INTERIM STORAGE
PARTNERS

October 30, 2019
E-55305

Director, Division of Fuel Management
Office of Nuclear Material Safety and Safeguards
U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
One White Flint North
11555 Rockville Pike
Rockville, MD 20852

Subject: Submission of ISP Draft Responses for Several RAIs and Associated Document Markups from First Request For Additional Information, Part 2, Docket 72-1050 CAC/EPID 001028/L-2017-NEW-0002

Reference:
1. Letter from John-Chau Nguyen (NRC) to Jeffery D. Isakson, "Interim Storage Partners LLC's License Application To Construct And Operate The Waste Control Specialists Consolidated Interim Storage Facility, Andrews County, Texas, Docket No. 72-1050 – First Request For Additional Information, Part 2," dated March 6, 2019
2. Letter from Jack Boshoven to John-Chau Nguyen (NRC), "Interim Storage Partners (ISP) First Request for Additional Information (RAI) Proposed Submittal Schedule, Docket 72-1050 CAC/EPID 001028/L-2017-NEW-0002," E-54395, dated May 31, 2019
3. Letter from Jack Boshoven to John-Chau Nguyen (NRC), "Submission of ISP Draft Responses for Several RAIs and Associated Document Markups from First Request For Additional Information, Part 2, Docket 72-1050 CAC/EPID 001028/L-2017-NEW-0002," E-54658, dated July 26, 2019

Interim Storage Partners LLC (ISP) hereby submits its draft responses to the Requests for Additional Information (RAIs) from Reference [1] in preparation for meetings to be scheduled with NRC staff for discussion. The draft responses and associated application change pages being submitted are consistent with those identified in Table 2 of Reference [2]. Enclosure 1 (Public) contains the draft responses to the RAIs and associated marked up pages for the Safety Analysis Report (SAR). There is no

NMSS20
NMSS26

proprietary information in this submittal and, therefore, no separate enclosures for proprietary documents or affidavits are required.

The subject of this submittal is the first portion of RAIs related to the Cask Handling Building (CHB), which will be submitted in two parts. Please note that the SAR markups may contain markups supporting other RAIs addressed in an earlier submittal. Included in this submittal are:

- RAIs NP-3-5, NP-7-9, NP-7-10, NP-7-11, NP-7-15, which are part of the CHB RAIs listed in Table 2 of Reference [2], originally scheduled for October 18.

The second portion of CHB-related RAIs, will be submitted on November 27 following completion of the evaluations required to submit complete and high-quality responses. Included in the November submittal will be:

- RAI NP-7-1, which is part of the CHB RAIs listed in Table 2 of Reference [2].
- RAIs NP-13-1, NP-13-3, NP-E-8, NP-E-9, NP-E-10, NP-F-6, NP-F-7, NP-G-4, NP-G-5, which are discussed in Reference [3] as being rescheduled for submittal with the CHB RAIs.
- RAI PLC-3, which is referred to in Table 4 of Reference [2] as TS-x, originally scheduled for October 18.

Finally, one CHB RAI will be submitted December 6, 2019 with the Pad-related RAIs, listed in Table 2 of Reference [2] and originally scheduled for November 1 after completion of the evaluations required to submit complete and high-quality responses. Included in the December submittal will be:

- RAI NP-7-12, which is part of the CHB RAIs listed in Table 2 of Reference [2].
- NP-4-4, NP-E-1, NP-F-1, NP-F-2, NP-G-1, which are discussed in Reference [3] as being rescheduled for submittal with the Pad RAIs.
- The 13 RAIs in the third row of Table 2 of Reference [2] (Pad-related).

Should you have any questions regarding this submission, please contact Chris Olsen by telephone at (410) 910-6897, or by email at christopher.olsen@orano.group.

Sincerely,

Jeffery D. Isakson
Chief Executive Officer
Interim Storage Partners LLC

cc: John-Chau Nguyen, Senior Project Manager, U.S. NRC
Jack Boshoven, ISP LLC
Elicia Sanchez, ISP LLC
Renee Murdock, ISP LLC

Enclosures:

1. Draft RAI Responses with associated application change pages (Public)

INTERIM STORAGE PARTNERS

Interim Storage Partners LLC

E-55305
October 30, 2019

Partial Response to First RAI Part 2 to Support a License Application for a Consolidated Interim Storage Facility for Spent Nuclear Fuel in Andrews County, Texas, Docket 72-1050

RAI NP-3-5:

Provide the basis to classify the Cask Handling Building (CHB) as an important to safety (ITS) Category C structure in WCS CISF SAR Section 3.4.1, "Cask Handling Building Quality Classification."

