APPENDIX H.7

CSB (CP-OP-5, CENTRAL PLATEAU)
EVALUATION UNIT SUMMARY TEMPLATE

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PART I. EXECUTIVE SUMMARY

EU LOCATION

200 East Area

RELATED EUS

K-Basin Sludge Treatment Facility (Engineered Container Retrieval and Transfer System [ECRTS]) (RC-OP-01), Low-level waste burial grounds (LLBG) (CP-LS-12 for West Burial Grounds and CP-LS-14 for East Burial Grounds)

PRIMARY CONTAMINANTS, CONTAMINATED MEDIA AND WASTES

CSB is considered to be a Hazard Category 2 Nuclear Facility[1]. The Interim Storage Area (located 0.1 mile away from the CSB) is independently evaluated from the CSB and the ISA is also considered to be a Hazard Category 2 Nuclear Facility based on radioactive content stored within the ISA facility operational boundaries[2].

Both CSB and ISA safely store used nuclear fuel originating from Hanford onsite and offsite reactor operations.

BRIEF NARRATIVE DESCRIPTION

The Canister Storage Building (CSB) is a large, 42,000-square-foot (3,906-square-meter) facility located in the 200-East Area. The facility stores about 2,300 tons (2,086 metric tons) of spent nuclear fuel packaged in approximately 400 multicanister overpacks from the 100-K Basins, 100-N Reactor, and T Plant. The multicanister overpacks are stored in 220 carbon steel tubes in a below-grade concrete vault. The irradiated fuel was cleaned, packaged, dried, and relocated to the CSB beginning in 2004 to provide safe interim storage in a consolidated location, allowing for cleanup of older facilities, which reduces the cleanup footprint of the Hanford Site and risk. The CSB has a design life of 40 years, and will safely store the multi-canister overpacks until they are permanently placed in a National Repository. Adjacent to the CSB is the Interim Storage Area, which also contains spent nuclear fuel packaged in various containers. This spent nuclear fuel will be subsequently repackaged and sent to a National Repository.[3]

The Canister Storage Building (CSB) operations and support structures and equipment are required for the receipt, handling, and interim storage of welded and monitored scrap/fuel multi-canister overpacks (MCOs) containing K Basin fuel assemblies, scrap pieces or knock-out pot (KOP) material, and Shippingport spent fuel canister (SSFC) MCOs containing Shippingport Pressurized Water Reactor (PWR) Core 2 blanket fuel assemblies. CSB is also authorized to receive, handle, weld, and temporarily store single-pass reactor (SPR)[4]/N-Reactor type fuels in found fuel containers (FFCs), and ceramic oxide fuel specimens from General Electric (GE) Vallecitos Nuclear Center in transuranic multiple burial containers

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[1] HNF-3553-ANXA, Rev 9, pg. vi

[2] HNF-40627, Rev 2, pg. iv and pg. v

[3] DOE-RL-2014-52, pg. 5.20

[4] Reactors onsite that were considered as SPRs were the first eight reactors built (B, D, F, H, DR, KE, and KW) [PNNL-13605, Rev 4, pg. 4]

(TMBCs). The CSB Facility provides for sampling, welding, monitoring, and interim storage of MCOs; interim storage of SSFCs; and receiving, handling, welding, and temporary storage of FFCs and TMBCs.[5]

In short, CSB is authorized to receive, sample, weld, and store MCOs, FFCs, and TMBCs. CSB is not authorized to transport MCOs out of CSB facility. Currently, MCOs are being stored at the CSB (379 Scrap/fuel MCOs and 18 SSFC MCOs[6]) and no FFCs or TMBCs are held within the CSB at this time. The FFCs and TMBCs will be transferred and stored at a later date (20 FFCs and 22 TMBCs)[7]. No formal accident analysis was required concerning the FFCs and TMBCs since this fuel has not been transferred to the CSB and the DSA only covered current authorized operations[8]. CSB is designed to operate for 75 years, but the safety authorization basis is only 40 years[9]

The 200 Area Interim Storage Area (ISA) is a separate facility located inside the CSB yard area[10] and is missioned with safely storing eight (8) different authorized dry storage systems: Fast Flux Test Facility (FFTF) fuel, Neutron Radiography Facility (NRF) TRIGA Fuel[11], Oregon State University (OSU) TRIGA Fuel, Commercial Light-Water Reactor (LWR) Fuel, Single-Pass Reactor (SPR)/N Reactor-Type Fuels, Experimental Fuels in Experimental Breeder Reactor-II (EBR-II) Casks, General Electric Vallecitos fuel, and Los Alamos Molten Plutonium Reactor Experiment (LAMPRE) fuel.

The ISA is a relatively simple facility consisting of boundary security fences with gates, perimeter lighting, and concrete and gravel pads on which the dry storage containers are placed. The 200 Area ISA is a radiological material and radiation area and is a protected area (PA) for physical security purposes. The 200 Area ISA is nominally 240,000 square-feet and is located just west of the CSB. Interim storage at the 200 Area ISA is intended for a period of up to 40 years until the materials are shipped offsite to a disposal facility. The ISA DSA does not address removal from storage or shipment from the 200 Area ISA.[12]

SUMMARY TABLES OF RISKS AND POTENTIAL IMPACTS TO RECEPTORS

Table H.7-1 provides a summary of nuclear and industrial safety related risks to humans and impacts to important physical Hanford site resources.

Human Health

A Facility Worker is deemed to be an individual located anywhere within the physical boundaries or immediate areas around the outside the facility; a Co-located Person is an individual located 100 meters from the facility boundary; and Public is an individual located at the closest point on the Hanford Site

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[5] HNF-3553-ANXA, Rev 9, pg. iv

[6] 15 of the 397 (379+18 = 397] of the MCOs storing Scrap/Fuel or KOP product material are mechanically sealed (i.e., not welded) and are included in the monitoring program (up to 20 MCOs may be designated as monitored MCOs) [HNF-3553-ANXA, Rev 9, pg. 2-83]

[7] HNF-3553-ANXA, Rev 9, pg. 2-56 , Section 2.5.1. “Baseline operations at CSB include receiving operations, cask servicing operations, MCO operations, and MCO sampling operations. Receipt of MCOs is complete. Equipment and operating procedures specifically associated with MCO receipt are not required to be maintained active. **Receipt of FFCs and TMBCs may occur in the future.** The FFCs will be transported to CSB in either a PAS-1 cask or within an MCO transportation cask on a transport trailer. The TMBCs will be transported to CSB on a transport trailer and may be placed into an engineered overpack for transport. The PAS-1 cask will contain a single FFC, while an MCO transportation cask may contain up to four FFCs. FFCs will be generated on the Hanford Site during ongoing cleanup efforts, and there may be a total of about 20 FFCs generated and shipped to CSB over about a 10 year period. There are a total of 22 TMBCs currently stored at the LLBG, which will be shipped to CSB and welded, most likely as a single campaign.”

8 HNF-3553-ANXA, Rev 9, pg. 3-35

9 Birk, S. and B. Carlsen (2010). Storage of DOE SNF at Hanford, Idaho National Laboratory (INL). (URL: http://nsnfp.inel.gov/program/strategymtg/Fact%20sheets/SNF%20storage%20Hanford_final.pdf): 2 pages.

10 HNF-40627, Rev 2, pg. 2-12

[11] TRIGA = Training Reactor Isotopes, General Atomics (registered trademark name) [URL: http://www.iaea.org/inis/collection/NCLCollectionStore/_Public/27/044/27044785.pdf, page 5]

12 HNF-40627, Rev 2, pg. iv

boundary not subject to DOE access control. The nuclear related risks to humans are based on unmitigated (unprotected or controlled conditions) dose exposures expressed in a range of from "low" to "high" according to the consequence levels. The estimated mitigated exposure that takes engineered and administrative controls and protections into consideration, when this information is available, is shown in parentheses within Table H.7-1, "IS" denotes insufficient information is available to provide a rating. The ratings are based on the calculated doses to human receptors associated with design basis accidents at the CSB facility. This is the conservative approach since the calculated unmitigated doses to the MOI associated with the ISA DSA are much lower than those of the CSB DSA. The MOI and CP doses are considered "Non-Discernible, ND" associated with the two ISA DSA analyzed accidents.

Groundwater and Columbia River

Direct impacts to groundwater resources and the Columbia River have been rated based on available information for the current status and estimates for future time periods. These impacts are also expressed in a range of from *Not Discernible* (*ND*) to *Very High.*

Ecological Resources

The risk ratings are based on the degree of physical disruption (and potential additional exposure to contaminants) in the current status and as a potential result of remediation options.

Cultural Resources[13]

No risk ratings are provided for Cultural Resources. Table H.7-1 identifies the three overlapping Cultural Resource landscapes that have been evaluated: Native American (approximately 10,000 years ago to the present); Pre-Hanford Era (1805 to 1943) and Manhattan/Cold War Era (1943 to 1990); and provides initial information on whether an impact (both direct and indirect) is KNOWN (presence of cultural resources established), UNKNOWN (uncertainty about presence of cultural resources), or NONE (no cultural resources present) based on written or oral documentation gathered on the entire EU and buffer area. Direct impacts include but are not limited to physical destruction (all or part) or alteration such as diminished integrity. Indirect impacts include but are not limited to the introduction of visual, atmospheric, or audible elements that diminish the cultural resource's significant historic features. Impacts to Cultural Resources as a result of proposed future cleanup activities will be evaluated in depth under Section 106 of the National Historic Preservation Act (16 USC 470, et. seq.) during the planning for remedial action.

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[13] References throughout this Evaluation Unit Summary Template supporting analyses related to Ecological Resources and/or Cultural Resources may be found in Appendices J and K, respectively. Refer to the specific EU when searching for the reference.

Table H.7-1. Risk Rating Summary (for Human Health, unmitigated nuclear safety basis indicated, mitigated basis indicated in parentheses (e.g., "High" (Low)).

		Evaluation Time Period	
		Active Cleanup (to 2064)	
Population or Resource		**Current Condition:** Stabilization & Deactivation	**From Cleanup Actions:** Final D&D: Proposed method: Dependent on D&D Methods yet to be determined. (Unknown)
Human Health	Facility Worker	***S&D***: High (Low)	***Proposed method***: IS
	Co-located Person	***S&D***: High (Low)	***Proposed method***: IS
	Public	***S&D***: ND (ND)	***Proposed method***: IS
Environmental	Groundwater[(a)]	*Not Discernible* (*ND*)	*ND*
	Columbia River[(a)]	*ND*	*ND*
	Ecological Resources[(b)]	ND	No cleanup decisions have been made for this EU. Estimated to be ND to Low
Social	Cultural Resources[(b)]	**Native American** Direct: Unknown Indirect: Known **Historic Pre-Hanford** Direct: Unknown Indirect: None **Manhattan/Cold War** Direct: None Indirect: Known	No cleanup decisions have been made for this EU. Estimated to be: **Native American** Direct: Unknown Indirect: Known **Historic Pre-Hanford** Direct: Unknown Indirect: None **Manhattan/Cold War** Direct: None Indirect: Known

a. Threat to groundwater or the Columbia River from Group A and B primary contaminants (PCs) (Table 6-1, CRESP 2015) remaining in the vadose zone. There are no vadose zone inventories associated with this EU (because of the nature of the facilities comprising the EU), and thus no threat to the vadose zone, groundwater, or the Columbia River.

b. For both Ecological and Cultural Resources see Appendices J and K, respectively, for a complete description of Ecological Field Assessments and literature review for Cultural Resources. Ecological ratings are described in Table 4-11 of the Final Report. (IS = insufficient information; ND = Not Discernible).

SUPPORT FOR RISK AND IMPACT RATINGS FOR EACH POPULATION OR RESOURCE HUMAN HEALTH

Current

CSB: Doses were calculated for the hypothetical co-located person placed at a distance of 100-m from the CSB for 7 design basis accidents (DBAs)[14]. Of the 7 DBAs evaluated within the CSB DSA, the three (3) accident scenarios resulting in the highest unmitigated doses to the co-located person[15] were considered "High" accordingly if the unmitigated dose calculated is greater than or equal to 25 rem. The Fires accident scenario was used to populate the risk rating tables due to availability of data for both unmitigated and mitigated doses that were provided in the CSB DSA. Active and passive safety systems are in place but have not been taken credit to reduce the estimated mitigated doses since the Mitigated Doses to the CP and MOI from fire accident scenarios were the same as the unmitigated doses[16].

Unmitigated Dose to the co-located worker for the top 3 accident scenarios: MCO internal hydrogen deflagration (54 rem); Mechanical damage of MCO (49 rem); Fires (35.6 rem).

Unmitigated Dose to the MOI for the top 3 accident scenarios were: MCO internal hydrogen deflagration (0.06 rem); Mechanical damage of MCO (0.055 rem); Fires (0.0206 rem). The human health ratings for all three scenarios are considered "Non-discernible, ND" for a MOI if the unmitigated dose calculated is less than 0.1 rem.

ISA: Unmitigated Doses to the co-located person for the two analyzed accident scenarios: External Impact/Drop Accident Scenarios Involving Aboveground Storage of Spent Nuclear Fuel Containers (0.18 rem); Vehicle Fuel Fire Accident Scenarios Involving Aboveground Storage of Spent Nuclear Fuel Containers (0.0008 rem). The human health rating for the container drop is "Low" if the unmitigated dose calculated is greater than 0.1 rem and less than or equal to 1 rem. The human health rating for the vehicle fuel fire is "Non-discernible, ND" for a co-located person if the unmitigated dose calculated is less than 0.1 rem.

Unmitigated Doses to the MOI for the two analyzed accident scenarios: External Impact/Drop Accident Scenarios Involving Aboveground Storage of Spent Nuclear Fuel Containers (0.00009 rem); Vehicle Fuel Fire Accident Scenarios Involving Aboveground Storage of Spent Nuclear Fuel Containers (0.00004 rem). The human health ratings for the two scenarios are considered "ND" for a MOI if the unmitigated dose calculated is less than 0.1 rem.

Risks and Potential Impacts from Selected or Potential Cleanup Approaches

Insufficient information exists to apply health risk ratings.

Groundwater, Vadose Zone, and Columbia River

There are no reported vadose zone inventories (because of the nature of the facilities that comprise the EU) and thus no significant threats to the vadose zone, groundwater, or the Columbia River for the purposes of this Review.

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[14] HNF-3553-ANXA, Rev 9, pg. vi, Dose calculation methodology to the hypothetical human receptor at 100 m away from the CSB facility was defined by risk evaluation guidelines and selection of safety-significant features according to PRC-PRO-NS-700, *Safety Basis Development* [HNF-3553-ANXA, Rev 9, pg. 1-4 and pg. 1-5]. Active and Passive Safety significant features can be found in HNF-3553-ANXA, Rev 9, pg. ii, iv through pg. ix

[15] HNF-3553-ANXA, Rev 9, pg. 3-35, and Table 3-8 "Summary of Consequences for Bounding Design Basis Accidents" pg. 3-47

[16] HNF-3553-ANXA, Rev 9, Table 3-34, pgs.3-133 through 3-139

Ecological Resources

Current

0% of EU and 32% of the buffer area are level 3 or higher resources. Historical surveys recorded black-tailed jack rabbit. Currently, the area is all disturbed with buildings, and cleared areas. There could be migratory birds nesting on buildings. Work would be done when birds are not nesting, or other mitigation activities.

