Safe Interim Storage of Spent Nuclear Fuel Assessment at the Hanford Site

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Office of Enterprise Assessments
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Acronyms

CFR	Code of Federal Regulations
CHPRC	CH2M HILL Plateau Remediation Company
CLW	Collocated Worker
COVID-19	Coronavirus Disease of 2019
CSB	Canister Storage Building
DOE	U.S. Department of Energy
DR	Damage Ratio
DSA	Documented Safety Analysis
EA	Office of Enterprise Assessments
ISA	200 Area Interim Storage Area
ISC	Interim Storage Cask
ISFSI	Independent Spent Fuel Storage Installation
ISI	In-service Inspection
ITS	Important to Safety
MAPS	Managing Aging Processes in Storage
MCO	Multi-canister Overpack
MRS	Monitored Retrievable Storage
NMMP	Nuclear Maintenance Management Program
NRC	U.S. Nuclear Regulatory Commission
OFI	Opportunity for Improvement
RL	Richland Operations Office
SNF	Spent Nuclear Fuel
SS	Safety Significant
SSC	Structure, System, and Component
TSR	Technical Safety Requirement

Safe Interim Storage of Spent Nuclear Fuel Assessment at the Hanford Site September 14-18, 2020

Summary

Scope
This assessment was conducted to verify that effective nuclear safety programs and controls are in place to ensure the safe interim storage of spent nuclear fuel (SNF) at the Hanford Site Canister Storage Building (CSB) and 200 Area Interim Storage Area (ISA) until a final disposition pathway for the SNF is identified. Because the SNF storage mission at the Hanford Site could extend beyond the design life of the storage facilities and systems, the aging-related degradation inspections were also evaluated. The assessment also included an analysis of the differences in nuclear safety regulatory approach between the U.S. Department of Energy (DOE) and the U.S. Nuclear Regulatory Commission (NRC) for the storage of SNF.

Significant Results for Key Areas of Interest
Overall, the assessment team concluded that SNF is being safely stored at the CSB and ISA.

<u>Comparison of DOE and NRC Storage Regulatory Approaches</u>
There are significant differences between the specific NRC storage regulations and the generic DOE nuclear safety regulations that are applied to SNF storage facilities. The primary differences arise from NRC's broader regulatory scope, which include aspects of the entire SNF lifecycle from generation to disposition, and the relative uniformity of SNF at NRC-licensed storage facilities. Conversely, DOE's regulatory focus is on the protection of workers and the public during storage operations for a variety of SNF types, storage systems, and DOE facilities. DOE lacks requirements and/or guidance that explicitly address the extended storage of SNF.

<u>Canister Storage Building Technical Safety Requirements Implementation</u>
The CSB technical safety requirements are adequately implemented. However, the in-service inspection for the CSB subsurface structure does not include Vault 2 or Vault 3. Both vaults are accessible and if inspected would provide valuable information on the condition of the CSB subsurface structure.

<u>200 Area Interim Storage Area Documented Safety Analysis</u>
A sample of the underlying hazard analysis key assumptions of the ISA documented safety analysis was assessed to determine their validity for the interim safe storage of SNF. One key assumption of the hazard and accident analysis, the damage ratio for the interim storage casks, lacks an adequate technical basis, which potentially affects the conclusion reached in the documented safety analysis that no safety structures, systems, or components are needed.

<u>Canister Storage Building and 200 Area Interim Storage Area Aging Management</u>
Overall, CH2M HILL Plateau Remediation Company (CHPRC) is adequately managing the aging of safety structures, systems, and components. However, CHPRC's aging management activities at the CSB are narrowly focused on the current design life and on compliance with technical safety requirements. CHPRC does not account for such considerations as the potential need for in-situ storage beyond the current documented design lives of the facility and container or the final transportation and disposition of SNF.

<u>Best Practices and Findings</u>
There were no best practices or findings identified during this assessment.

Recommendation
The Office of Environment, Health, Safety and Security should collaborate with the Office of Environmental Management and the Office of Nuclear Energy to develop specific requirements and/or guidance for storage of DOE-owned SNF that take into consideration extended storage and future disposition, including transportation and disposal.

Follow-up Actions
A narrowly focused follow-up assessment at the Hanford Site is planned to allow walkdowns and observations of operations at the CSB and ISA.

