time (hours)	Worker Location Around Cask	Worker Distance (m)	Total Dose Rate (mrem/hr)	Total Dose (person-mrem)[1]	Reference SAR/FSAR Table/Figure
Unbolt and remove TSC Lift Adapter Plate from the top of the TSC and store.	2	1	Top of MAGNASTOR TSC	1	75	150	FSAR Figure 5.8.3-20 and operation performed on top of transfer adapter mounted on VCC
Using mobile crane, remove transfer adapter plate from VCC and store.	2	1	Top of MAGNASTOR VCC	1	10	20	Remote operation using CTF mounted cameras after connection of lifting slings
Install and bolt in place the VCC lid.	2	1	Top of MAGNASTOR VCC	1	25	50	Operation performed from top of VCC Figure 5.8.3-10
Using the VCT, lift and move loaded UMS VCC and position it in the designated storage location.	2	1	VCT Platform	>4	10	20	Operation performed from VCT and FSAR Figure 5.8.3-8
Prepare empty MAGNATRAN cask for empty return transport. Transfer and rotate to horizontal MAGNATRAN cask on the transport/shipping frame. Install transport tie-downs, impact limiters and personnel barrier.	3	9	CTF/VCT/Rail Car	1 to 4	0	0	Empty cask preparation activities
					Total (person-mrem)	*1,035*	

Note:

1. Rounded up to the nearest whole number

As indicated in Figure G.12-4, the acceleration time history shows two types of pulses. The DLF for the short pulse is based on a triangular shaped pulse. The DLF associated with the short pulse for the basket evaluation is dependent on the fundamental modal frequency of the MAGNASTOR basket and the time duration of the short pulse. Details of the modal analysis for the MAGNASTOR basket are contained in Reference G.12-3. The bounding DLF associated with the short pulse, which is dependent on basket orientation, is 1.05 resulting in an amplified acceleration for the short pulse of 29.2 g's. For the accelerations during the long pulse, the bounding DLF, for the sine pulse is 1.76, regardless of the fundamental modal frequency of the basket. The DLF of 1.76 for the sine pulse is conservatively applied to the peak transient analysis acceleration. The table below shows the basket acceleration obtained from the transient analysis, the maximum DLF, and the amplified accelerations. The acceleration used in the basket and canister evaluations for the MAGNASTOR system in Reference *G.12-1* was 35g's. The peak amplified basket acceleration, which is shown below, is 33.1 and the peak canister acceleration of 28.8, and both of these accelerations are bounded by 35g. Therefore, the basket and canister evaluations contained in Reference G.12-1 are bounding for the conditions at the CISF.

H.8.2 Accident Analyses for the WCS CISF

The accident conditions are listed in Table 1-2 of this SAR. The various GTCC waste canisters are comparable to the SNF canisters for the associated Cask System listed in Table 1-1 of this SAR for the parameters provided in Section H.8.1 above. Accident pressurization is not considered a credible event due to the very low heat load of the GTCC waste canisters.

Since the structural design criteria for the GTCC storage systems used at WCS CISF are the same as the structural design criteria used for the storage systems listed in Table 1-1, the results of the accident analyses for the storage systems (which include drop accidents, floods, lightning, tornados and wind missiles, and tip-over) bound the results for the same accidents involving the GTCC storage systems. These accident analyses are presented in Appendix A.12 (NUHOMS®-MP187 Cask System), Appendix E.12 (NAC-MPC), Appendix F.12 (NAC-UMS), and Appendix G.12 (NAC-MAGNASTOR).

H.8.2.1 Accidental GTCC Canister/Cask Drop

Section 5.2.2 of the Technical Specifications [H.8-1] addresses required inspections following a cask drop.

H.8.2.2 GTCC Canister Leakage

The various GTCC canister shells are designed with pressure retaining features to prevent leakage of contaminated materials. There are no credible conditions that can breach the canister shell or fail the welds at each end of the canisters. The GTCC waste closure lid welds are multi-pass closure welds and are the same as closure welds for canisters loaded with SNF. Performance of a multi-pass closure weld on GTCC waste canisters ensures no leakage path through the closure lid to shell weld. Some of the canisters also include a redundant closure lid with multi pass welds providing an additional barrier to leakage at the ends.

H.8.2.3 Accident Pressurization

The various GTCC canisters contain insignificant heat loads. In addition, temperature variations in the various GTCC shell assemblies are small. Since the heat load is small and the material temperatures are only slightly greater than ambient, the temperature variations at any point in the shell are approximately equal to the variation in ambient temperature. These small temperature cycles do not result in damage to, or failure of, the GTCC shell assemblies.

H.8.2.4 Earthquake

A seismic event is not expected to negatively impact the GTCC waste canisters. The GTCC waste canisters are comparable to the previously analyzed SNF canisters for the associated Cask System listed in Table 1-1 of this SAR.

H.8.3 Structural Evaluation of Canister Confinement Boundary under Normal Conditions of Transport

The confinement boundaries for the canisters used to store GTCC waste are designed to meet ASME B&PV, Subsection NB, Article NB-3200 (Level A allowables) during normal conditions of transport in order to provide reasonable assurance that the confinement boundaries are not adversely impacted by transport to the WCS CISF. Since the structural design criteria for each of the GTCC waste canisters authorized for storage at the WCS CISF are the same as the structural design criteria used for the associated spent fuel canisters listed in Table 1-1, the structural evaluations of the spent fuel canister confinement boundaries under Normal Conditions of Transport also bound the corresponding GTCC waste canisters. These structural evaluations are presented in Appendix A.7.7 (NUHOMS®-MP187 Cask System); Appendix E.7.1.11, and Appendix E.1.2.11 (NAC-MPC); Appendix F.7.11 (NAC-UMS); and Appendix G.7.1.9 (NAC-MAGNASTOR).