Risks and Potential Impacts from Selected or Potential Cleanup Approaches

No cleanup decisions have been made, and as a result, the potential effects of cleanup on ecological resources are uncertain for the active cleanup evaluation period.

Cultural Resources

Current

Much of the land within the EU is extensively disturbed. The entire EU has been inventoried for cultural resources. Geomorphology indicates a moderate potential to contain intact archaeological resources on the surface and/or subsurface. Traditional cultural places are visible from EU.

A National Register eligible Manhattan Project and Cold War Era archaeological resource is located within 500 meters of the EU, which has been mitigated. National Register eligible Manhattan Project/Cold War Era significant resources located within 500 meters of the EU will be demolished, but they have already been mitigated.

Risks and Potential Impacts from Selected or Potential Cleanup Approaches

No cleanup decisions have been made for the deep vadose zone, and archaeological investigations and monitoring may need to occur prior to remediation. The geomorphology indicates a low to moderate potential for intact archaeological resources. Remediation disturbance may result in impacts to archaeological resources if they are present in the subsurface. No cleanup decisions have been selected, however the potential range of impacts could include: Temporary indirect effects during remediation; Permanent indirect effects are possible if contamination remains after remediation.

A National Register eligible Manhattan Project and Cold War Era archaeological resource is located within 500 meters of the EU, which has been mitigated. National Register eligible Manhattan Project/Cold War Era significant resources located within 500 meters of the EU will be demolished, but they have already been mitigated.

Considerations for Timing of the Cleanup Actions

No cleanup decisions have been made for this EU.

Near-Term, Post-Cleanup Risks and Potential Impacts

No cleanup decisions have been made for this EU.

PART II. ADMINISTRATIVE INFORMATION

OU AND/OR TSDF DESIGNATION(S)

Not Applicable

COMMON NAME(S) FOR EU

Canister Storage Building, CSB, Interim Storage Area, ISA

KEY WORDS

Used nuclear fuel (UNF), multi-canister overpack (MCO), found fuel canister (FFC), transuranic multiple burial container (TMBC), knockout pot (KOP) material, K Basin, Fast Flux Test Facility (FFTF) fuel, Neutron Radiography Facility (NRF) TRIGA Fuel, Oregon State University (OSU) TRIGA Fuel, Commercial Light-Water Reactor (LWR) Fuel, Single-Pass Reactor (SPR)/N Reactor-Type Fuels, Experimental Fuels in Experimental Breeder Reactor-II (EBR-II) Casks, General Electric Vallecitos fuel, and Los Alamos Molten Plutonium Reactor Experiment (LAMPRE) fuel

REGULATORY STATUS:

Regulatory basis

CSB:

10 CFR 830, "Nuclear Safety Management," *Code of Federal Regulations*, as amended

ISA:

10 CFR 830, Subpart A, "Quality Assurance Requirements." This rule requires that a sufficient quality assurance program be in place.

Title 10, *Code of Federal Regulations*, Part 835, "Occupational Radiation Protection" (10 CFR 835). This rule provides requirements for radiation protection programs.

DOE Order 5480.28, *Natural Phenomena Hazards Mitigation*. This Order was used to define design requirements for seismic events and straight wind.

DOE-STD-1020-94, *Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities*. This standard provides natural phenomena hazard design and evaluation criteria. The 200 Area ISA was designed and evaluated for seismic events and straight wind in accordance with this standard.

DOE-STD-1021-93, *Natural Phenomena Hazards Performance Categorization Guidelines for Structures, Systems, and Components*. This standard was used to define the specific performance category for structures, systems, and components (SSC).

DOE-STD-1027-92, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports*. This standard was used to determine the hazard category for the 200 Area ISA.

DOE-STD-3009-94, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses.* This document describes the DSA preparation method that is acceptable to DOE as delineated for those specific facilities listed in Table 2 of Appendix A, "General Statement of Safety Basis Policy," to Subpart B, "Safety Basis Requirements," of 10 CFR 830.

Applicable regulatory documentation

CSB:

DOE Order 5480.23

DOE-STD-3009-94, 2006, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*, Change Notice No. 3, U.S. Department of Energy, Washington, D.C.

DOE-STD-1027-92, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports*

HNF-8739, 2012, *Hanford Safety Analysis and Risk Assessment Handbook (SARAH)*, Rev. 2, CH2M HILL Plateau Remediation Company, Richland, Washington

ISA:

DOE-HDBK-3010-94, *Airborne Release Fractions/Rates and Respirable Fractions for DOE Nonreactor Nuclear Facilities*. This document provides the bases for calculating radiological dose consequences

Applicable Consent Decree or TPA milestones

None

RISK REVIEW EVALUATION INFORMATION

Completed

3/20/2017

Evaluated by

Bethany Burkhardt and Steve Krahn

Ratings/Impacts Reviewed by

Henry Mayer

PART III. SUMMARY DESCRIPTION

CURRENT LAND USE

The DOE Hanford Site is designated as industrial use. All current land-use activities in the 200 East Area are industrial in nature[17]. Both CSB and ISA are part of the 200 East Area.

DESIGNATED FUTURE LAND USE

The DOE preferred alternative is the Industrial Exclusive Use Category for the CSB and ISA areas within the 200 East area[18].

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[17] EPA 2012, 'Record of Decision For Interim Remedial Action -- Hanford 200 Area Superfund Site 200-UP-1 Operable Unit,' U.S. Environmental Protection Agency, Washington State Department of Ecology, and U.S. Department of Energy, Olympia, Washington. Available at: http://www.epa.gov/region10/pdf/sites/hanford/200/Hanford_200_Area_Interim_ROD_Remedial_Action_0912.pdf.

[18] DOE-EIS-0222 CLUP-EIS Summary document, Figure S-10 on page 45/131

PRIMARY EU SOURCE COMPONENTS

Legacy Source Sites

Not Applicable

High-Level Waste Tanks and Ancillary Equipment

Not applicable

Groundwater Plumes

Not applicable

Operating Facilities

CSB: The inventory at CSB includes the 379 Scrap/Fuel MCOs and the 18 SSFC MCOs transferred from other operations at the Hanford site and transferred from offsite locations. Within each Scrap/Fuel MCO contains approximately 6 metric tons uranium (MTU) containing fission products, activation products, uranium, plutonium, and other minor actinides with a summed radioactivity estimated at 4.11E+04 Ci/MTU. [19]

The SSFC MCO contains blanket fuel assemblies (BFA) from Shippingport PWR Core 2 operations that began in April 1965 to February 1974. [20] The SSFC MCO inventory information of plutonium and uranium content is provided and shown in Part V, "Waste and Contamination Inventory" (

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19 HNF-3553-Anxa, Rev 9, Table 3-2, pg. 3-25

[20] Clayton, J. C. (1993). The Shippingport Pressurized Water Reactor and Light Water Breeder Reactor. 25th Central Regional Meeting of the American Chemical Society. Westinghouse Electric Company and Bettis Atomic Power Laboratory. Pittsburgh, Pennsylvania, October 4-6, 1993. American Chemical Society. (URL: http://large.stanford.edu/courses/2009/ph204/coleman1/docs/10191380.pdf): 11 pages.

Table H.7-5).

ISA: There are eight (8) types of spent nuclear fuel authorized for storage at the ISA. Two types of fuel are not stored currently at the ISA (TMBCs holding GE's Vallecitos fuel and FFCs holding SPR/N Reactor fuel).[21] The remaining six (6) fuel types considered as part of the inventory at ISA is described below (and reported in Past V "Waste and Contamination Inventory", Table H.7-6):

- FFTF fuel
- NRF TRIGA fuel
- OSU TRIGA fuel
- Commercial LWR fuel
- EBR-II fuel
- LAMPRE-I EBR-II fuel

LOCATION AND LAYOUT MAPS

The CSB and the ISA are located in the 200 East Area and are situated within 0.1 miles of each other with the ISA on the west side of the CSB (see Figure H.7-1, below).

Other notable locations pertinent to the CSB DSA and the ISA DSA are the Hanford Site boundary defined at a distance of 17,390 m east of the CSB describing a hypothetical offsite receptor and a distance of 100m from the CSB facility as the location of the co-located worker.[22]

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[21] The overall radioactive inventory for the FFCs, Experimental Breeder Reactor-II (EBR-II) casks, TMBCs, and Los Alamos Molten Plutonium Reactor Experiment (LAMPRE) EBR-II casks are summarized in Table 3-8. The FFCs and TMBCs have yet to be moved into CSB for further handling and these containers must move to CSB first before movement on the ISA can occur. Therefore, the inventory within the FFCs and TMBCs are not included in the inventory of the ISA within this summary. The FFC inventory is estimated since the FFCs will be loaded as found fuel is retrieved. The inventories for EBR-II casks and TMBCs are based on existing storage data at the low-level burial grounds. [HNF-40627, Rev 2, pg. 3-21].

[22] HNF-3553-ANXA, Rev 9, pg. 3-35; HNF-40627, Rev 2, pg. 3-5

EU Designation: CP-OP-5

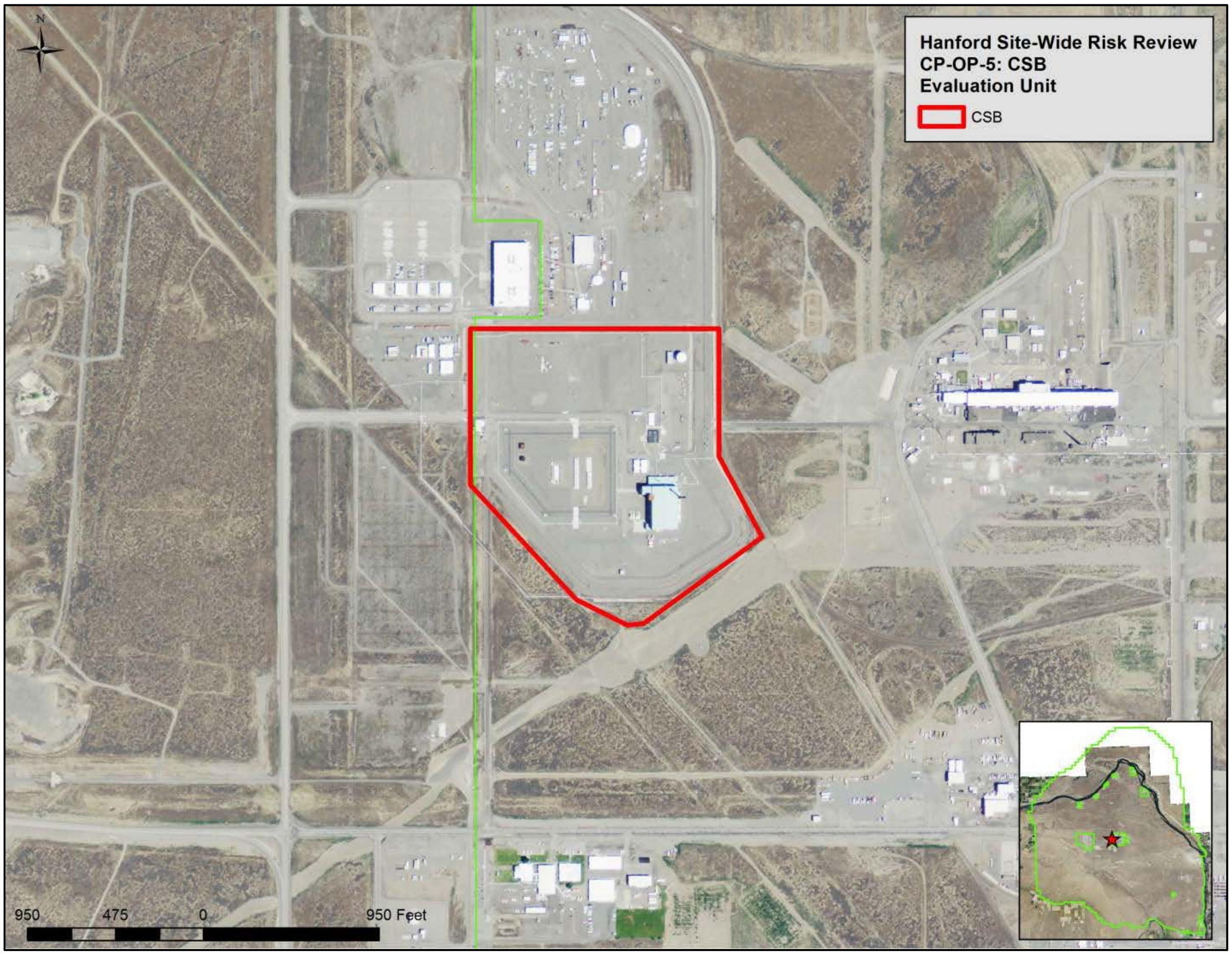

Figure H.7-1. CP-OP-05 (CSB) Site Location Map

Figure H.7-2. CSB Facility Arial Photo [23]

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[23] http://www.hanford.gov/page.cfm/CSB#CSB