Safe Interim Storage of Spent Nuclear Fuel Assessment at the Hanford Site

1.0 INTRODUCTION

The U.S. Department of Energy (DOE) Office of Nuclear Safety and Environmental Assessments, within the independent Office of Enterprise Assessments (EA), conducted an assessment at the Hanford Site to verify that effective nuclear safety programs and controls are in place to ensure the safe interim storage of spent nuclear fuel (SNF) until it can be dispositioned, which could potentially be beyond the design life of the storage facilities and containers.

In accordance with the *Plan for the Safe Interim Storage of Spent Nuclear Fuel at the Hanford Site – September 2020*, the assessment focused on the following:

- Technical safety requirements (TSRs) implementation
- Aging-related degradation inspections for the structures, systems, and components (SSCs) important to the safe interim storage of SNF at the Canister Storage Building (CSB) and the 200 Area Interim Storage Area (ISA).

As part of the assessment of the aging-related degradation inspections, the assessment team evaluated the validity of the underlying key assumptions of the approved ISA safety basis. Because of the similar regulatory responsibilities of the DOE and the U.S. Nuclear Regulatory Commission (NRC) for the safe storage of SNF, the assessment also included an analysis of the differences in nuclear safety regulatory approach between DOE and NRC for the storage of SNF.

In consideration of the Hanford Site's response to the coronavirus disease of 2019 (COVID-19) pandemic, this assessment was conducted remotely from September 14-18, 2020, and consisted of document reviews and personnel interviews. Observations of facility conditions and operations were not performed as a part of this assessment.

SNF at the Hanford Site is arranged in several dry storage configurations and consolidated at two adjacent nuclear facilities, the CSB and the ISA. These facilities are managed and operated by CH2M HILL Plateau Remediation Company (CHPRC) for the DOE Richland Operations Office (RL) under the direction of the DOE Office of Environmental Management. SNF is stored at the CSB in 412 multi-canister overpacks (MCOs) in below-grade storage tubes. The MCO inventory containing N Reactor SNF accounts for approximately 86% of the overall DOE SNF inventory by mass and exceeds 50 million curies of radioactivity. The ISA consists of concrete and gravel pads on which various types of aboveground dry storage casks/containers are used to store eight different types of SNF. The SNF in these casks/containers exceeds 10 million curies of radioactivity. The CSB and ISA facilities are at the approximate midpoint of their respective 40-year design lives.

2.0 METHODOLOGY

The DOE independent oversight program is described in and governed by DOE Order 227.1A, *Independent Oversight Program*, which is implemented through a comprehensive set of internal protocols, operating practices, assessment guides, and process guides. This report uses the terms "best practices, deficiencies, findings, opportunities for improvement (OFIs), and recommendations" as defined in DOE Order 227.1A.

The assessment team considered requirements related to the nuclear safety of the interim storage of SNF from sections SNF.1 and SNF.3 of EA Criteria and Review Approach Document 31-37, Rev. 0, *Safe Interim Storage of Spent Nuclear Fuel*.

The assessment team examined key documents, such as documented safety analyses (DSAs), TSR documents, hazard analysis documents, calculations and analyses, procedures, and manuals. The assessment team also interviewed key personnel responsible for developing and implementing the nuclear safety controls and aging-related degradation inspections associated with the interim storage of SNF. The members of the assessment team, the Quality Review Board, and management responsible for this assessment are listed in Appendix A.

EA has not conducted a recent assessment of the interim storage of SNF at the Hanford Site, so there were no previous items for follow-up during this assessment.

3.0 RESULTS

In this section, results are grouped into the following categories: DOE and NRC requirements for SNF storage, implementation of CSB TSRs, analysis of the ISA safety basis, and management of the aging CSB and ISA.

3.1 Comparison of DOE and NRC SNF Storage Regulatory Approaches

The objective of this portion of the assessment was to compare the DOE and NRC regulatory approaches for storing SNF and to evaluate the adequacy of regulatory requirements, programs, and controls for ensuring the safe storage of SNF at the Hanford Site in a condition that would facilitate future disposition. Commercial fuels are relatively uniform in design, including fuel matrix (i.e., uranium-oxide), enrichment (i.e., less than 5 weight percent uranium-235 (U-235), cladding (i.e., zircaloy for the large majority), assembly geometry (i.e., bundled fuel rods), and depletion characteristics (i.e., thermal flux with a burnup up to approximately 60 gigawatt-days per metric ton of uranium (GWd/MTU). DOE-owned SNF is highly variable in fuel composition (e.g., mixed-oxide, uranium metal, aluminum alloys), enrichment (up to greater than 90 weight percent U-235 or plutonium-239), assembly geometry (e.g., pins, plates, carbide blocks), and depletion (thermal and fast neutron spectra with burnups ranging from a few GWd/MTU to over 200 GWd/MTU). Although commercial SNF has significantly different characteristics than DOE-owned SNF, the fundamental considerations important to their safe storage are similar and include confinement of radioactive material, radiation protection, and management of decay heat.