NUREG/CR-6407, "Classification of Transportation Packaging and Dry Spent Fuel Storage System Components Accordance to Importance to Safety," defines ITS Category C as structures, systems and components (SSCs) whose failure or malfunction would not significantly reduce the effectiveness of storage system components and would not be likely to create a situation adversely affecting public health and safety. Category B items are defined as SSCs whose failure or malfunction could indirectly result in a condition adversely affecting public health and safety. Furthermore, the failure of a Category B item, in conjunction with the failure of an additional item, could result in an unsafe condition.

Based on the above definitions, justify the classification of the CHB as an ITS Category C SSC when collapse of the CHB structural members, failure of other structural members such as the overhead cranes, or dropping of other heavy objects under wind and seismic events, could create conditions leading to damage of canisters during transfer operations within the CHB.

This information is needed to determine compliance with 10 CFR 72.122(b)(2)(ii).

Response to RAI NP-3-5:

WCS CISF SAR Section 3.4.1 has been revised to classify the Cask Handling Building (CHB) as an ITS Category B structure.

WCS CISF SAR Sections 1.2.3, 3.2.8.4, 3.4, 4.3.9.1, 4.7.1, 4.7.1.6, 5.2.1.2.1, and 7.5.3, as well as Tables 3-5 and 7-1, have been revised to reflect the reclassification of the CHB and address consequences thereof.

Impact:

SAR Sections 1.2.3, 3.2.8.4, 3.4, 3.4.1, 4.3.9.1, 4.7.1, 4.7.1.6, 5.2.1.2.1, and 7.5.3, as well as Tables 3-5 and 7-1, have been revised as described in the response.

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 140 feet long by 130 feet wide by 70 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

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 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

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 7.5.3.2.1.*.

RAI NP-7-11

3.2.8.6 Cask Handling Building Cranes

The overhead bridge cranes are classified as Not-Important-to-Safety (NITS) and are designed in accordance with ASME B30.2, "Overhead and Gantry Cranes (Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoist)" [3-30]. 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 ASME B30.2 [3-30].

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. 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

AI NP-3-5

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	
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.

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

4.7.1 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.

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

The CHB houses two 130 ton overhead bridge cranes. These cranes are classified as NITS. 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.

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

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.

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 for the WCS CISF Cask Handling Building (CHB). The CHB is designed to meet the requirements of 10 CFR 72.122(b)(2)(ii). The CHB is a two bay commercially designed and fabricated steel frame structure with metal siding designed to support two commercial overhead cranes used to move transportation casks from the rail car to the transfer vehicle. The CHB is 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. The overhead cranes are NITS as all lifts are limited to a maximum height of 80 inches.

7.5.3.1 Descriptions of Systems, Structures and Components

To facilitate rail car unloading activities for NUHOMS® systems, the CHB design incorporates two overhead bridge cranes rated at 130 tons each for lifting loaded transportation casks from the rail car, removal of impact limiters, and shielding, etc. The vertical systems will utilize the overhead bridge cranes to remove impact limiters and personnel barriers, and the VCT is used to move the NAC transportation casks from the rail car to the CTS.

The overhead bridge cranes are classified as Not-Important-to-Safety and are designed in accordance with ANSI B30.2, "Overhead and Gantry Cranes (Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoist)." 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 during the above-described seismic event. Seismic clips are provided on the overhead crane bridge trucks and trolley to limit uplift during a seismic event, thereby eliminating the potential for the bridge or trolley to fall onto loaded casks inside the CHB.

Lifts performed by the overhead bridge crane are governed by the guidance of NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants: Resolution of Generic Technical Activity A-36," to minimize the potential for release of radioactive material from a spent fuel cask. NUHOMS® transportation/transfer cask lifts are performed using the overhead bridge crane and the lift height is administratively controlled to ensure that the 80-inch design basis drop accidents previously approved by the NRC remain bounding (Reference WCS CISF SAR Tables A.3-1, B.3-1, C.3-1, and D.3-1). The overhead cranes may be used for miscellaneous lifts that do not involve lifting of loads over loaded transportation or storage casks inside the CHB.

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

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

RAI NP-7-9:

Provide the basis for the assumption in WCS CISF SAR Section 7.5.3.2 that an administrative control will be adequate to prevent failures of structural members and potential collapse of overhead cranes onto canisters during receipt, transfer, storage, and retrieval operations for the spent nuclear fuel and GTCC waste within the CHB.