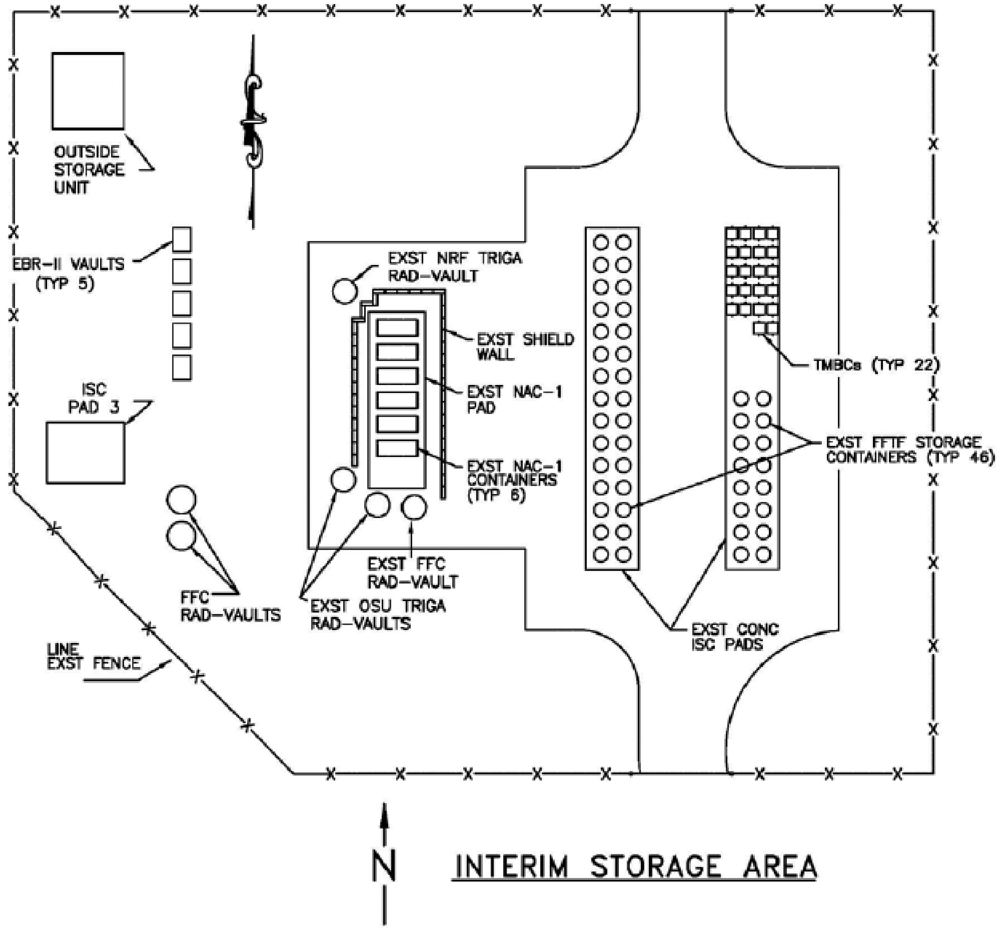

Figure H.7-3. 200 Area Interim Storage Area (ISA) Site Layout[24]

PART IV. UNIT DESCRIPTION AND HISTORY

EU FORMER/CURRENT USE(S)

CSB was constructed in 1995[25] and the CSB facilities complex (including ISA) began operations in 2000[26]. Consistent with the current mission and operations of CSB, the initial activities performed were receiving and storing multi-canister overpacks (MCOs) from K Basins[25]. There was a brief period in the early 2000s during which slightly irradiated fuel from the Fast Flux Test Facility (FFTF) was packaged into FFTC fuel storage canisters (FSFC)[27] and transferred to the Interim Storage Area (ISA) where the fuel is safely stored currently.[28]

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[24] HNF-40627, Rev 2, Figure 2-1, pg. 2-113

[25] Fluor Hanford. (2016). "Fluor Nuclear Experience." Accessed February 8, 2016, from http://www.fluor.com/client-markets/power/nuclear/pages/history-text-only.aspx.

[26] Birk, S. and B. Carlsen (2010). Storage of DOE SNF at Hanford, Idaho National Laboratory (INL). (URL: http://nsnfp.inel.gov/program/strategymtg/Fact%20sheets/SNF%20storage%20Hanford_final.pdf): 2 pages.

[27] HNF-SD-SNF-HIE-001, Rev 3b, pg. 1

[28] HNF-40627, Rev 2, pg. iii

OPERATING FACILITIES

1. Processes that produced the radioactive material and waste contained in the facility

CSB & ISA: No processes within CSB produced the waste that is being stored within CSB and the ISA. The radioactive material contained in the CSB and at the ISA originated from reactors onsite and offsite the Hanford reservation.

CSB: CSB stores, monitors, tests, welds, and packages scrap/fuel multi-canister overpacks (MCOs) containing K Basin fuel assemblies, scrap pieces or knock-out pot (KOP) material, and Shippingport spent fuel canister (SSFC) MCOs containing Shippingport Pressurized Water Reactor (PWR) Core 2 blanket fuel assemblies. CSB is also authorized for future receipt, handling, welding, and temporarily storing single-pass reactor (SPR)/N-Reactor type fuels in "found fuel containers (FFCs)", and ceramic oxide fuel specimens from General Electric (GE) Vallecitos Nuclear Center in transuranic multiple burial containers (TMBCs). A typical MCO at CSB contains five or six baskets of dried spent nuclear fuel (SNF) that are stacked one on top of the other, and may contain up to two scrap baskets. A few MCOs received at the CSB contain up to three baskets fitted with inserts (MCO basket inserts) loaded with K-Basin's KOP product material. An SSFC contains four Shippingport PWR Core 2 blanket fuel assemblies. An FFC contains SPR/N-Reactor fuel and a TMBC stores ceramic oxide fuel from the GE Vallecitos Nuclear Facility.[30]

ISA: The 200 Area Interim Storage Area (ISA) is a separate facility located inside the CSB yard area[29] and is missioned with safely storing eight (8) different authorized dry storage systems: Fast Flux Test Facility (FFTF) fuel, Neutron Radiography Facility (NRF) TRIGA Fuel, Oregon State University (OSU) TRIGA Fuel, Commercial Light-Water Reactor (LWR) Fuel, Single-Pass Reactor (SPR)/N Reactor-Type Fuels, Experimental Fuels in Experimental Breeder Reactor-II (EBR-II) Casks, General Electric Vallecitos fuel, and Los Alamos Molten Plutonium Reactor Experiment (LAMPRE) fuel.

2. Primary radioactive and non-radioactive constituents that are considered risk drivers

CSB: The categorization estimated the amount of radiological material at risk for the hazard categorization in accordance with DOE-STD-1027-92, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports* and 10 CFR 830. Consistent with DOE-STD-1027-92, the final categorization was based on the unmitigated release of available radiological inventories. These CSB material quantities were compared against the threshold quantities contained in DOE-STD-1027-92. [30]

The bounding source term considered for the accident analyses is based on data for the fuel in the K East and K West Basins[31]. The fuel type that results in the highest estimated dose to people exposed to the material, was selected as the bounding inventory for radiological dose calculations. Nuclear

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29 HNF-40627, Rev 2, pg. 2-12

[30] HNF-3553-ANXA, Rev 9, pg. iv through pg. vi

[31] Given in HNF-SD-SNF-SARR-005. HNF-SD-SNF-TI-015, K Basin Closure Project Technical Databook KOP Material (OCRWM), Volume 3, defines the radionuclide content for MCOs containing KOP product material. HNF-SD-SNF-TI-009, 105-K Basin Material Design Basis Feed Description for Spent Nuclear Fuel Project Facilities, Volume 2, Sludge, defines an inventory for safety analysis by considering inventories of Mark IV, Mark IA, and single-pass reactor (SPR) fuel in the K Basins. High-burnup Mark IV fuel [HNF-3553-ANXA, Rev 9, pg. 3-48 through 3-49]

accountability records give the basis for the quantity, exposure variation, and decay time variation of the stored fuel. The radionuclide inventory was estimated from these data. [32]

The MCO contains finely divided particulate material associated with oxidation of the fuel. This material includes an oxide layer on the fuel and particulate remaining on fuel surfaces and in crevices after fuel washing and racking into the MCO as well as expected increases in oxidation products that occur during queuing at the K Basins and processing at the Cold Vacuum Drying Facility (CVDF). The particulate inventory of the MCO dominates the airborne release. [32]

The quantity of particulate released following an MCO breach from the accident scenarios analyzed within the CSB DSA depends on the amount of particulate mass generated in the MCO during processing. This quantity is a function of processing times and temperatures as well as of the condition of the fuel in the MCO (e.g., exposed surface area of fuel). SNF-3328 provides two estimates of this quantity: one for the safety basis, which is considered the bounding value, and the other for the design basis, which is considered the nominal value. When the fuel/scrap MCO is received at CSB, the safety basis value is 28.3 kg uranium and the design value is 0.54 kg uranium. After 40 years of storage at CSB, the safety basis, or bounding, value is 35.2 kg uranium. PRC-STP-CN-N-00456, *Uranium Oxide Generation in Multi-Canister Overpacks Containing Knockout Pot Product Material (OCRWM),* estimates the KOP MCO to have 28.3 kg UO2, which contains 24.9 kg U (safety basis values) after 40 years storage at CSB. Therefore, the fuel/scrap MCO is considered the bounding case for MAR assumed in dose consequence calculations.[33]

Because any environmental release of SNF could have toxicological as well as radiological effects, both are computed for comparison with risk evaluation guidelines. From this comparison, the predominant risk of the spent fuel particles can be determined, and controls can be identified that prevent or mitigate both risks, thus simplifying the analysis and presentation. A detailed comparison of the toxicological and radiological hazards presented by the spent fuel particles has been performed and is documented in HNF-SD-SNF-TI-059, *A Discussion on the Methodology for Calculating Radiological and Toxicological Consequences for the Spent Nuclear Fuel Project at the Hanford Site*. The basic assumptions used to show that the radiological risk guidelines are more limiting are presented within the CSB DSA. [32]

The primary material released under accident conditions is SNF particulate matter, which is mostly oxides of uranium. Because SNF contains no corrosive chemicals, a conservative exposure averaging time of 15 minutes was used in the calculation of average air concentration from a radiological and chemical exposure analysis. [32,34]

Since the FFC and TMBC hazard evaluation documented in HNF-SD-SNF-HIE-001 identified that all unmitigated radiological dose consequences were “low” for the FFC and TMBC activities, no formal accident analysis was performed. Therefore, no accident selection was performed for FFC or TMBC activities, and no beyond design basis accident scenarios were developed. The control selection for FFC and TMBC activities at the CSB was based on the hazard evaluation rather than development of an unmitigated accident analysis for DBAs, consistent with specific direction in HNF-8739, *Hanford Safety*

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[32] HNF-3553-ANXA, Rev 9, pg. 3-48 through 3-49

[33] HNF-3553-ANXA, Rev 9, pg. 3-69

[34] The safety basis composition of SNF from HNF-SD-SNF-TI-015, *Spent Nuclear Fuel Project Technical Databook, Volume 2, Sludge*, was used in the comparison. It is assumed that the bounding case accidents do not introduce toxic chemicals in addition to the particulate or change the relative toxicological versus radiological hazard of the particulate inventory used in the comparison (i.e., the particulate is assumed to be a single material with both radiological and toxicological effects). Note that chemical forms were assumed that would be most limiting. For added conservatism, the radiological dose factors were the largest allowed, and the air concentration limits were the smallest allowed.

Analysis and Risk Assessment Handbook (SARAH). No safety-structures, systems, and components (SSCs) were credited for prevention or mitigation of identified FFC or TMBC hazardous conditions.[35]

ISA: Because the hazard evaluation documented in HNF-32883 identified that all radiological dose consequences were "low" for the all 200 Area ISA storage system hazardous conditions, no formal accident analysis was performed. Therefore, no accident selection was performed for 200 Area ISA activities, and no BDBA scenarios were developed. Section 3.4 within the ISA DSA [HNF-40627, Rev 2] does not contain any accident analysis, and there is no discussion of controls established based on accident analysis. No safety SSCs were credited for prevention or mitigation of identified 200 Area ISA hazardous conditions.[36] The main inventory of hazardous material in the ISA is the radionuclide content of the stored fuel. The toxicological hazards of the radionuclide inventory were considered and determined to be controlled by the same controls to prevent and mitigate a radiological release. Other hazardous material identified by the hazard identification process includes pyrophoric metals and hydrides, sodium, oxidizers, hydrogen, diesel fuel, and other flammable or combustible materials.[37]

3. Containers or storage measures are used for radioactive materials at the facility

CSB: Interim storage of welded and monitored scrap/fuel multi-canister overpacks (MCOs) containing K Basin fuel assemblies, scrap pieces or knock-out pot (KOP) material, and Shippingport spent fuel canister (SSFC) MCOs containing Shippingport Pressurized Water Reactor (PWR) Core 2 blanket fuel assemblies. CSB is also authorized to receive, handle, weld, and temporarily store single-pass reactor (SPR)/N-Reactor type fuels in found fuel containers (FFCs), and ceramic oxide fuel specimens from General Electric (GE) Vallecitos Nuclear Center in transuranic multiple burial containers (TMBCs). A typical MCO at CSB contains five or six baskets of dried spent nuclear fuel (SNF) that are stacked one on top of the other, and may contain up to two scrap baskets. A few MCOs received at the CSB contain up to three baskets fitted with inserts (MCO basket inserts) loaded with K-Basin's KOP product material. An SSFC contains four Shippingport PWR Core 2 blanket fuel assemblies. An FFC contains SPR/N-Reactor fuel and a TMBC stores ceramic oxide fuel from the GE Vallecitos Nuclear Facility.[30]

ISA: See Part VI: response to Question 4 and Table H.7-13 through Table H.7-19.[38] The different dry storage systems used at the 200 Area ISA are as follows: [39]

- Interim storage cask (ISC) used for the FFTF SNF
- NRF TRIGA casks and DOT-6M16 containers within a Rad-Vault17 storage vault used for NRF TRIGA SNF
- OSU TRIGA overpack containers within Rad-Vaults used for OSU TRIGA SNF
- NAC-1 casks18 within International Organization for Standardization (ISO) containers used for commercial LWR SNF from the 300 Area
- FFCs containing SPR/N Reactor-type fuels within one or two Rad-Vault(s)
- EBR-II casks containing oxide and experimental fuels, including EBR-II, FFTF, and commercial LWR fuel specimens, within five concrete vaults
- TMBCs containing ceramic oxide fuel specimens from General Electric (GE) Vallecitos Nuclear Center
- EBR-II casks containing metal LAMPRE fuel within a concrete Outside Storage Unit.