The Hanford Spent Nuclear Fuel Project (SNFP) managed the design and construction of the CSB and ISA. At its inception the SNFP adopted a regulatory policy to apply technical requirements consistent with the NRC storage regulation. RL letter 95-SFD-167, as endorsed by the DOE Assistant Secretary for Environmental Management (EM-1), states, “It is DOE’s policy that the K Basin SNFP will achieve nuclear safety equivalence to comparable NRC licensed facilities.” The policy letter does not specifically address the CSB or ISA. After the startup of the CSB, the application of the additional NRC requirements was subsequently limited to major modifications or higher classification of controls as indicated in HNF-8663, Rev4D, *Fluor Hanford Requirements Applicability Matrix*.

Given the initial intent of consistency with NRC regulations, this section provides a comparison of the NRC and DOE storage regulations and evaluates the potential issues at the CSB and ISA based on the NRC regulation, guidance, and storage experience at NRC-licensed facilities.

3.1.1 Summary of NRC SNF Storage Regulation

The NRC authority to regulate various aspects of nuclear power generation and SNF storage, transportation, and disposal comes from the Atomic Energy Act of 1954, as amended; the Energy Reorganization Act of 1974, as amended; and the Nuclear Waste Policy Act of 1982, as amended. NRC regulates the storage of SNF, high-level radioactive waste, and greater-than-class-C waste under 10 CFR 72, *Licensing Requirements for the Independent Storage of Spent Nuclear Fuel, High-Level Radioactive Waste, and Reactor Related Greater than Class C Waste*. These regulations establish requirements, procedures and criteria for the issuance of licenses to receive, transfer, and possess SNF, high-level radioactive waste, and greater-than-class-C waste. SNF can be stored in a commercial independent spent fuel storage installation (ISFSI) at or away from power reactor sites, or in a DOE-managed monitored retrievable storage (MRS) installation for an interim period pending disposal in a geologic repository.

10 CFR 72 defines the general safety functions of a storage facility, which primarily focus on maintaining the conditions required to store SNF safely; preventing damage to the SNF and waste container during handling and storage; and providing reasonable assurance that the SNF can be received, handled, packaged, stored, and retrieved without undue risk to the health and safety of the public. To meet these regulatory requirements, NUREG-1567 §4.4.3.1, *Standard Review Plan for Dry Storage Facilities*, specifies the basic design criteria for important to safety (ITS) SSCs, including maintaining subcriticality, maintaining radiological confinement, ensuring that radiation rates and doses for workers and public do not exceed acceptable levels, maintaining SNF retrievability, and providing heat removal. These design criteria requirements go beyond meeting dose consequence limits during storage and include important aspects for transportation and disposition. 10 CFR 72.236(m) requires that "consideration should be given to compatibility with removal of the stored spent fuel from a reactor site, transportation, and ultimate disposition...." To meet this compatibility requirement, NRC issued license review guidance on retrievability in Interim Staff Guidance-2, *Fuel Retrievability in Spent Fuel Storage Applications*.

NRC relies on several regulatory guidance documents and commercial industry standards that provide analysis guidance on various topics pertaining to dry storage. One of the relevant key guidance documents is NUREG-2214, *Managing Aging Processes in Storage (MAPS) Report*. The MAPS report establishes the technical bases for the review of license renewal applications (i.e., licenses for ISFSIs and certificates of compliance for dry cask storage systems) for SNF dry storage. The MAPS report evaluates known aging degradation mechanisms to determine whether they could affect the ability of dry storage system components to fulfill their safety functions. The report also provides examples of aging management programs that address the credible aging mechanisms to ensure that the design bases of dry storage systems will be maintained. The MAPS report is cited extensively in NRC's review and approval of revised ISFSI final safety analysis reports as documented in recent publicly available safety evaluation reports.