The NRC staff needs additional information to determine the effectiveness of the administrative control to prevent failures leading to a reduction of storage cask system effectiveness. The evaluation of the effectiveness of this administrative control should consider factors such as time available to take mitigative actions because of an inclement weather watch/warning or other notification; estimated time to complete activities to place systems in a safe configuration; estimates of the tornado strike probabilities and maximum wind speeds for the site; and the capability of SNF transportation, transfer, and storage cask systems to withstand tornado missile impacts.

This information is needed to determine compliance with 10 CFR 72.122(b)(2)(i) and (ii).

Response to RAI NP-7-9:

Reduction or loss of storage cask system effectiveness, due to failure of structural members and potential collapse of overhead cranes onto canisters during receipt, transfer, storage, and retrieval operations for the spent nuclear fuel and Greater than Class C (GTCC) waste within the Cask Handling Building (CHB), will be prevented by a combination of (1) administrative controls to prevent potential collapse of overhead cranes onto canisters and (2) design of the CHB to resist failure of structural members against design-basis tornados and tornado-generated missiles, in accordance with American Society of Civil Engineers (ASCE) code ASCE 7-05. WCS CISF SAR Section 7.5.3.2 has been revised to reflect that administrative controls are no longer being credited solely for prevention of reduction in storage cask system effectiveness due to failures of structural members and potential collapse of overhead cranes onto canisters during wind or tornado events. Additional explanation of relevant administrative controls and a discussion of the design and analysis of the CHB to resist failure of structural members under design-basis tornado and tornado missile loading are provided in the revised Section 7.5.3.2.

WCS CISF SAR Sections 3.2.1.1, 3.2.1.4, 4.7.1.1, and 7.5.3.2, and Table 1-2 have been revised, and Section 3.2.1.3 has been deleted, to reflect that the CHB is designed to prevent collapse under design-basis tornado and tornado missile loading, and to provide the relevant standards.

Impact:

SAR Sections 3.2.1.1, 3.2.1.4, 4.7.1.1, 7.5.3.2, and Table 1-2 have been revised, and Section 3.2.1.3 has been deleted, as described in the response.

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(l)
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

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].

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.

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

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.

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 ASCE-4, Seismic Analysis of Safety-Related Nuclear Structures and Commentary on Standard for Seismic Analysis of Safety-Related Nuclear Structures, American Society of Civil Engineers, 1986.

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.

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

RAI NP-7-9

7.5.3.2 Design Analysis

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.

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.

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

Finally, administrative controls ensure that during unsafe weather conditions, all facility doors will be closed and locked; as well, automobiles are not permitted to be parked within a 0.5-mile radius of the building at any time, except in designated parking areas (preventing the possibility of automobiles in the vicinity of the CHB being elevated more than the analyzed 30 feet above the base of the CHB due to local topography). These actions eliminate the potential for unanalyzed wind pressure and tornado-generated missile loading, respectively, on the CHB structure.

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
- 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

Load Definitions

- **Dead Load** – 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. The effects of differential settlement are considered when determining dead loads. In addition, a minimum uniform load allowance of 20 lb/ft^2 is applied to roof 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** – 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, 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.
  - **Rain, Snow and Ice** – Described in Chapter 3, the design live load due to rain, snow, and ice is 10 lb/ft^2 which is the ground snow load. Determination of roof snow and ice loads is in accordance with the requirements of American Society of Civil Engineers (ASCE) Standard 7-05 [7-34].

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

- **Thermal Load (T_0)** – Consist of thermally induced forces and moments resulting from operation and environmental conditions affecting the dry storage components and transfer facility building structure. Thermal loads are based on the most critical transient or steady-state condition. Thermal expansion loads due to axial restraint, as well as loads resulting from thermal gradients, are considered. The ambient temperature values during normal operating conditions identified in Chapter 3 are used for structural analysis and design.

- ***Wind Loads (W)*** *– Are those pressure loads generated by the design wind. The basic wind speed used to determine design wind loads on the CHB walls and roof areas is 120 mph. Design wind loads are determined in accordance with the requirements of ASCE Standard 7-16 [7-69], which uses the "limit state" methodology, in common with the other codes used in design of the CHB. The velocity pressures (q_z) for the transfer facility main wind-force resisting structures and the dry storage systems determined in accordance with ASCE Standard 7-16, where the exposure coefficient is taken as 1.17 (for Exposure Category C due to the flat terrain and a height of 70 feet above ground), topographic factor and wind direction factor are both 1.0, and basic wind speed is 120 mph. Design basis wind pressures for each component are computed individually for the configuration and dimensions of each component.*

- ***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:

$W_t = W_p$

$W_t = W_w + 0.5W_p + W_m$

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

Where:

W_w = *windward, leeward, and sidewall 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.