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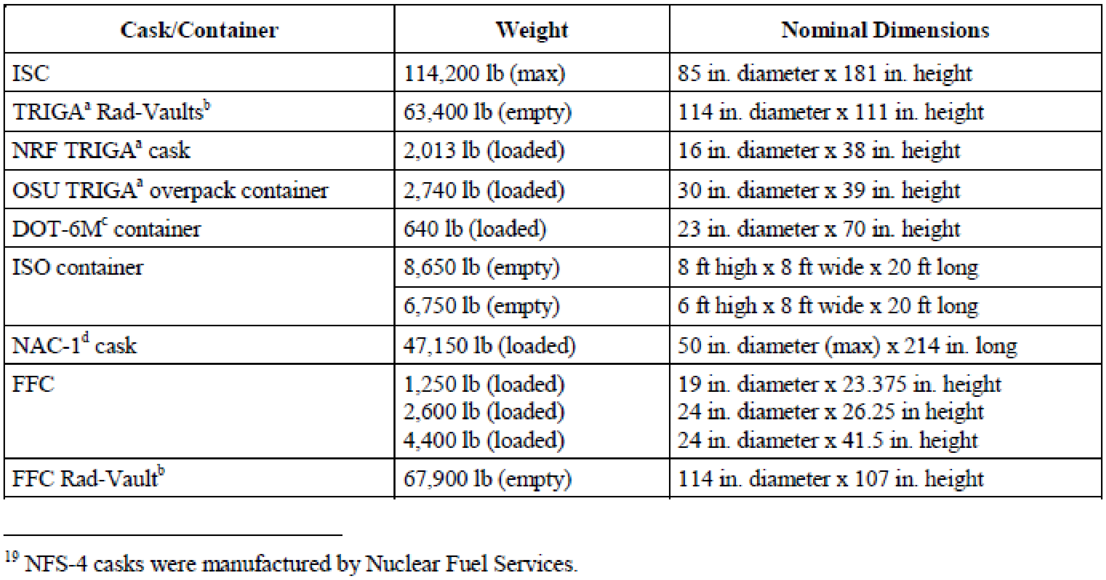
[35] HNF-3553-ANXA, Rev 9, pg. viii and pg. 3-35
[36] HNF-40627, Rev 2, pg. 3-26
[37] HNF-40627, Rev 2, pg. 3-13
[38] HNF-40627, Rev 2, Table 3-10, pgs. 3-27 through pg. 3-33
[39] HNF-40627, Rev 2, pg. 2-11 and pg. 2-12

Table H.7-2. 200 Area Interim Storage Facility (ISA) Cask/Container Summary[40]



Cask/Container	Weight	Nominal Dimensions
ISC	114,200 lb (max)	85 in. diameter x 181 in. height
TRIGA[a] Rad-Vaults[b]	63,400 lb (empty)	114 in. diameter x 111 in. height
NRF TRIGA[a] cask	2,013 lb (loaded)	16 in. diameter x 38 in. height
OSU TRIGA[a] overpack container	2,740 lb (loaded)	30 in. diameter x 39 in. height
DOT-6M[c] container	640 lb (loaded)	23 in. diameter x 70 in. height
ISO container	8,650 lb (empty)	8 ft high x 8 ft wide x 20 ft long
	6,750 lb (empty)	6 ft high x 8 ft wide x 20 ft long
NAC-1[d] cask	47,150 lb (loaded)	50 in. diameter (max) x 214 in. long
FFC	1,250 lb (loaded) 2,600 lb (loaded) 4,400 lb (loaded)	19 in. diameter x 23.375 in. height 24 in. diameter x 26.25 in height 24 in. diameter x 41.5 in. height
FFC Rad-Vault[b]	67,900 lb (empty)	114 in. diameter x 107 in. height

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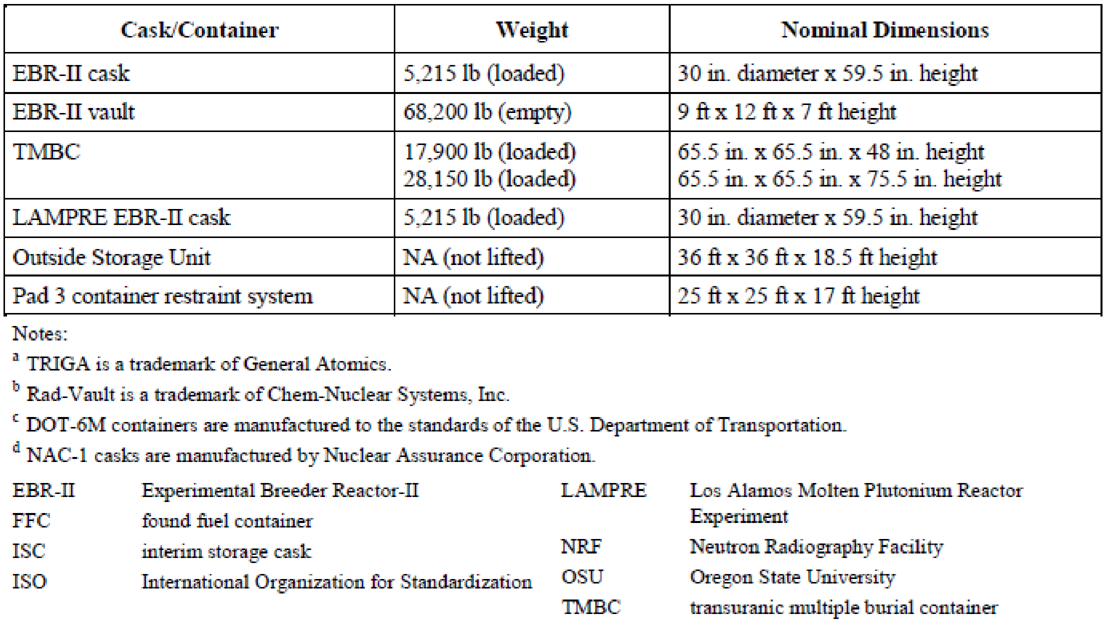
[19] NFS-4 casks were manufactured by Nuclear Fuel Services.

Table H.7-3. 200 Area Interim Storage Facility (ISA) Cask/Container Summary (cont.) [40]



Cask/Container	Weight	Nominal Dimensions
EBR-II cask	5,215 lb (loaded)	30 in. diameter x 59.5 in. height
EBR-II vault	68,200 lb (empty)	9 ft x 12 ft x 7 ft height
TMBC	17,900 lb (loaded) 28,150 lb (loaded)	65.5 in. x 65.5 in. x 48 in. height 65.5 in. x 65.5 in. x 75.5 in. height
LAMPRE EBR-II cask	5,215 lb (loaded)	30 in. diameter x 59.5 in. height
Outside Storage Unit	NA (not lifted)	36 ft x 36 ft x 18.5 ft height
Pad 3 container restraint system	NA (not lifted)	25 ft x 25 ft x 17 ft height

Notes:

[a] TRIGA is a trademark of General Atomics.

[b] Rad-Vault is a trademark of Chem-Nuclear Systems, Inc.

[c] DOT-6M containers are manufactured to the standards of the U.S. Department of Transportation.

[d] NAC-1 casks are manufactured by Nuclear Assurance Corporation.

EBR-II	Experimental Breeder Reactor-II	LAMPRE	Los Alamos Molten Plutonium Reactor Experiment
FFC	found fuel container		
ISC	interim storage cask	NRF	Neutron Radiography Facility
ISO	International Organization for Standardization	OSU	Oregon State University
		TMBC	transuranic multiple burial container

4. Classification of radioactive material and waste contained or stored within the facility

CSB and ISA: Used nuclear fuel (UNF)[41]

5. Average and maximum occupational radiation doses incurred at the facility

CSB: Shielding calculations have assumed that each MCO contains the maximum activity value associated with Mark IV fuel listed in HNF-S-0425. The shielding calculations indicate that the dose

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40 HNF-40627, Rev 2, Table 2-1 pgs. 2-13 and pg. 2-14

41 Often times the term spent nuclear fuel (SNF) is utilized

rate at the intake stack base will be less than the design requirements (0.05 mrem/h [5.0E-04 mSv/h]) (CSB-SH-1002, *Phase I Bulk Shielding Calculations for CSB*), of which less than 10 percent is attributed to neutron scatter with SNF as the source term. Heating of the concrete by the radiation field inside the vault has been calculated (7.0E-08 W/m^2). The value is insignificant compared with convection heat transfer according to CSB-HV-0001, *SNF Canister Storage Building Thermal Analysis*. Neutron and gamma effects from the spontaneous fission of californium were not included in the shielding calculations or concrete heating calculations because their contribution is negligible.[42]

ISA: The radiological dose limits are according to the ALARA Program (CHPRC-00073):[43]

0.5 mR/hour at the fence

60 mR/hour on contact

Table H.7-4. Thermoluminescent Dosimeter Results for year 2013 and 2014[44]

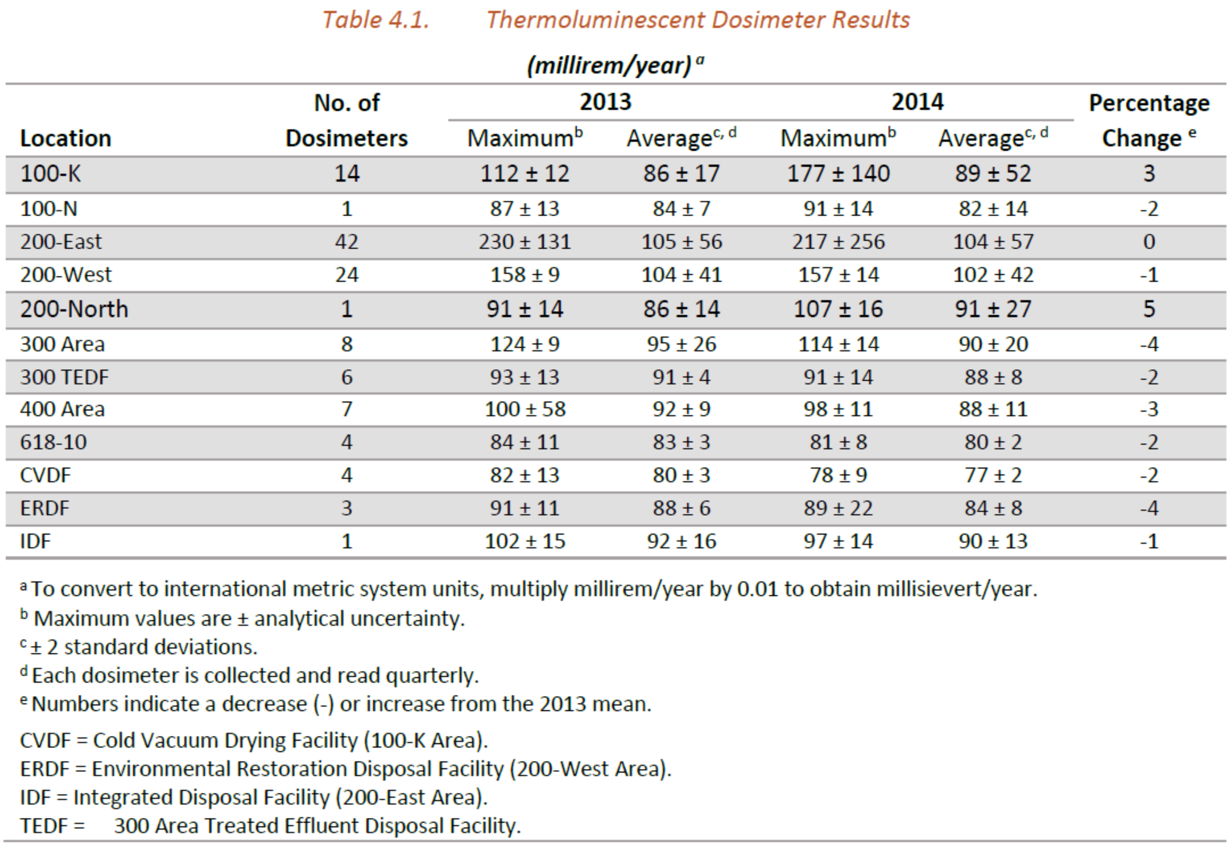

Table 4.1. Thermoluminescent Dosimeter Results

(millirem/year) [a]

Location	No. of Dosimeters	2013		2014		Percentage Change [e]
		Maximum[b]	Average[c, d]	Maximum[b]	Average[c, d]	
100-K	14	112 ± 12	86 ± 17	177 ± 140	89 ± 52	3
100-N	1	87 ± 13	84 ± 7	91 ± 14	82 ± 14	-2
200-East	42	230 ± 131	105 ± 56	217 ± 256	104 ± 57	0
200-West	24	158 ± 9	104 ± 41	157 ± 14	102 ± 42	-1
200-North	1	91 ± 14	86 ± 14	107 ± 16	91 ± 27	5
300 Area	8	124 ± 9	95 ± 26	114 ± 14	90 ± 20	-4
300 TEDF	6	93 ± 13	91 ± 4	91 ± 14	88 ± 8	-2
400 Area	7	100 ± 58	92 ± 9	98 ± 11	88 ± 11	-3
618-10	4	84 ± 11	83 ± 3	81 ± 8	80 ± 2	-2
CVDF	4	82 ± 13	80 ± 3	78 ± 9	77 ± 2	-2
ERDF	3	91 ± 11	88 ± 6	89 ± 22	84 ± 8	-4
IDF	1	102 ± 15	92 ± 16	97 ± 14	90 ± 13	-1

[a] To convert to international metric system units, multiply millirem/year by 0.01 to obtain millisievert/year.
[b] Maximum values are ± analytical uncertainty.
[c] ± 2 standard deviations.
[d] Each dosimeter is collected and read quarterly.
[e] Numbers indicate a decrease (-) or increase from the 2013 mean.

CVDF = Cold Vacuum Drying Facility (100-K Area).
ERDF = Environmental Restoration Disposal Facility (200-West Area).
IDF = Integrated Disposal Facility (200-East Area).
TEDF = 300 Area Treated Effluent Disposal Facility.

6. Processes and operations conducted within the facility

CSB: CSB operations and support structures and equipment are required for the receipt, handling, and interim storage of welded and monitored scrap/fuel multi-canister overpacks (MCOs) containing K Basin

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[42] HNF-3553-ANXA, Rev 9, pg. iv through pg. 2-31 and pg. 2-33

[43] HNF-40627, Rev 2, Table 2-2, pg. 2-27

[44] Department of Energy (DOE) (2015). Hanford Site Environmental Report for Calendar Year 2014. **DOE-RL-2014-52, Revision 0 (URL: https://msa.hanford.gov/files.cfm/DOE-RL-2014-52.pdf):** 409 pages.

fuel assemblies, scrap pieces or knock-out pot (KOP) material, and Shippingport spent fuel canister (SSFC) MCOs containing Shippingport Pressurized Water Reactor (PWR) Core 2 blanket fuel assemblies. CSB is also authorized to receive, handle, weld, and temporarily store single-pass reactor (SPR)/N-Reactor type fuels in found fuel containers (FFCs), and ceramic oxide fuel specimens from General Electric (GE) Vallecitos Nuclear Center in transuranic multiple burial containers (TMBCs). The CSB Facility provides for sampling, welding, monitoring, and interim storage of MCOs; interim storage of SSFCs; and receiving, handling, welding, and temporary storage of FFCs and TMBCs.

CSB main operations considered (within the DSA) were those involved with bringing the transportation cask containing the spent fuel container into the facility, moving the cask to the proper location, removing the spent fuel canister from the cask, transporting the spent fuel container for storage, welding or sampling, and performing sampling and/or welding activities.

The CSB MCO handling machine (MHM) is used to transport an MCO or SSFC across the operating deck to the CSB sampling/weld area or down into a storage tube in Vault 1. The receiving crane places the FFC into a temporary storage/shielding overpack fixture and the FFC is temporarily stored in a single tier array on the operating deck. Either the receiving crane or a forklift is used to remove the TMBC from the transport vehicle and the TMBC is stored in a single tier array in the receiving area. The sampling/weld area, located on the south end of the operating area, will contain equipment for pressure-checking and sampling the MCOs and welding equipment for installing cover caps.