The MAPS report evaluates known aging degradation mechanisms to determine if they could affect the ability of dry storage system components to fulfill their safety functions for extended operation. The initial license term for an ISFSI or MRS must not exceed 40 years. Licenses for each type of installation may be renewed for a period not to exceed 40 years. Applications for ISFSI license renewals must, among other items, include:

- Time-limited aging analyses that demonstrate that ITS SSCs will continue to perform their intended function for the requested period of extended storage life operation

- A description of the aging management program for management of issues associated with aging that could adversely affect ITS SSCs.

3.1.2 Summary of DOE SNF Storage Regulation

DOE regulates storage of SNF under 10 CFR 830, *Nuclear Safety Management*. Safety SSCs are derived based on unmitigated consequence analyses for potential accidents. The unmitigated consequences are estimated either qualitatively or quantitatively for the offsite public and a hypothetical collocated worker (CLW) located 100 meters from the accident, and qualitatively characterized for the facility worker. Two types of safety controls could be derived based on the unmitigated analysis: safety class and safety significant (SS) controls. Safety class controls are identified if the unmitigated offsite radiological dose consequences for a design basis accident exceed 25 rem. SS control designation is based on protection of the CLW from radiological hazards at a threshold of 100 rem, protection of workers and the public from significant chemical consequences, protection of facility workers from fatality or serious injury, or a control determined to be a significant contributor to defense in depth.

The contractor responsible for a DOE nuclear facility must establish and maintain the safety basis by preparing a DSA, which establishes the hazard controls for ensuring adequate protection of workers, the public, and the environment. 10 CFR 830, Subpart B, Appendix A, Table 2 provides acceptable methodologies for preparing a DSA. DSAs for nonreactor nuclear facilities, including SNF storage, are prepared in accordance with DOE-STD-3009-94, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*, or a successor document. DOE reviews and approves DSAs in accordance with DOE-STD-1104-2016, *Review and Approval of Nuclear Facility Safety Basis and Safety Design Basis Documents*. DOE Order 420.1C, *Facility Safety*, establishes several facility and programmatic safety requirements for nuclear safety design criteria, fire protection, criticality safety, the cognizant system engineer program, and mitigation of natural phenomena hazards. Several DOE orders and invoked standards are used to support a DSA for various technical areas, including safety management programs.

DOE Order 433.1B, *Maintenance Management Program for DOE Nuclear Facilities*, requires contractors responsible for hazard category 1, 2 and 3 nuclear facilities to develop and implement a nuclear maintenance management program (NMMP). A specific NMMP requirement, *Aging Degradation and Technical Obsolesce*, identifies the contractor process for conducting inspections to evaluate aging-related degradation and technical obsolescence to determine whether the performance of SSCs is compromised. The focus of the NMMP-required inspections is on safety systems and meeting applicable TSRs and does not take into account non-safety-related considerations with potential importance to extended storage and future disposition.

3.1.3 Comparison of SNF Storage Regulatory Approaches

Table 1 summarizes the results of the comparison between the DOE and NRC regulatory approaches:

Table 1. Comparison between NRC and DOE Requirements for SNF Storage

Parameter	NRC (10 CFR 72)	DOE (10 CFR 830)
Regulatory Approach	Prescriptive based on industry experience with SNF performance and associated hazards	Generic based on consequences and qualitative hazard evaluation
Initial License Term	Up to 40 years	An initial design life is established by the site-specific design process and resulting code of record.

Parameter	NRC (10 CFR 72)	DOE (10 CFR 830)
Renewals Term	Up to 40 years	Extensions to design life must be substantiated through periodic DSA updates and the unreviewed safety question process.
Specific Dose Thresholds for Designation of Safety Systems	Normal operations: 25 millirem annual dose at controlled area boundary; Accident conditions: 5 rem at controlled area boundary	>25 rem for the public >100 rem for the CLW
Confinement	Redundant sealing of confinement boundary	No specific requirement. Derived based on facility-specific hazard and accident analysis.
Criticality Safety	Subcriticality based on double contingency	Subcriticality based on double contingency
Radiological Protection	10 CFR 20, *Standards for Protection Against Radiation*	10 CFR 835, *Occupational Radiation Protection*
Thermal Management	Passive heat removal	No specific requirement. Derived based on facility specific hazard and accident analysis.
Compatibility	SNF storage system must be compatible with wet and dry operations	No specific requirement
Future Waste Management Considerations	To the extent practicable, consideration should be given to compatibility with removal of the stored spent fuel from a reactor site, transportation, and ultimate disposition by DOE.	No specific requirement
Analysis Areas	Prescribed normal conditions, off-normal conditions, accident conditions, and natural phenomena events	Facility-specific design/evaluation basis accidents
Specific Off-normal Conditions	Examples include temperatures beyond normal, failure of 10% of fuel rods, failure of a single confinement boundary, partial blocked air vent.	No specific requirement
Accident Conditions	Examples include cask drop, cask tip over, fire, fuel rod rupture, leakage of the confinement boundary, explosive overpressure, and airflow blockage.	Derived based on facility-specific hazard and accident analysis.