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).

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

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."

AI NP-7-11

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."

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

RAI NP-7-9

RAI NP-7-10:

Pertaining to the seismic loads information in WCS CISF SAR Section 7.5.3.2, "Design Analysis:" (1) Provide the basis to use IBC/ASCE 7 default response spectra for the seismic loads of the CHB rather than the site-specific response spectra developed from the Probabilistic Seismic Hazard Evaluation described in WCS CISF SAR Chapter 2; and (2) Provide a comparison of the IBC/ASCE 7 default spectrum with the site-specific uniform hazard spectrum at 2% probability of exceedance in 50 years. Define the soil classification used for the soil amplification factor coefficients in order to reach the conclusion that the site could be classified as Seismic Design Category C.

The NRC staff needs additional justification on the applicability of the International Building Code (IBC) as the seismic design criteria for the CHB. Standards such as the ASCE 4 establish criteria for nuclear facilities and provide facilities such as the CHB with design methods that result in a lower probability of unacceptable seismic performance than conventional facilities.

This information is needed to determine compliance with 10 CFR 72.122(b)(2)(i) and (ii).

Response to RAI NP-7-10:

Item 1:

As discussed in the ISP Response to RAI NP-3-5, the Cask Handling Building (CHB) has been reclassified in the WCS CISF SAR as an important-to-safety (ITS) Category B structure. Accordingly, the seismic demands and analysis methods are determined using nuclear facility standards, including American Society of Civil Engineers (ASCE) 4-16 and ASCE 43-05. 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).

Item 2:

Since ASCE 7 is no longer being used to define the input response spectra, but rather the site-specific uniform hazard spectra are used, comparison with the site-specific spectra is not required, nor is discussion of the ASCE 7 soil classification for the WCS CISF site. Nevertheless, soil-structure interaction (SSI) effects must be addressed in the CHB seismic analysis, as required by ASCE 4-16, Section 5.1(a). However, SSI effects can be neglected in accordance with the code due to the stiff soils at the WCS CISF site and the relatively low dominant structural frequencies. Further discussion of this is provided in the revised WCS CISF SAR Section 7.5.3.2.

WCS CISF SAR Section 7.5.3.2 has been revised to reflect the use of ASCE 4-16 and ASCE 43-05 as seismic design criteria for the CHB, to reflect that the response spectrum analysis is performed using the site-specific seismic response spectra from the Probabilistic Seismic Hazard Analysis, and to provide a justification for neglecting SSI effects on the CHB structure.

SAR Sections 3.2.3, 3.2.3.5, 3.2.3.8, and 3.2.3.9 have also been revised to reflect that CHB seismic demands and analysis methods are determined using nuclear facility standards.

Impact:

SAR Sections 3.2.3, 3.2.3.5, 3.2.3.8, 3.2.3.9, and 7.5.3.2 have been revised as described in the response.

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.

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.

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.

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*].

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.

RAI NP-7-10

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

- **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.*

  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).

  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.

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

RAI NP-7-11:

Provide the basis for the use of the IBC load combinations and ACI 318 in WCS CISF SAR, Section 7.5.3.2.1, "Reinforced Concrete Load Combinations" for the design of reinforced concrete members of the CHB, which is an ITS structure.

NUREG-1567 Section 5.4.4, "Other SSCs Important to Safety," references ANSI 57.9 standards. The standards referenced on load combinations and design limits are in line with those for nuclear facilities such as ACI 349. Further justification is needed on the applicability of the IBC and ACI 318 for the design of reinforced concrete members of the CHB.

This is needed to determine compliance with 10 CFR 72.122(b)(2)(i) and (ii).

Response to RAI NP-7-11:

As stated in the ISP Response to RAI NP-3-5, the WCS CISF SAR has been revised to classify the Cask Handling Building (CHB) as an important-to-safety (ITS), Category B structure. Consequently, load combinations for the design of CHB reinforced concrete structures such as the CHB foundations are developed in accordance with American Concrete Institute (ACI) code 349-13. Construction of CHB reinforced concrete members remains in accordance with ACI 318-08.

WCS CISF SAR Section 7.5.3.2.1, in addition to Sections 3.2.8.5, and 7.5.3.3 have been revised to reference ACI 349-13 for development of reinforced concrete load combinations for design.

Impact:

SAR Sections 3.2.8.5, 7.5.3.2.1, and 7.5.3.3 have been revised as described in the response.