CSB’s Vault 1 contains 220 standard storage tubes and 6 overpack storage tubes. Vault 1 is cooled by natural convection through an above-grade inlet structure and exhaust stack, and through below-grade concrete intake and exhaust plenums. The CSB subsurface structure provides shielding for the intake and exhaust plenums. The 3-ft-thick interior walls of the subsurface structure provide shielding from the source term associated with SNF storage. Each standard storage tube is capable of staging or storing two MCOs or SSFCs. Each overpack storage tube is available to accommodate an abnormal or suspect MCO or SSFC, as described in an associated recovery plan. The Vault 1 storage tubes are supported from the foundation base slab of the vault and are accessed through penetrations in the operating deck. These embedments or storage tubes are normally closed with removable tube plugs. The standard tube plugs provide radiation shielding, a filtered vent, and connections for sampling the storage tube atmosphere. The overpack storage tube plugs have connections for sampling, purging, and pressure-relief of the storage tube atmosphere; pressure gauges for surveillance of the tube pressure; and lock-down devices. Each standard storage tube contains both a bottom impact absorber and an intermediate impact absorber to mitigate the impact of dropped MCOs or SSFCs. Each overpack storage tube is fitted with a bottom impact absorber. [45]

ISA: The 200 Area ISA at the Hanford Site provides for the interim storage of reactor SNF housed in aboveground dry storage systems. Interim storage at the 200 Area ISA is intended for a period of up to 40 years until the materials are shipped offsite to a disposal facility. The ISA is not authorized to move material out of the facility boundaries. [46]

7. Process flow of material into and out of the facility

CSB: Inflows of materials to CSB involve bringing the transportation cask containing the spent fuel container into the facility, moving the cask to the proper location, removing the spent fuel canister from the cask, transporting the spent fuel container for storage, welding or sampling, and performing

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[45] HNF-3553-ANXA, Rev 9, pg. iv through pg. vi

[46] HNF-40627, Rev 2, pg. iii

sampling and/or welding activities[30]. Outflow of material from the CSB is directly sent to the ISA that sits 0.1 mile west of the CSB. CSB is not authorized to transport MCOs out of CSB

In the future, TMBCs will be received from the low-level burial grounds (LLBGs) and these canisters will be temporarily stored on the CSB operating deck so they can be welded prior to transfer for interim storage at ISA.[47] Both FFCs and TMBCs will be transported to ISA for storage after being welded at CSB [48].

ISA: The ISA received materials from the CSB and will safely store material for up to 40 years until the materials are shipped offsite to a disposal facility – this will include authorized near-term movement of FFCs and TMBCs from the CSB to ISA, as described above. Currently, no material is authorized to be removed from the ISA site boundaries and the relevant DSA does not address material transfer out of the ISA site. An aboveground dry container storage location is necessary for the spent fuel because other storage facilities are being shut down and deactivated. The spent fuel is being transferred to interim storage because no permanent repository storage is currently available.[49]

8. Potential effects of potential delays on the processes, operations, and radioactive materials in the facility

CSB & ISA: Inability to receive FFCs and TMBCs would delay operations at the originating operations for the FFCs (various reactors undergoing D&D if fuel still remains) and the low-level burial grounds (LLBGs) for the TMBCs.

9. Other facilities or processes that are involved in the flow of radioactive material into and out of the facility

CSB: K-Basin (inflow of scrap/fuel MCOs), LLBG (inflow of TMBCs), Single-pass reactors (inflow of FFCs), ISA (potential outflow of LLBG and FFCs in the future)

ISA: Fast Flux Test Facility (FFTF), Neutron Radiography Facility (NRF), Oregon State University (OSU), Commercial light-water reactor within the 300 Area, Single-pass reactor (SPR)/N Reactor-type reactors, Experimental Breeder Reactor-II (EBR-II), General Electric Vallecitos Facility, Los Alamos Molten Plutonium Reactor Experiment (LAMPRE)

10. Shipping of material

CSB: Intra-area transport of the loaded, welded FFCs to the 200 Area ISA will be by forklift on the existing roadway within the CSB complex. Intra-area transport of the loaded, welded TMBCs to the 200 Area ISA will be by transport truck without overpack on the existing roadway within the CSB complex.[50] The FFCs will be transported to CSB in either a PAS-1 cask or within an MCO transportation cask on a transport trailer. The PAS-1 cask will contain a single FFC, while an MCO transportation cask may contain up to four FFCs. FFCs will be generated on the Hanford Site during ongoing cleanup efforts, and there may be a total of about 20 FFCs generated and shipped to CSB over about a 10 year period. There are a total of 22 TMBCs currently stored at the LLBG, which will be shipped to CSB and welded, most likely as a single campaign[51]

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[47] HNF-3553-ANXA, Rev 9, pg. 2-15

[48] HNF-3553-ANXA, Rev 9, pg. 3-35

[49] HNF-40627, Rev 2, pg. iii and pg. iv

50 HNF-3553-ANXA, Rev 9, pg. 2-12

51 HNF-3553-ANXA, Rev 9, pg. 2-56 , Section 2.5.1.

ISA: It is not presently authorized to transport material out of the ISA. Moving containers at the ISA is performed by crane lift from the transport trailer and placed in the storage array on the assigned concrete pad.[52]

11. Infrastructure considered a part of the facility

CSB: The CSB Facility is a steel-framed building that encloses the operating area; the load-in/load-out area; and three equally sized, below-grade concrete vaults. The concrete vaults are covered by a concrete operating deck. Support functions and equipment are housed in a steel-framed support area building adjacent to the north side of the operating area building. Only the northernmost vault (Vault 1) in the operating area is equipped with steel tubes for storage of the MCOs and SSFCs. Operations in Vaults 2 and 3 are outside the scope of the final safety analysis report (FSAR) [HNF-3553-ANXA, Rev 9]. The CSB operating deck is a 5-ft-thick, at-grade, reinforced concrete structure. The operating area deck floor is bounded to the north by the load-in/load-out area (trailer vestibule and MCO service station) and support area building foundations, and to the south by the sampling/weld area foundation. The operating deck structure contains numerous full-thickness, embedded steel sleeves that receive the storage tubes and tube plugs for standard storage tubes and overpack storage tubes in Vault 1. The embeds also provide a location for securing the tube plug cover plates in Vault 1 and the deck embed cover plates in Vaults 2 and 3. These embeds are offset and arranged at a center-to-center distance of 4 ft 8 in. east–west and 4 ft 6 in. north–south. The distance between storage tubes has been evaluated for prevention of inadvertent criticality and has been found to be adequate for both MCOs and SSFCs. [53].

ISA: The ISA is a relatively simple facility consisting of boundary security fences with gates, perimeter lighting, and concrete and gravel pads on which the dry storage containers are placed. The 200 Area ISA is a radiological material and radiation area, and is a protected area (PA) for physical security purposes. A double fence supports safeguards and security and establishes an isolation zone with a perimeter intrusion detection and assessment system (PIDAS) between the two fences. Vehicle barriers are also installed around the 200 Area ISA and the Canister Storage Building (CSB) perimeter. The 200 Area ISA is nominally 240,000 square-feet and is located just west of the CSB. Interim storage at the 200 Area ISA is intended for a period of up to 40 years until the materials are shipped offsite to a disposal facility. The ISA DSA does not address removal from storage or shipment from the 200 Area ISA.[54]

The structural descriptions for the 200 Area ISA of the various storage pads are below:[55]

Interim Storage Area Yard: The 200 Area ISA is nominally 600 ft by 400 ft and is surrounded by two chain-link fences, with gates in the fences that control access of vehicles and personnel. Within the fenced area are four concrete pads, three for placement of ISCs and one for placement of the NAC-1 casks within ISO containers. Except for ISC Pad 3, the concrete pads have embedded conduit that is intended to support any future monitoring needs. The Rad-Vault holding NRF TRIGA casks and DOT-6M containers is placed on graded, compacted gravel. The two Rad-Vaults holding OSU TRIGA overpack containers are placed on graded, compacted gravel. The FFC Rad-Vault(s) is placed on graded compacted gravel. The Outside Storage Unit is constructed in the northwest corner of the 200 Area ISA with a concrete and steel foundation.

Fast Flux Test Facility Interim Storage Cask Pad: The ISC storage pads comprise two pads approximately 171 ft by 26 ft by 1.5 ft thick and one smaller pad (Pad 3) approximately 25 ft by 25 ft by 2 ft thick, in the southwest corner of the ISA. These pads are reinforced with upper and lower rebar mats. These two ISC

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[52] HNF-40627, Rev 2, pg. 2-85
[53] HNF-3553-ANXA, Rev 9, pg. iv
[54] HNF-40627, Rev 2, pg. iv
[55] HNF-40627, Rev 2, pg. 3-23 through pg. 2-26

concrete pads are separated by approximately 43 ft for industrial safety considerations. The western-most edge of the inner ISC concrete pad and the eastern inner edge of the NAC-1/ISO concrete pad are separated by approximately 80 ft.

Pad 3 is used to store four ISCs. It is a reinforced concrete slab with a multitude of vertical columns around and between the four ISCs, with horizontal cross-members between columns. The structure is covered by structural steel grating and plates. The structure is seismically qualified for the design basis earthquake. Each ISC was placed in a storage position, and a new robust weather cover was placed on the top of each ISC. The top covers are secured by bolts in the lifting lug positions, and the bolt heads are welded to the cask covers.

Each of the two long ISC pads is intended to support storage of 30 ISC containers. The storage locations are two-abreast. Each position has a nominal circular contact footprint 7 ft in diameter. There are 11 ft between the center lines of adjacent containers. There is nominally 4 ft between the edges of adjacent storage positions, and 4 ft between each outer edge and the edge of the ISC concrete pad. The smaller Pad 3 stores four ISCs with nominally 2-ft edge-to-edge spacing. The ISC spacing is consistent with thermal analysis performed in SNF-4790, *200 Area Interim Storage Area Design Basis Accident Analysis Documentation for FFTF Fuel*.

Compacted Gravel Areas: The NRF and OSU Rad-Vaults, FFC Rad-Vaults, and EBR-II vaults are not placed on a concrete pad; instead, the storage vaults are placed on graded and compacted gravel areas within the 200 Area ISA. The gravel is compacted to a soil-bearing capacity greater than 2,500 lb/ft2.

Commercial Light-Water Reactor ISO Container Pad: The NAC-1/ISO container storage pad is approximately 88 ft by 28 ft by 1 ft thick. The NAC-1/ISO container pad is designed to support storage of seven containers. The storage locations are sequential, with 4 ft of space between adjacent storage ISO container edges and 4 ft to the edge of the concrete pad. Each position has a nominal footprint of 8 ft x 20 ft. A shield wall (see Figure 2-1) has been added along the north, east, and west sides of the NAC-1/ISO container pad. The wall is constructed primarily of 2-ft by 2-ft by 6-ft concrete blocks stacked three rows high. The wall is placed an adequate distance from the pad such that if the wall toppled, it would not impact the NAC-1 casks. The arrangement of the blocks also minimizes the potential to topple toward the Rad-Vaults used for TRIGA fuel storage. The wall is not seismically qualified and was placed on the existing gravel of the ISA. Although the neutron field around the NAC-1 casks was not excessive, the wall was added for as low as reasonably achievable (ALARA) purposes.

Outside Storage Unit: There is one Outside Storage Unit installed in the northwest corner of the 200 Area ISA. The Outside Storage Unit is a robust concrete monolith with internal steel reinforcement, approximately 36 ft square, with a truncated pyramid shape approximately 15 ft high. It is configured to provide storage of three unmodified EBR-II casks, each in a separate compartment, with a minimum 12-in. concrete thickness between compartments. The design precludes water ingress into the storage compartments. Once the LAMPRE EBR-II casks are loaded into the Outside Storage Unit, the robust lid/cover block is fabricated by placement of forms and components and pouring of concrete in place to create the lid. The Outside Storage Unit lid/cover block is not lifted as part of the LAMPRE EBR-II cask receipt and handling activity. The lid is not removed for surveillance activities. The lid will only be removed at the end of the interim storage period when the material is ready to be retrieved and shipped to a spent fuel repository.

LEGACY SOURCE SITES

Not Applicable

GROUNDWATER PLUMES

Not applicable

D&D OF INACTIVE FACILITIES

Not Applicable

ECOLOGICAL RESOURCES SETTING

Landscape Evaluation and Resource Classification

The CSB EU contains primarily level 0 habitat (96% of the EU) comprising several buildings surrounded by bare ground (Appendix J, Figure J.107, and Table J.93). On the south side of the EU, outside the facility fence but included within the EU, lies 1.7 acres (~4%) containing small patches of level 2 resources.

The amount and proximity of biological resources surrounding the CSB EU were examined within the adjacent landscape buffer area, which extends 1939 ft (591 m) from the geometric center of the EU. Approximately 73% of the combined EU and buffer area is classified as level 2 or lower with fragmented resources primarily to the north and east. Nearly 27% of the combined area is classified as level 3 and level 4 habitat (Appendix J, Table J.93). There is no level 5 habitat within the combined EU and buffer area.

Field Survey

Access into the CSB EU is restricted, requiring ecologists to observe vegetation from the EU perimeter. Over 95% of the EU is covered by a complex of buildings surrounded by bare ground. Nearly 5% of the area encompassed within the CSB EU is dominated by gray rabbitbrush (*Ericameria canescens*) and an understory dominated by exotic annuals—cheatgrass (*Bromus tectorum*), and Russian thistle (*Salsola tragus*) (Appendix J, Table J.92

Birds and animals were not readily observable from outside the EU and none were recorded during the June survey. Historical surveys done by PNNL biologists noted the presence of black-tailed jackrabbits (*Lepus californicus*), a Washington state candidate species (personal communication).

CULTURAL RESOURCES SETTING

The entire CP-OP-5, CSB EU was inventoried for cultural resources under HCRC#87-200-004 (Chatters 1987). This review did not result in the identification of any cultural resources. It is unknown if an NHPA Section 106 review has been completed specifically for remediation of the CP-OP-5, CSB EU. No cultural resources have been documented within the CP-OP-5, CSB EU. It is unlikely that intact archaeological material is present in the EU, which has been extensively disturbed by building and utilities construction.

One archaeological resource associated with the Manhattan Project and Cold War Era Landscape, has been recorded within 500 meters of the CP-OP-5, CSB EU. This site has been determined a National Register-eligible property, and is considered a contributing property within the Manhattan Project and Cold War Era Historic District. In accordance with the *Hanford Site Manhattan Project and Cold War Era Historic District Treatment Plan* (DOE/RL-97-56) (DOE-RL 1998), all documentation requirements have been completed for this property. Direct impacts to contributing components of the archaeological site however have not been addressed and are dealt with on a project-by-project basis. Segments of the National Register-eligible Hanford Site Plant Railroad, a contributing property within the Manhattan

Project and Cold War Era Historic District with documentation required have also been recorded within 500 meters of the EU. Lastly, 12 National Register-eligible buildings that are contributing properties within the Manhattan Project and Cold War Era Historic District (all 12 are contributing within the Manhattan Project and Cold War Era Historic District, 3 with documentation required, and 9 with no additional documentation required). All National-Register-eligible Manhattan Project and Cold War Era buildings have been documented as described in the *Hanford Site Manhattan Project and Cold War Era Historic District Treatment Plan* (DOE/RL-97-56) (DOE-RL 1998).