Parameter	NRC (10 CFR 72)	DOE (10 CFR 830)
Maximum Leakage Rate	Consistent with American National Standards Institute N14.5-1997, *Radioactive Materials—Leakage Tests on Packages for Shipment*, for meeting dose limits above.	Derived based on facility-specific hazard and accident analysis.
Monitoring	Storage confinement systems must have the capability for continuous monitoring. NRC has accepted that confinement of welded canisters does not need to be monitored, however NRC requires routine surveillance programs and active instrumentation for monitored bolted casks.	Requirements for monitoring or in-service inspections are established based on facility-specific hazard evaluation, control selection, and accident analysis.

The specific NRC storage regulation (10 CFR 72) and associated review plans and regulatory guidance documents aim at standardizing safe SNF storage requirements, guidance, review, and approval with cognizance of the entire SNF lifecycle, including ISFSI storage, transportation, potential interim storage at an MRS, and geologic disposal. 10 CFR 51, *Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions*, which applies to the entire lifecycle, was updated in 2014 to reflect the environmental impacts of continued storage of SNF beyond the licensed life of the reactors that were evaluated in NUREG-2157, *Generic Environmental Impact Statement [GEIS] for Continued Storage of Spent Nuclear Fuel*. NUREG-2157 assumes an initial reactor licensed life of 40 years and up to two 20-year license extensions for each reactor, for a total of up to 80 years of operation. NUREG-2157 considers possible continued storage time frames, including 60 and 160 years after the end of a reactor's licensed life for operations, as well as indefinite storage at a reactor site or at an away-from-reactor ISFSI. Based on the analyses, NRC concludes that "continued safe storage of spent fuel in dry casks for the time frames considered in the GEIS is technically feasible."

The general DOE regulation (10 CFR 830), which was intended for a broad range of nonreactor nuclear facilities, does not contain specific requirements for SNF management and is narrowly focused on meeting facility-specific nuclear safety objectives (i.e., reasonable assurance of adequate protection of the public and workers). The requirements for DOE facilities are derived from the safety analysis process, which includes hazard evaluation, control selection, and accident analysis. Beyond the design life of the storage facility, there are no specific regulatory requirements or guidance aimed at addressing SNF lifecycle management, such as retrievability to facilitate potential repackaging or treatment for disposal. Consistent with these requirements, DOE's NMMPs focus on maintenance (taking into consideration aging, and degradation of safety SSCs) to meet applicable DSA requirements. DOE's approach contrasts with the NRC's aging management requirements, which take into consideration lifecycle management, including extended storage and SNF disposition. Additionally, unlike the evaluations in 10 CFR 51 and NUREG-2157, DOE has not performed nuclear safety evaluations to support the confidence in the ability to safely store the fuel for extended periods until a disposition path is available. Without such formal evaluations and subsequent regulatory requirements, there is no documented basis to support a conclusion that DOE's SNF storage facilities can continue to safely operate beyond the current design life and accommodate future disposition considerations.

3.1.4 Comparison of DOE and NRC SNF Storage Regulatory Approaches Conclusion

There are significant differences between the specific NRC storage regulations and the generic DOE nuclear safety regulations that are applied to SNF storage facilities. The primary differences arise from NRC's broader regulatory scope, which include aspects of the entire SNF lifecycle from generation to disposition, and the relative uniformity of the SNF at NRC-licensed storage facilities. Conversely, DOE's regulatory focus is on the protection of workers and the public during storage operations for a variety of SNF types, storage systems, and DOE facilities without factoring in storage-specific, broad-perspective, and forward-looking considerations. (See **RECOMMENDATION-AU-1**.)

3.2 Canister Storage Building Technical Safety Requirements Implementation

The objective of this portion of the assessment was to determine whether the safety basis hazard controls for safe interim storage of SNF at the CSB are effectively implemented to ensure adequate protection of workers, the public, and the environment from adverse consequences.