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 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

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 7.5.3.2.1.*.

RAI NP-7-11

3.2.8.6 Cask Handling Building Cranes

The overhead bridge cranes are classified as Not-Important-to-Safety (NITS) and are designed in accordance with ASME B30.2, "Overhead and Gantry Cranes (Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoist)" [3-30]. 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 ASME B30.2 [3-30].

7.5.3.2.1 Reinforced Concrete Load Combinations

Load combinations for design of CHB reinforced concrete structures such as the CHB foundation and slab are developed in accordance with ACI 349-13 [7-68]. Design of ITS embedded plates and concrete anchors are also in accordance with the requirements of ACI 349-13.

7.5.3.2.2 Structural Steel Loading Combinations

Steel sections for the CHB structure will be designed in accordance with AISC 360 [7-62]. Load combinations used for the design of structural steel components of the WCS CISF CHB will follow those specified in IBC Section 1605.

7.5.3.3 Reinforced Concrete Structural Analysis and Design

The Cask Handling Building reinforced concrete foundations are analyzed and designed to resist the loads and loading combinations specified in Section 7.5.3.2. A computer model will be generated and used to analyze the CHB for appropriate loading conditions. *Design of the reinforced concrete components will be in accordance with ACI 349-13 [7-68].* Construction of the reinforced concrete components will be in accordance with ACI 318-08 [7-39].

The Cask Transfer System (CTS) is a standalone hydraulic gantry system that will be housed in the CHB. The CTS is independent of the CHB structural system. The CHB slab-on-grade and foundations will be designed to accommodate the CTS mat foundation that is isolated from the building foundation. The CTS and its foundation will be designed to meet the requirements of the CTS as described in Section 7.5.1.

7.5.3.4 Structural Steel Design

Structural steel beams are provided in the CHB along the crane runways to support the rails for two 130-ton capacity overhead bridge cranes. The steel crane runway support beams are classified as category C Important to Radiological Safety since they provide support for the overhead cranes during a seismic event and prevent the cranes falling onto the transportation cask stations. The steel crane runway support beams are supported on steel columns that are tied to the main structural steel columns of the CHB on one end and steel brackets that protrude from the main structural steel columns of the CHB at the other end. In order to provide lateral support for the steel crane runway support beams, tie members are provided between the steel beams and the CHB frame to resist lateral forces on the steel beams due to crane trolley movement and seismic thrust loads. The steel crane runway support beams are shown in plan on Figure 1-7 and in elevation on Figure 1-8.

The CHB steel crane runway support beams are constructed using ASTM A992 and A36 mild carbon steel rolled shapes and/or plate sections. Standard carbon steel crane rails are connected by bolts to the top flanges of the steel crane runway support beams. All bolts used for primary structural connections are either A325 or A490. Welding electrodes are compatible with the joined materials.

All Indicated Changes are in response to RAI NP-7-11

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."

RAI NP-7-11

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."

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

RAI NP-7-9

RAI NP-7-15:

Provide the basis for the use of the International Building Code (IBC) as stated in WCS CISF SAR Section 7.5.3.2, "Design Analysis" to determine the design earthquake loads for the Cask Handling Building, which is an important to safety structure.

NUREG-1567, Section 5.4.4, "Other SSCs Important to Safety," references ANSI 57.9 standards. The standards on earthquake loading follow references that are in line with those for nuclear facilities. The use of codes and standards such as the IBC appear in NUREG-1567, Section 5.4.5, "Other SSCs," which invokes commercial building codes for the design of Non-ITS SSCs, including load combinations.

The NRC staff needs additional justification on the applicability of the IBC as the seismic design criteria for the CHB. Standards such as ASCE 4 establish criteria for nuclear facilities. This code also provides analysis methods for facilities such as the CHB with design methods that result in a lower probability of unacceptable seismic performance than conventional facilities.

This information is needed to determine compliance with 10 CFR 72.122(b)(2)(i) and (ii).

Response to RAI NP-7-15:

As discussed in the ISP Response to RAI NP-3-5, the Cask Handling Building (CHB) has been reclassified in the WCS CISF SAR as an important-to-safety (ITS) Category B structure. Additionally, as discussed in the ISP Response to RAI NP-7-10, WCS CISF SAR Section 7.5.3.2 has been revised to state that seismic design and analysis methods are determined using ASCE 43-05 and ASCE 4-16. This approach is considered consistent with the intent of NUREG-1567 and its reference to ANSI 57.9 for design of structures important to nuclear safety.

Impact:

No change as a result of this RAI.