Historic maps and aerial imagery indicate a low potential for archaeological resources associated with the Pre-Hanford Early Settlers/Farming Landscape to be present within the CP-OP-5, CSB EU. Geomorphology indicates a moderate potential for the presence of archaeological resources associated with the Native American Precontact and Ethnographic Landscape to be present within the EU. However, extensive ground disturbance within the EU suggests little to no potential for intact cultural resources at or below ground surface. Resources, if present, would likely be limited to areas of intact or undisturbed sediments.

Because of the potential for archaeological resources within the EU, it may be appropriate to conduct surface archaeological investigations prior to initiation of remediation activities. Indirect effects are always possible when TCPs are known to be located in the general vicinity. Consultation with Hanford Tribes (Confederated Bands of the Yakama Nation, Wanapum, Confederated Tribes of the Umatilla Indian Reservation, and the Nez Perce) and other groups associated with these landscapes (e.g. East Benton Historical Society, the Franklin County Historical Society and the Prosser Cemetery Association, the Reach, and the B-Reactor Museum Association) may be necessary to provide input on indirect effects to both recorded and potential unrecorded TCPs in the area and other cultural resource issues of concern.

PART V. WASTE AND CONTAMINATION INVENTORY

CONTAMINATION WITHIN PRIMARY EU SOURCE COMPONENTS

Vadose Zone Contamination

The reported inventories for CP-OP-5 (Table H.7-7 through Table H.7-9) are isolated from the environment because of the nature of the facilities comprising the EU. Thus there is no reported vadose zone inventory to be evaluated.

Groundwater Plumes and Columbia River

Not applicable

Operating Facilities

CSB: The inventory at CSB includes the 379 Scrap/Fuel MCOs and the 18 SSFC MCOs. Within each Scrap/Fuel MCO contains approximately 6 metric tons uranium (MTU) containing fission products, activation products, uranium, plutonium, and other minor actinides with a summed radioactivity estimated at 4.11E+04 Ci/MTU. [56] Shown in

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[56] HNF-3553-Anxa, Rev 9, Table 3-2, pg. 3-25

Table H.7-5 are the activities of individual radionuclides within one MTU of the Scrap/Fuel MCO stored material. The uranium and plutonium isotopes have been summed to represent U (total) and Pu (total) for both the Scrap/Fuel MCOs and the SSFC MCOs.

The SSFC MCO contains blanket fuel assemblies (BFA) from Shippingport PWR Core 2 operations that began in April 1965 to February 1974.[57] The SSFC MCO inventory information of plutonium and uranium content is provided and shown in

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[57] Clayton, J. C. (1993). The Shippingport Pressurized Water Reactor and Light Water Breeder Reactor. 25th Central Regional Meeting of the American Chemical Society. Westinghouse Electric Company and Bettis Atomic Power Laboratory. Pittsburgh, Pennsylvania, October 4-6, 1993. American Chemical Society. (URL: http://large.stanford.edu/courses/2009/ph204/coleman1/docs/10191380.pdf): 11 pages.

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Table H.7-5, below.

Table H.7-5. CSB Inventory[58,59]

Radionuclide	Fuel Activity [Ci/MTU]	CSB Inventory containing 379 Scrap/Fuel MCOs (6 MTU/MCO) [Ci]	Shippingport Core 2 Blanket Fuel Assembly Inventory within 18 SSFC MCOs [Ci]	Sum
Fission and Activation Products				
3H	2.61E+01	5.94E+04	--	5.94E+04
14C	5.53E-01	1.26E+03	--	1.26E+03
55Fe	5.41E-01	1.23E+03	--	1.23E+03
60Co	2.09E+00	4.75E+03	--	4.75E+03
59Ni	3.18E-02	7.23E+01	--	7.23E+01
63Ni	3.47E+00	7.89E+03	--	7.89E+03
79Se	6.54E-02	1.49E+02	--	1.49E+02
85Kr	3.70E+02	8.41E+05	--	8.41E+05
90Sr	6.93E+03	1.58E+07	--	1.58E+07
90Y	6.93E+03	1.58E+07	--	1.58E+07
93Zr	2.95E-01	6.71E+02	--	6.71E+02
93mNb	1.93E-01	4.39E+02	--	4.39E+02
99Tc	2.19E+00	4.98E+03	--	4.98E+03
106Ru	2.56E-02	5.82E+01	--	5.82E+01
106Rh	2.56E-02	5.82E+01	--	5.82E+01
107Pd	1.56E-02	3.55E+01	--	3.55E+01
110Ag	7.17E-10	1.63E-06	--	1.63E-06
110mAg	5.39E-08	1.23E-04	--	1.23E-04
113mCd	2.78E+00	6.32E+03	--	6.32E+03
113mIn	1.36E-19	3.09E-16	--	3.09E-16
113Sn	1.36E-19	3.09E-16	--	3.09E-16
119mSn	6.14E-08	1.40E-04	--	1.40E-04
121mSn	6.27E-02	1.43E+02	--	1.43E+02
123Sn	1.72E-16	3.91E-13	--	3.91E-13
126Sn	1.29E-01	2.93E+02	--	2.93E+02
125Sb	0	0.00E+00	--	0.00E+00
126Sb	1.81E-02	4.12E+01	--	4.12E+01
126mSb	1.29E-01	2.93E+02	--	2.93E+02
123mTe	1.50E-21	3.41E-18	--	3.41E-18
125mTe	0	0.00E+00	--	0.00E+00
127Te	2.12E-19	4.82E-16	--	4.82E-16
127mTe	2.16E-19	4.91E-16	--	4.91E-16
129I	5.16E-03	1.17E+01	--	1.17E+01

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[58] Scrap/Fuel MCOs: HNF-3553-Anxa, Rev 9, Table 3-3, pg. 3-27 and pg. 3-28
[59] SSFC MCOs: SNF-7199, Rev 2, Table 1, pg. 15 and pg. 16

Radionuclide	Fuel Activity [Ci/MTU]	CSB Inventory containing 379 Scrap/Fuel MCOs (6 MTU/MCO) [Ci]	Shippingport Core 2 Blanket Fuel Assembly Inventory within 18 SSFC MCOs [Ci]	Sum
134Cs	6.47E+00	1.47E+04	--	1.47E+04
135Cs	6.04E-02	1.37E+02	--	1.37E+02
137Cs	9.66E+03	2.20E+07	--	2.20E+07
137mBa	9.14E+03	2.08E+07	--	2.08E+07
144Ce	7.91E-04	1.80E+00	--	1.80E+00
144Pr	7.82E-04	1.78E+00	--	1.78E+00
144mPr	9.48E-06	2.16E-02	--	2.16E-02
147Pm	1.09E+02	2.48E+05	--	2.48E+05
151Sm	1.02E+02	2.32E+05	--	2.32E+05
152Eu	8.45E-01	1.92E+03	--	1.92E+03
154Eu	1.13E+02	2.57E+05	--	2.57E+05
155Eu	1.06E+01	2.41E+04	--	2.41E+04
153Gd	5.19E-19	1.18E-15	--	1.18E-15
Actinides				
U (total)	7.99E-01	1.82E+03	6.73E-02	1.82E+03
237Np	4.66E-02	1.06E+02	--	--
Pu (total)	7.26E+03	1.65E+07	1.35E+04	1.65E+07
241Am	4.34E+02	9.87E+05	--	
242Am	3.71E-01	8.44E+02	--	
242mAm	3.72E-01	8.46E+02	--	
243Am	2.78E-01	6.32E+02	--	
242Cm	3.08E-01	7.00E+02	--	
244Cm	4.47E+00	1.02E+04	--	
Mass [kg]				
U Total [kg]	--	1.82E+03	3.21E+01	1.85E+03
Pu Total [kg]	--	1.65E+07	1.20E+02	1.65E+07

ISA: There are eight (8) types of spent nuclear fuel authorized for storage at the ISA. Two types of fuel are not stored currently at the ISA (TMBCs holding GE's Vallecitos fuel and FFCs holding SPR/N Reactor fuel).[60] The remaining six (6) fuel types considered as part of the inventory at ISA is described below (and reported in Table H.7-6, below):

- FFTF fuel
- NRF TRIGA fuel

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[60] The overall radioactive inventory for the FFCs, Experimental Breeder Reactor-II (EBR-II) casks, TMBCs, and Los Alamos Molten Plutonium Reactor Experiment (LAMPRE) EBR-II casks are summarized in Table 3-8. The FFCs and TMBCs have yet to be moved into CSB for further handling and these containers must move to CSB first before movement on the ISA can occur. Therefore, the inventory within the FFCs and TMBCs are not included in the inventory of the ISA within this summary. The FFC inventory is estimated since the FFCs will be loaded as found fuel is retrieved. The inventories for EBR-II casks and TMBCs are based on existing storage data at the low-level burial grounds. [HNF-40627, Rev 2, pg. 3-21].

- OSU TRIGA fuel
- Commercial LWR fuel
- EBR-II fuel
- LAMPRE-I EBR-II fuel

The total inventories are provided within FFTF spent nuclear fuel containers and NRF TRIGA fuel (within Table 3-5 and Table 3-6 of the ISA DSA [HNF-40627, Rev 2]) and are presented below. OSU TRIGA fuel inventory values were taken from Table 2-9 of the ISA DSA. Presently stored EBR-II and LAMPRE EBR-II casks at the ISA are included in the inventory and the inventory values are provided within Table -16 and Table 2-20, respectively within the ISA DSA.

The spent nuclear fuel from the commercial light-water reactors constitutes 7 assemblies stored within 6 dry storage canisters. The spent nuclear fuel from the commercial light-water reactors is shown for a single assembly for a listing of individual radionuclides in Table 3-7 of the ISA DSA [HNF-40627, Rev 2] and the number of assemblies was reported as receipt of 7 assemblies[61]. Many of the individual fuel rods were removed from the originally received assemblies and examined. The fuel rods were then placed back into a storage structure similar to geometry of a reactor fuel assembly.

Table H.7-6. 200 Area Interim Storage Area (ISA) Inventory[62]

Isotope	FFTF SNF	NRF TRIGA Fuel	OSU TRIGA Fuel	Commercial LWR Fuel	EBR-II Fuel	LAMPRE-I	Sum
Radioactivity [Ci]							
H-3	547	0.52	--	649.6	--	--	1197.1
Kr-85	4,718	12.86	--	9170	--	--	13900.9
Sr-90	35,280	188.26	--	138600	--	--	174068.3
Y-90	35,350	188.37	--	138600	--	--	174138.4
Tc-99	14	0.04	--	36.47	--	--	50.5
Cs-134	17,570	0.92	--	3437	--	--	21007.9
Cs-137	95,900	198.47	--	199500	--	--	295598.5
I-129	0	--	--	0.0882	--	--	0.1
Rh-106	--	3.42	--	59.01	--	--	62.4
Ru-106	34,230	3.42	--	58.94	--	--	34292.4
Ag-110m	62	--	--	--	--	--	62.0
Cd-113m	90	0.02	--	91.7	--	--	181.7
Sb-125	8,470	1.38	--	910	--	--	9381.4
Ce-144	11,620	18.82	--	--	--	--	11638.8
Pr-144	11,620	--	--	--	--	--	11620.0

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[61] HNF-40627, Rev 3, pg. 2-51

[62] FFTF fuel values were taken from Table 3-5 of the ISA DSA. NRF TRIGA Fuel values were taken from Table 3-6 of the ISA DSA. Commercial LWR fuel isotopic inventory values were presented on an assembly basis within Table 3-7 of the ISA DSA and were scaled to 7 assemblies from information found on page 2-51 on the ISA DSA. OSU TRIGA fuel inventory values were taken from Table 2-9 of the ISA DSA. EBR-II Fuel mass values were taken from Table 2-16 and summed over all Pu and U isotopes. It was assumed that the specific activities of Pu-239 and U-235 were applicable in order to calculate the radioactivity of the inventory. Indication of the particular radionuclides within the spent fuel of EBR-II was provided in Table 3-8 within the ISA DSA reporting mixed quantities of fissile Pu-239 and U-235. LAMPRE-I fuel inventory values of only plutonium were provided within Table 2-20. The specific activity of Pu-239 was used as a conservative approach to estimating the radioactivity. [ISA DSA report number is HNF-40627, Rev 2]

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Isotope	FFTF SNF	NRF TRIGA Fuel	OSU TRIGA Fuel	Commercial LWR Fuel	EBR-II Fuel	LAMPRE-I	Sum
Pm-147	61,110	67.97	--	5719	--	--	66897.0
Sm-151	3,647	5.04	--	861	--	--	4513.0
C-14	--	0	--	--	--	--	0.0
Fe-55	--	19.23	--	--	--	--	19.2
Ni-59	--	0.06	--	--	--	--	0.1
Ni-63	--	6	--	--	--	--	6.0
Co-60	--	0.07	--	5516	--	--	5516.1
Zr-93	--	0	--	--	--	--	0.0
Te-125m	--	0.34	--	221.9	--	--	222.2
Eu-152	--	0.28	--	--	--	--	0.3
Eu-154	--	0.21	--	10850	--	--	10850.2
Eu-155	--	1.52	--	2814	--	--	2815.5
Np-237	--	0	--	0.938	--	--	0.9
Np-239	--	--	--	89.6	--	--	89.6
Am-241	1,771	0.01	--	6608	--	--	8379.0
Am-242	--	--	--	74.9	--	--	74.9
Am-242m	135	--	--	74.9	--	--	209.9
Am-243	--	--	--	89.6	--	--	89.6
Cm-242	--	--	--	61.74	--	--	61.7
Cm-243	--	--	--	73.5	--	--	73.5
Cm-244	143	--	--	8470	--	--	8613.0
Pu Total	--	0.78	0.79	182679	2345.2	756.0	185781.8
U Total	--	0.26	0.01	5.01	0.4	--	5.7
Mass [kg]							
Pu Total [kg]	--	0.01	0.01	24.2	37.2	12	73.4
U Total [kg]	--	35.10	3.31	2793.0	178.4	--	3009.8

Notes: “- -“ denotes no reported value

Table H.7-7. Inventory of Primary Contaminants [(a)]

WIDS	Description	Decay Date	Ref	Am-241 (Ci)	C-14 (Ci)	Cl-36 (Ci)	Co-60 (Ci)	Cs-137 (Ci)	Eu-152 (Ci)	Eu-154 (Ci)	H-3 (Ci)	I-129 (Ci)
All	Sum			1.00E+06	1,300	NR	10,000	2.20E+07	1,900	270,000	61,000	12
246-S	Infrastructure Building		See footnotes 56, 57, and 60	8,400	0	NR	5,500	300,000	0.3	11,000	1,200	0.1
212-H	Process Building		See footnotes 56, 57, and 60	990,000	1,300	NR	4,800	2.20E+07	1,900	260,000	59,000	12

a. NR = Not reported

Table H.7-8. Inventory of Primary Contaminants (cont)[(a)]