CHPRC procedure CSB-PRO-CP-51231, *CSB/ISA – Compliance Matrix*, identifies the procedures and documents used to implement the CSB safety basis requirements. This comprehensive matrix facilitates access to implementing documents. The assessment team reviewed all implementing procedures for TSR limiting conditions for operations (LCOs) and specific administrative controls, as well as procedures and preventive maintenance work packages for performing ISIs of safety design features. The procedures contain adequate detail and all the necessary steps to perform the LCO surveillance requirements and to comply with the specific administrative controls identified in the TSRs. The assessment team reviewed all 20 system health reports for CSB active safety SSCs from 2019 and 2020, which demonstrate that appropriate facility management and cognizant system engineers review the surveillance results and take appropriate actions. The assessment team also reviewed recent work package and procedure data sheets documenting surveillance performance. All surveillances are current and satisfactorily documented. Although several LCO surveillance frequencies are based on a time period prior to equipment use (e.g., within one year prior to use of the equipment), CHPRC has chosen to continue those surveillances at the identified frequencies even when equipment has been idle for several years. This practice will ensure that active safety SSCs are available for use if needed.

Additionally, the assessment team reviewed a sample of 11 ISIs for aboveground structures, subsurface structures, MCO handling machine structure and shielding, and site grading completed within the last five years. The ISIs were performed as work packages with attached data sheets that contain design feature requirements, work instructions, and results. The design feature ISI requirements are traceable to the DSA. The work instructions are clear and require re-inspection of previously noted concerns. Inspection results include adverse conditions, which require continued monitoring, and degraded items requiring repair. Time frames (e.g., immediate, within one year) were not identified for items requiring repair. Some items requiring repair, which were minor in nature and not highly prioritized, were not repaired within the inspection time frame of one year and were re-identified by ISI as requiring repair the next year.

The work instructions for the CSB subsurface structure ISI only require a visual inspection of accessible above-grade features as an indirect indication of the condition of the subsurface structure. This indirect approach is justified for Vault 1, where the SNF inventory is stored, because the subsurface structure is not accessible in Vault 1. However, Vault 2 and Vault 3, comprising approximately two-thirds of the subsurface structure of the CSB, are empty and can be accessed for inspection activities. (See **OFI-CHPRC-1**.)

Canister Storage Building Technical Safety Requirements Implementation Conclusion

The CSB TSRs are adequately implemented based on the document reviews and interviews conducted. However, the ISI for the CSB subsurface structure does not include inspections in the accessible Vault 2 and Vault 3, which would provide valuable information on the condition of the CSB subsurface structure.

3.3 200 Area Interim Storage Area Documented Safety Analysis

The objective of this portion of the assessment was to determine whether the key assumptions used in the hazard analysis of the ISA DSA (HNF-40627) remain valid for the interim safe storage of SNF.

A sample of one of the eight SNF types was used to determine the adequacy of key assumptions of the unmitigated hazard analysis. The ISA stores these eight types of SNF in different dry storage systems. The assessment team selected Fast Flux Test Facility (FFTF) SNF because it has the highest radiological inventory per container. The ISA uses 49 interim storage casks (ISCs), each holding a core component container, to store FFTF SNF. Each ISC is loaded with 7 FFTF assemblies with a radiological content up to 234 times the DOE-STD-1027-92 Hazard Category 2 threshold value for a nuclear facility.

The ISA DSA hazard evaluation identified only low CLW radiological consequence (i.e., <100 rem) events, so no safety SSCs (e.g., ISCs) were identified. Unmitigated radiological consequences in excess of the 100-rem dose threshold to the CLW determine whether the ISC safety functional classification is safety-significant. Therefore, the DSA functionally classified the ISCs as defense in depth. The assessment team determined that the low radiological consequences and subsequent defense-in-depth classification of SNF ISCs is due to the assumed low damage ratio (DR) factors used in unmitigated dose consequence calculations. For example, a DR of 1×10^{-4} was applied to the ISCs, which results in a bounding accident CLW dose of 0.17 rem, leading to no credited safety SSCs. DOE-HDBK-1224-2018, *Hazard and Accident Analysis Handbook*, §5.2.2.1 recommends that a DR of 1.0 be assigned in unmitigated analysis, unless there is technical justification for a lesser value. The assessment team determined that there is no technical justification for the assigned unmitigated DR values other than these casks are evaluated as "robust" by qualitative descriptions of uncredited barriers. The ISA DSA was initially developed and approved in accordance with DOE-STD-3009-94, and the ISC DR used values from HNF-8739, Rev. 1, *Hanford Safety Analysis & Risk Assessment Handbook* (SARAH). The DR technical basis used in the ISA DSA and SARAH is derived from the ISA radiological dose calculation in HNF-38490, Rev. 1, *200 Area Interim Storage Area Radiological Dose Consequence Calculations for DSA Development*. The calculation cites the Hanford SARAH as the basis of the ISC DR, reflecting the untraceability and circular logic of the assigned ISC DR value.