WIDS	Description	Decay Date	Ref	Ni-59 (Ci)	Ni-63 (Ci)	Pu (total) (Ci)	Sr-90 (Ci)	Tc-99 (Ci)	U (total) (Ci)
All	Sum			72	7,900	1.70E+07	1.60E+07	5,000	NR
246-S	Infrastructure Building		See footnotes 56, 57, and 60	0.1	6	190,000	170,000	51	NR
212-H	Process Building		See footnotes 56, 57, and 60	72	7,900	1.70E+07	1.60E+07	5,000	NR

a. NR = Not reported

Table H.7-9. Inventory of Primary Contaminants (cont)[(a)]

WIDS	Descrip-tion	Ref	CCl4 (kg)	CN (kg)	Cr (kg)	Cr-VI (kg)	Hg (kg)	NO3 (kg)	Pb (kg)	TBP (kg)	TCE (kg)	U (total) (kg)
All	Sum		NR	NR	NR	NR	NR	NR	NR	NR	NR	4,900
246-S	Infrastructure Building	See footnotes 56, 57, and 60	NR	NR	NR	NR	NR	NR	NR	NR	NR	3,000
212-H	Process Building	See footnotes 56, 57, and 60	NR	NR	NR	NR	NR	NR	NR	NR	NR	1,900

a. NR = Not reported

Table H.7-10. Summary of the Evaluation of Current Threats to Groundwater as a Protected Resource from Saturated Zone (SZ) and Remaining Vadose Zone (VZ) Contamination associated with the Evaluation Unit

PC	Group	WQS	Porosity[a]	K_d (mL/g)[a]	ρ (kg/L)[a]	VZ Source M^{Source}	SZ Total M^{SZ}	Treated[c] M^{Treat}	VZ Remaining M^{Tot}	VZ GTM (Mm^3)	VZ Rating[d]
C-14	A	2000 pCi/L	0.25	0	1.82	---	---	---	---	---	*ND*
I-129	A	1 pCi/L	0.25	0.2	1.82	---	---	---	---	---	*ND*
Sr-90	B	8 pCi/L	0.25	22	1.82	---	---	---	---	---	*ND*
Tc-99	A	900 pCi/L	0.25	0	1.82	---	---	---	---	---	*ND*
CCl4	A	5 µg/L	0.25	0	1.82	---	---	---	---	---	*ND*
Cr	B	100 µg/L	0.25	0	1.82	---	---	---	---	---	*ND*
Cr-VI	A	10 µg/L[b]	0.25	0	1.82	---	---	---	---	---	*ND*
TCE	B	5 µg/L	0.25	2	1.82	---	---	---	---	---	*ND*
U(tot)	B	30 µg/L	0.25	0.8	1.82	---	---	---	---	---	*ND*

a. Parameters obtained from the analysis provided in Attachment 6-1 to Methodology Report (CRESP 2015).

b. "Model Toxics Control Act—Cleanup" (WAC 173-340) Method B groundwater cleanup level for hexavalent chromium.

c. Treatment amounts from the 2015 Hanford Annual Groundwater Report (DOE/RL-2016-09, Rev. 0).

d. Groundwater Threat Metric rating based on Table 6-3, Methodology Report (CRESP 2015).

PART VI. POTENTIAL RISK/IMPACT PATHWAYS AND EVENTS

CURRENT CONCEPTUAL MODEL

Pathways and Barriers

1. **What nuclear and non-nuclear safety accident scenarios dominate risk at the facility? What are the response times associated with each postulated scenario?**

CSB: The CSB hazards analysis addresses normal CSB operations for handling and storing a sealed MCO. The hazards analysis also identifies and analyzes potential hazards associated with storing an off-normal MCO in an overpack storage tube. Bounding and representative accidents were selected from the hazard analysis for further quantitative evaluation as design basis accidents (DBAs). There were seven major DBA events evaluated for the MCO.[63,64] Of the 7 DBAs listed above, the three (3) accident scenarios resulting in the highest unmitigated doses to the co-located person that are further discussed within this EU document are the following [65]:

- MCO internal hydrogen deflagration (54 rem);
- Mechanical damage of MCO (49 rem);
- Fires(35.6 rem)

SSFCs contain BFAs irradiated in Shippingport Pressurized Water Reactor (PWR) Core 2. The hazards analysis for SSFC handling and storage is based on the final hazards analysis performed for MCOs. All hazards identified for MCOs were reviewed for potential impact on the SSFCs. SSFCs have certain characteristics that will tend to make some hazards more significant, such as higher local dose rates due to the PWR fuel characteristics and other less significant hazards (e.g., the hazards associated with hydrogen generation). In addition, the possibility of new SSFC-specific accidents was investigated.[66]

Receiving the transporter containing the cask-SSFC and moving it into the facility.

- Moving the cask-SSFC to the service area and removing the cask lid.

- Transporting the SSFC from the service area with the MHM to a sampling/weld station for cover cap welding or to a standard storage tube if a sample/weld station is unavailable and the SSFC must be staged.

- Transporting the SSFC with the MHM from the standard storage tube to a sampling/weld station and returning it to a standard storage tube after welding. There is no reason to require periodic sampling for this stable, natural, uranium-based fuel. However, the SSFC will be transported to the sampling/weld

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[63] 1. Mechanical damage of the MCO (HNF-3553-ANXA, Rev 9 CSB DSA Section 3.4.2.1)
2. Gaseous release from the MCO (HNF-3553-ANXA, Rev 9 CSB DSA Section 3.4.2.2)
3. MCO internal hydrogen deflagration (HNF-3553-ANXA, Rev 9 CSB DSA Section 3.4.2.3)
4. MCO external hydrogen deflagration (HNF-3553-ANXA, Rev 9 CSB DSA Section 3.4.2.4)
5. Thermal runaway reactions inside the MCO (HNF-3553-ANXA, Rev 9 CSB DSA Section 3.4.2.5)
6. Violation of design temperature criteria (HNF-3553-ANXA, Rev 9 CSB DSA Section 3.4.2.6)
7. Fires (HNF-3553-ANXA, Rev 9 CSB DSA Section 3.4.2.7)

[64] The categorization estimated the amount of radiological material at risk for the hazard categorization in accordance with DOE-STD-1027-92, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports* and 10 CFR 830. Consistent with DOE-STD-1027-92, the final categorization was based on the unmitigated release of available radiological inventories. These CSB material quantities were compared against the threshold quantities contained in DOE-STD-1027-92. [HNF-3553-ANXA, Rev 9, pg. iv through pg. vi, and pg. 3-9]

[65] HNF-3553-ANXA, Rev 9, pg. 3-35, and Table 3-8 “Summary of Consequences for Bounding Design Basis Accidents” pg. 3-47

[66] HNF-3553-ANXA, Rev 9, pg. 3-8

station for welding on the cover cap. After leak testing of the cover cap welds, the SSFC will be placed in a standard storage tube by the MHM for long-term storage.

- Conducting activities during welding. It is not anticipated that SSFCs will be sampled. The SSFCs will have cover caps welded on in the same manner as the MCO cover caps.

Off-normal SSFC storage operations were also considered assuming the following conditions.

- The event or accident leading to SSFC damage has been terminated and recovery actions completed.
- The off-normal SSFC is in place in the overpack storage tube.
- The overpack storage tube plug cover is installed.
- An inert atmosphere has been established in the overpack storage tube.

The CSB hazards analysis was also revised to address hazards related to FFC and TMBC receipt, handling, welding and storage at CSB consistent with HNF-8739, *Hanford Safety Analysis and Risk Assessment Handbook (SARAH)*. CSB is scheduled to receive FFCs from site cleanup activities, and TMBCs from the LLBG. The FFC and TMBC hazard evaluation documented in HNF-SD-SNF-HIE-001 concluded that all radiological dose consequences were “low” for the FFC and TMBC activities. Therefore, no formal accident analysis was required for these spent fuel canisters.[67]

Because spent nuclear fuel considered as source material within the CSB DSA contains no corrosive chemicals, a conservative exposure averaging time of 15 minutes was used in the calculation of average air concentration. [68]

ISA: No accident scenarios or design-basis accidents were evaluated within the ISA since the results from the Hazards Analysis (HNF-32883) were considered “Low” and therefore no further calculations were required within the ISA DSA.[69] (Unmitigated (nor mitigated) doses were not calculated to the Facility Worker receptor in the ISA DSA.) Within the HNF-32883 Hazards Analysis, the greatest threat to workers was initiated from standard industrial safety accidents and not from a radiological hazard source. The postulated hazardous conditions at ISA include the following () [70]:

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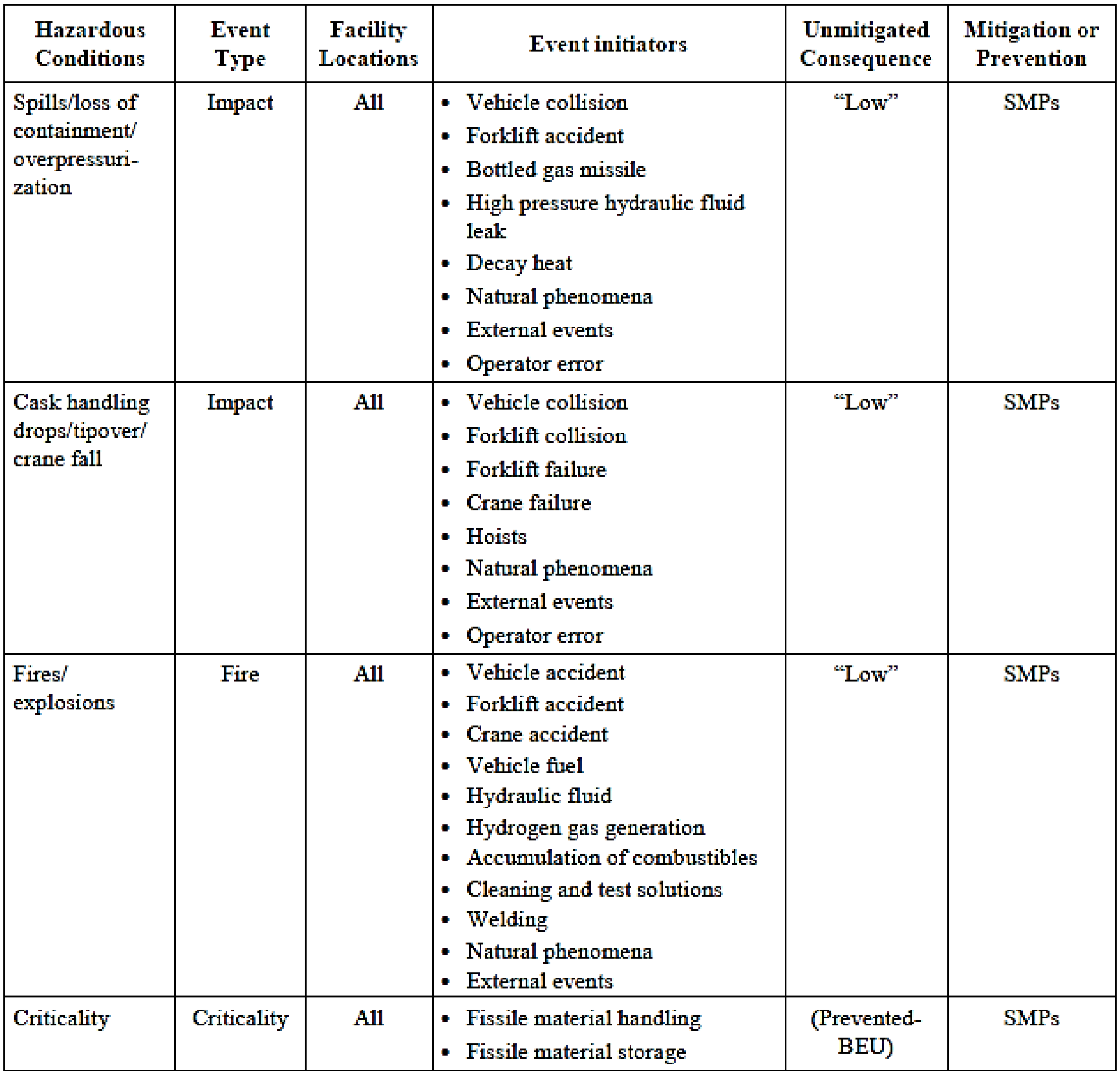
67 HNF-3553-ANXA, Rev 9, pg. 3-35
68 HNF-3553-ANXA, Rev 9, pg. 3-48
69 HNF-40627, Rev 2, pg. 3-26
70 HNF-40627, Rev 2, Table 3-4, pg. 3-14

Table H.7-11. Summary of Hazard Analysis Results for 200 Area Interim Storage Area Activities[71]



Hazardous Conditions	Event Type	Facility Locations	Event initiators	Unmitigated Consequence	Mitigation or Prevention
Spills/loss of containment/ overpressurization	Impact	All	• Vehicle collision • Forklift accident • Bottled gas missile • High pressure hydraulic fluid leak • Decay heat • Natural phenomena • External events • Operator error	"Low"	SMPs
Cask handling drops/tipover/ crane fall	Impact	All	• Vehicle collision • Forklift collision • Forklift failure • Crane failure • Hoists • Natural phenomena • External events • Operator error	"Low"	SMPs
Fires/ explosions	Fire	All	• Vehicle accident • Forklift accident • Crane accident • Vehicle fuel • Hydraulic fluid • Hydrogen gas generation • Accumulation of combustibles • Cleaning and test solutions • Welding • Natural phenomena • External events	"Low"	SMPs
Criticality	Criticality	All	• Fissile material handling • Fissile material storage	(Prevented-BEU)	SMPs