In response to this concern, line management indicated that if new calculations were performed in accordance with DOE-STD-3009-2014, *Preparation of Nonreactor Nuclear Facility Documented Safety Analysis*, the ISC DR may be similar to the assumed value in the ISA DSA. However, based on the more prescriptive guidance of DOE-STD-3009-2014, §3.2.2, the ISC would likely be classified as an SS SSC to protect the DR assumptions of the hazard analysis. The assessment team noted that applying DOE-STD-3009-2014 to the ISA is not required by DOE Order 420.1C. (See **OFI-RL-1**.)

200 Area Interim Storage Area Documented Safety Analysis Conclusion

The ISC DR value lacks a traceable technical basis and has potentially impacted the identification of TSR controls in order to protect the assumption that the ISCs limit accident releases. Applying DOE-STD-3009-2014 requirements to the ISA DSA would likely require selection of the ISC as an SS control.

3.4 Canister Storage Building and 200 Area Interim Storage Area Aging Management

The objective of this portion of the assessment was to assess the aging-related degradation inspections of SSCs that are implemented for safe interim storage of SNF throughout the design life of the CSB and ISA.

The 20 system health reports for CSB active SSCs reviewed by the assessment team indicate that there are no issues about the systems meeting their design life. The systems are infrequently used, and spare parts are available. Preventive maintenance and surveillances are being performed on time, with the exception of 2020 during the COVID-19-related shutdown, when verification of active safety system operability was allowed to lapse. This lapse was appropriate because no operations were performed and active safety systems are only required when MCOs are moved or sampled. Aging degradation of active safety systems is not considered beyond the current design life because the systems are repairable or replaceable. The system health reports are effective in tracking issues related to active safety SSCs and provide assurance that the systems will remain operable for the remainder of their design life.

TSR ISIs evaluate the condition of CSB passive safety features to identify degradation which would impact the ability of the design features to perform their credited safety functions. The review of the 11 ISIs for aboveground structures, subsurface structures, MCO handling machine structure and shielding, and site grading completed within the last five years identified that the ISIs were implemented as work packages. These work packages appropriately identified the safety functions of the SSCs, were conducted by the designated Design Authority for the design feature, included rudimentary tracking and trending, and were appropriately conducted for all design features on an annual basis. The ISIs are adequate to identify and evaluate age-related degradation of the passive safety design features.

CHPRC-04391, *Fuel Facilities Plant Life Extension Report*, provides a periodic SSC life extension evaluation for CSB and other nuclear facilities. The report compares the remaining design life expectancy of each SSC to the projected operational needs, including expected system component replacement or recommended major maintenance activities that are critical for maintaining CSB's primary mission. The report also facilitates proper preventive maintenance management through appropriate facility operational planning, maintenance management funding, and resource allocation. The evaluation determined that the CSB active safety SSCs are expected to operate for at least an additional 10 years based on modest maintenance to and replacement investments in the heating, ventilating, and air conditioning systems and certain electrical components. Moreover, the credited safety design features are expected to meet their safety functions (with minor maintenance activities) for the remaining design life. The periodic life extension evaluations provide an appropriate technical basis input (in conjunction with active safety system health reports) for an effective CSB aging management program.

As discussed in Section 3.1.2, the focus of the NMMP-required aging-related degradation inspections is on safety systems and meeting applicable TSRs. Because passive SNF container systems are not identified as safety SSCs in the ISA DSA, there are no associated TSRs. Therefore, the NMMP does not require aging-related degradation inspections for the ISA SNF container systems. However, annual ISA container inspections are conducted to record the physical conditions of accessible cask surfaces. There are no timely repairs or trending of physical conditions based on the relatively minor degradation of SNF container concrete surfaces.

Aging management considerations at the CSB and ISA are narrowly focused on the current design life and on compliance with TSRs and do not account for considerations such as the potential need for in-situ storage beyond the current documented facility and container design lives and final transportation and disposition of the SNF. This strategy, however, is consistent with DOE's requirements as summarized in Section 3.1 and the use of DOE-STD-3009-94 in preparing the ISA DSA. (See **OFI-RL-2**.)

Canister Storage Building and 200 Area Interim Storage Area Aging Management Conclusion

CHPRC is adequately managing the aging of safety SSCs identified in the CSB DSA. However, aging management requirements are narrowly focused on safety SSCs and therefore do not apply to the ISA SNF storage containers.

4.0 BEST PRACTICES

There were no best practices identified as part of this assessment.

5.0 FINDINGS

There were no findings identified as part of this assessment.

6.0 DEFICIENCIES

There were no deficiencies identified as part of this assessment.

7.0 OPPORTUNITIES FOR IMPROVEMENT

The assessment team identified three OFIs to assist cognizant managers in improving programs and operations. While OFIs may identify potential solutions to findings and deficiencies identified in assessment reports, they may also address other conditions observed during the assessment process. These OFIs are offered only as recommendations for line management consideration; they do not require formal resolution by management through a corrective action process and are not intended to be prescriptive or mandatory. Rather, they are suggestions that may assist site management in implementing best practices or provide potential solutions to issues identified during the assessment.

Richland Operations Office

OFI-RL-1: Consider applying the newer methodology from DOE-STD-3009-2014 to the ISA DSA to provide additional rigor in determining the functional classification of hazard controls needed to ensure safety.

OFI-RL-2: Consider broadening the aging management program at the CSB and ISA to be forward looking in considering not just current safety controls, but also those SSCs whose designation could change based on evolving DOE requirements (e.g., ISA upgrade to DOE-STD-3009-2014) and those SSCs that may be required to facilitate potential lifecycle SNF management considerations, including continued in-situ storage beyond the current documented facility and container design lives and final transportation and disposition of SNF.

CH2M HILL Plateau Remediation Company

OFI-CHPRC-1: Consider performing a visual inspection, either directly or remotely, of the interior portion of the accessible CSB subsurface structure in Vault 2 and Vault 3 to provide more representative information on the condition of the subsurface structure than the current inspections being performed.

8.0 RECOMMENDATION

EA identified one recommendation for consideration by senior line management. Recommendations do not require formal resolution through a corrective action process and are not intended to be prescriptive or mandatory. Rather, they are suggestions derived from the aggregate results of an assessment that may assist senior line management in improving the effectiveness of programs or site management.

Office of Environment, Health, Safety and Security

RECOMMENDATION-AU-1: In order to establish uniform DOE expectations for SNF storage, the Office of Environment, Health, Safety and Security should collaborate with the Office of Environmental Management and the Office of Nuclear Energy to develop specific requirements and/or guidance for storage of DOE-owned SNF that take into consideration extended storage and future disposition, including transportation and disposal. This consideration should include the diversity of DOE storage facilities and SNF types and should support the ability to demonstrate confidence that DOE's SNF storage facilities can continue to safely operate beyond their current design lives and accommodate future disposition considerations.

9.0 ITEMS FOR FOLLOW-UP

A narrowly focused follow-up assessment at the Hanford Site is planned to allow walkdowns and observations of operations at the CSB and ISA.

Appendix A
Supplemental Information

Dates of Assessment

Remote Assessment: September 14-18, 2020

Office of Enterprise Assessments (EA) Management

Nathan H. Martin, Director, Office of Enterprise Assessments
John E. Dupuy, Deputy Director, Office of Enterprise Assessments
Kevin G. Kilp, Acting Director, Office of Environment, Safety and Health Assessments
Kevin M. Witt, Director, Office of Nuclear Safety and Environmental Assessments
Charles C. Kreager, Director, Office of Worker Safety and Health Assessments
Terrance J. Jackson, Acting Director, Office of Emergency Management Assessments

Quality Review Board

John E. Dupuy
Carrianne J. Zimmerman
Robert J. Hailstone
Michael A. Kilpatrick – Advisor to the QRB

EA Site Lead for Hanford (RL)

Ronald G. Bostic

EA Assessors

Ronald G. Bostic – Lead
James O. Low
Halim A. Alsaed
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Katherine S. Lehew
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