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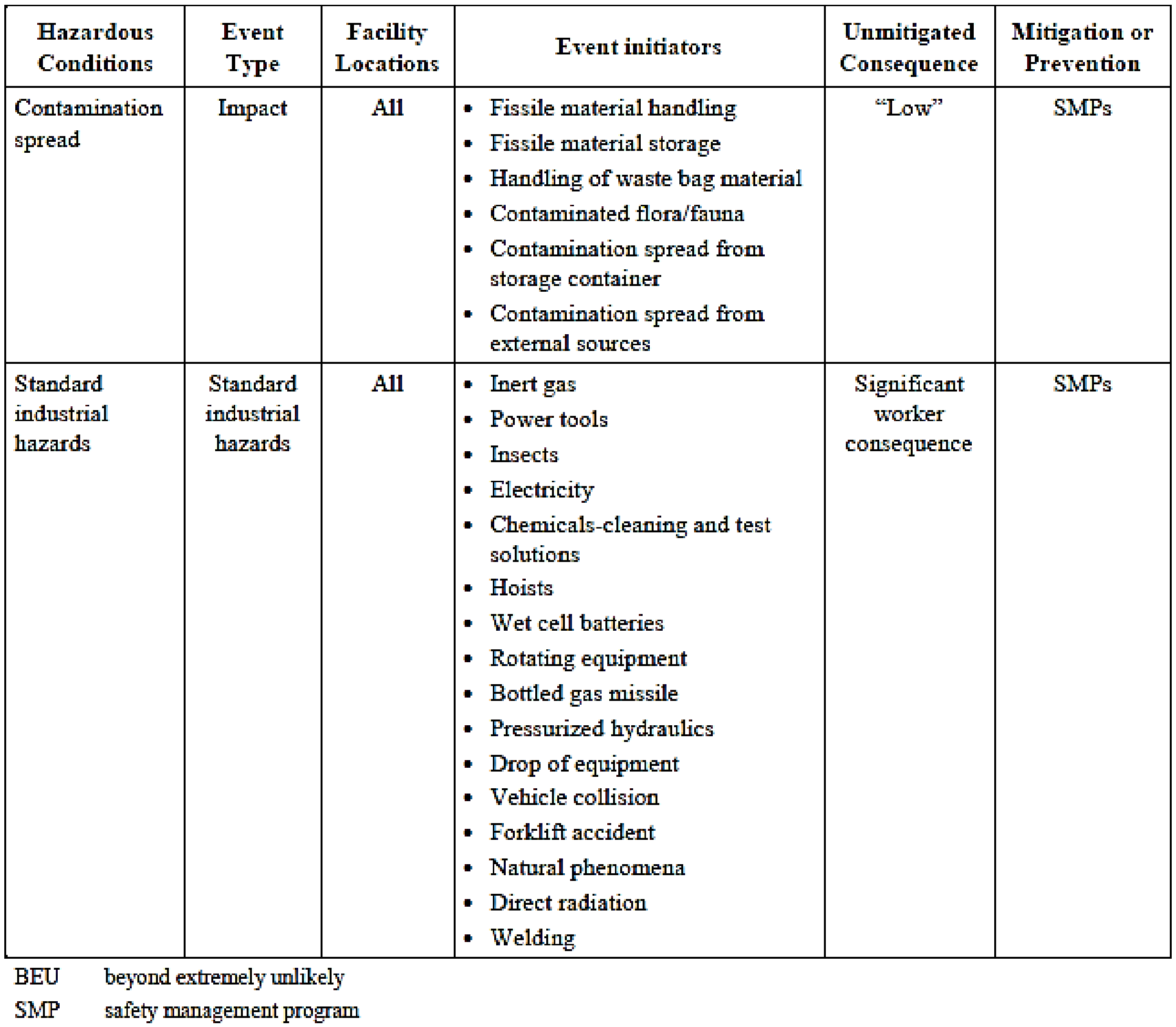
[71] HNF-40627, Rev 2, Table 3-4, pgs. 3-14 through 3-15

Table H.7-**12. Summary of Hazard Analysis Results for 200 Area Interim Storage Area Activities (cont.)**[71]



Hazardous Conditions	Event Type	Facility Locations	Event initiators	Unmitigated Consequence	Mitigation or Prevention
Contamination spread	Impact	All	• Fissile material handling • Fissile material storage • Handling of waste bag material • Contaminated flora/fauna • Contamination spread from storage container • Contamination spread from external sources	"Low"	SMPs
Standard industrial hazards	Standard industrial hazards	All	• Inert gas • Power tools • Insects • Electricity • Chemicals-cleaning and test solutions • Hoists • Wet cell batteries • Rotating equipment • Bottled gas missile • Pressurized hydraulics • Drop of equipment • Vehicle collision • Forklift accident • Natural phenomena • Direct radiation • Welding	Significant worker consequence	SMPs

BEU	beyond extremely unlikely
SMP	safety management program

2. What are the active safety class and safety significant systems and controls?

CSB: CSB active technical safety requirements (TSRs), administrative controls (ACs) and specific administrative controls (SACs):[72]

- TSRS: MCO handling machine (MHM) (Shear and Drop Prevention Interlock System), Confinement Systems (Sampling Hood Exhaust System and Sampling Piping Confinement System)
- ACs: Nuclear Criticality Safety, Combustible Loading Limits, Configuration Management of Design Features, Safety Management Programs

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[72] HNF-3553-ANXA, Rev 9, pg. iv through pg. viii

- SACs: Operational Controls, Intermediate Impact Absorbers, Storage Tube Plugs, Receipt Acceptance Criteria, Vehicle Access

ISA: None[73], see Question 4, below.

3. What are the passive safety class and safety significant systems and controls?

CSB Passive Safety-Class Features:[74]

- CSB subsurface structures, including vaults, air intake, and exhaust plenums
- Carbon steel base slab embeds for the standard and overpack storage tubes
- CSB at-grade structures, including operating deck (including the sampling/weld area and load-in/load-out area), and bases for intake tower and exhaust stack
- Standard storage tubes and tube base assemblies
- Overpack storage tubes and tube base assemblies
- CSB intake structure (including screens) and exhaust stack
- MCO handling machine (MHM) seismic restraint system
- MCO handling machine (MHM)/receiving crane rails and rail frogs

CSB Passive Safety-Significant Features:[74]

- Operating area shelter and support area building (including the rolling shield gates, fire protective coating in the north vestibule, site grading, and support area building foundation)
- Standard storage tube plugs
- Overpack storage tube plugs
- MHM structural components, MCO grapple and hoist, MHM interlocks P2, P6, and P21, and MHM hydraulic power unit spray shield.
- Tube vent and purge cart
- Receiving crane structure and hoist
- Cask receiving pit
- Transportation cask servicing system
- Multi-canister overpacks (MCO) sampling system
- Standard storage tube intermediate impact absorber
- Helium supply system rupture disk
- MHM fixed shielding
- Transportation cask
- MCO shell, locking ring and shield plug
- Standard storage tube lower flange, bottom impact absorber, and standard interface guide ring funnel
- Overpack storage tube lower flange, bottom impact absorber, and overpack interface guide ring funnel
- Cask lifting yoke
- Multi-canister overpacks (MCO) centering guide

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[73] HNF-40627, Rev 2, pg. ii

[74] HNF-3553-ANXA, Rev 9, pg. iv through pg. vii through pg. ix

- Cask receiving impact absorber
- Sampling/weld station impact absorber and shield halves
- Shield hatch and MCO guide assembly
- MCOs
- Shippingport spent fuel canisters (SSFCs)

Features Chosen to Provide Defense in Depth for the Canister Storage Building.[75] Defense-in-depth features for CSB were selected based on a relative ranking of the hazards from the hazard identification process, followed by selection of the safety-class and safety-significant features and TSRs for the DBAs,

The first layer of defense in depth at CSB is facility design. All SSCs are designed in accordance with applicable codes and standards with a high degree of reliability and simplicity. The design encompasses human factors considerations to ensure that operations can be conducted safely. Defense-in-depth features for preventing and mitigating hazards and accidents associated with recovery-related activities and SSCs have also been identified. The overpack storage tube assemblies and the tube vent and purge cart, described in Section 2.5.3, could be used in storage/monitoring of MCOs involved in accidents. The overpack storage tubes and the tube vent and purge cart were identified as defense-in-depth items for recovery purposes. The MCOs associated with accidents will be handled within recovery operations under operations procedures, with the preferred approach being to move the MCO to an overpack storage tube for short-term observation and storage. Use of the overpack storage tube is an option for recovery. Recovery will be based on analysis and the development of a recovery plan.

HNF-SD-SNF-HIE-001also summarizes the results of the hazards analysis performed for storage and monitoring of off-normal MCOs in overpack storage tubes. The hazards analysis concluded that system and equipment design changes from early hazard and accident analysis activities resulted in installation of passive preventative features which reduced the likelihood of MCO damage (i.e., drops leading to MCO cracks, which provide an open path to the atmosphere). These preventative design features, when introduced into the hazard analysis process for off-normal MCO storage, reduced the risk ranking to below requirements for further analysis.[76]

Safety-Significant Structures, Systems, and Components.[75] Safety-significant SSCs are predominantly required to prevent or mitigate consequences of postulated accident events to the collocated onsite worker. PRC-PRO-NS-700 provides a correlation of evaluation guidelines to identification of safety-significant SSCs. In addition, DOE-STD-3009-94 suggests that SSCs be designated as safety-significant if they play a key role in defense in depth (or worker safety). The severity of the event being prevented or mitigated and the number of barriers present are provided in DOE-STD-3009-94 as guidance for the identification of defense-in-depth safety-significant SSCs.

Safety-significant features are described in Chapter 4.0 and include the following:

1. MHM hoist and grapple—Provide safe handling of the MCO

2. MHM interlocks P2, P6, and P21—Prevent damage to MCO or operating deck by structural failure of the MHM

3. Sampling/weld station shield halves and impact absorber—Protect MCO from drop by crane into sampling/weld station

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[75] HNF-3553-ANXA, Rev 9, pg. 3-30 and 3-31

[76] HNF-3553-ANXA, Rev 9, pg. 3-21

4. Cask lifting yoke—Limit MCO lifting height

5. Standard storage tube bottom and intermediate impact absorbers—Mitigate drop impact to MCO for drop into standard storage tube

6. Cask receiving impact absorber—Mitigate drop impact to MCO for drop into the cask receiving pit

7. MCO centering guide—Limit eccentricity of MCO drop

8. Shield hatch and MCO guide assembly—Mitigate drop impact to MCO from drop at cask receiving pit

9. Interface guide ring funnel—Mitigate drop impact to MCO from drop in the storage tube

10. Standard storage tube lower flange—Mitigate drop impact to MCO from drop into the standard storage tube

11. MHM seismic restraints (trolley, turret, and bridge)—Prevent damage to operating deck from MHM, prevent shear of MCO by MHM

12. MHM rail and rail frogs—Prevent damage to operating deck from MHM, prevent shear of MCO by MHM

13. AH-006 exhaust ducting up to the HEPA filter—Provide confinement for significant worker safety protection when the MCO is connected to the MCO Sampling System

Technical Safety Requirements[75]. TSRs were identified for postulated accident events that could challenge accident consequence evaluation guidelines for the offsite public and collocated onsite worker. TSRs are identified in the individual DBA sections and further explained in Chapter 5.0. Only when items are elevated to safety-significant to provide significant defense in depth or significant facility worker safety do they warrant TSR coverage.

ISA: None of the engineered features were elevated to safety-class or safety-significant designation. The spent nuclear fuel (SNF) containers were identified as passive equipment important-to-safety. Safety management programs were identified that provide adequate protection and reduce risk to workers, the public, and the environment. These programmatic safety management programs were elevated to technical safety requirement-level administrative control. Table 3-10 from the ISA DSA are shown in description of Question 4, below, and are provided as excerpts within Table H.7-13 through Table H.7-19. [77]

4. What are the current barriers to release or dispersion of contamination from the primary facility? What is the integrity of each of these barriers? Are there completed pathways to receptors or are such pathways likely to be completed during the evaluation period?

CSB: Current barriers of material within analyzed MCOs that are considered safety-structures, systems, and components (SSCs) are listed within the description of Question 3, above, along with technical safety requirements (TSRs) and administrative controls (ACs) Overall, the set of SSCs, TSR controls, and TSR design features defined by the analyses ensures all identified hazards associated with CSB operation are adequately controlled.[78] CSB radiological material of the N-Reactor type fuels in found fuel containers (FFCs) and Vallecitos Nuclear Center in transuranic multiple burial containers (TMBCs) hazard evaluation documented in HNF-SD-SNF-HIE-001 identified that all unmitigated radiological dose

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[77] HNF-40627, Rev 2, pg. ii and pg. 3-25

[78] HNF-3553-ANXA, Rev 9, pg. ix

consequences were "low" for the FFC and TMBC activities, no formal accident analysis was performed. No SSCs were credited for prevention or mitigation of identified FFC or TMBC hazardous conditions.[79]

Scrap/Fuel MCO: The MCO shell is a stainless steel (304L) cylindrical vessel with access at the top end that is closed with a stainless steel shield plug. The shell is fabricated from a 24-in.-diameter pipe with a wall thickness of 0.5 in. and an overall length of 160 in., without the cover cap, when assembled with the shield plug assembly in place. The shield plug protects workers from photons and neutrons emanating from the inside of the MCO. The shield plug is closed using a mechanical closure assembly. The mechanical closure assembly holds the shield plug in place using a threaded locking ring that is put into the MCO collar after the shield plug is inserted. Once assembled, the 18 set screws in the locking ring are tightened down into the shield plug's back side to hold the silver clad seal between the MCO shell and the shield plug. The design of the MCO vessel meets service level "A" requirements for normal operating loads and service level "D" requirements for accident conditions under the *Boiler and Pressure Vessel Code*, Section III, Subsection NB (ASME 2013). The MCO baskets are categorized into two major types: intact fuel element baskets and scrap fuel (fragment) baskets. The Mark IV (Figure 2-7) and Mark IA (Figure 2-8) fuel and scrap basket structural portions are made of 304L or 304 stainless steel. Scrap basket materials also include copper for added thermal conductivity.[80] There are also a few MCOs that contain inserts loaded with K Basins KOP product material. These MCOs contain six Mark IA scrap baskets (with up to three of the baskets with inserts and the remainder of the baskets empty).

CSB currently stores 379 welded Scrap/Fuel and KOP MCOs and 15 mechanically sealed Scrap/Fuel and KOP MCOs (i.e., not welded) in the monitoring program (up to 20 MCOs may be designated as monitored MCOs), which are sampled periodically at a sampling/weld station to provide data on interim storage of MCOs containing fuel and scrap or KOP product material.[81]

Shippingport Spent Fuel Canister (SSFC) MCO: The SSFC MCO has the identical external dimensions of a Scrap/Fuel MCO. An SSFC MCO has Shippingport Pressurized Water Reactor (PWR) Core 2 blanket fuel assemblies (BFAs) in a modified MCO container. The SSFC MCO assembly consists of a shell, a shield plug, and an insert to facilitate loading of the Shippingport PWR Core 2 spent fuel assemblies. The SSFC MCO shell is fabricated from type 304/304L stainless steel and the SSFC MCO shell assembly is not modified from the Scrap/Fuel MCO design. The PWR Core 2 insert is designed such that it does not require attachment to the SSFC shell. The insert is fabricated of type 304 stainless steel and a single internal insert holds four blanket fuel assemblies (BFAs) inside the container. The insert is not designed to provide any physical support of the fuel for criticality geometry control or shielding purposes after loading. CSB has 18 SSFC MCOs, which store 72 Shippingport PWR Core 2 BFAs in storage tubes located in Vault 1 of CSB.[82] The condition of the Shippingport PWR Core 2 blanket fuel cladding is good.[83]

Found Fuel Containers (FFCs): HNF-37492, *Spent Nuclear Fuel Acceptance Criteria Document (OCRWM),* specifies the assumed fuel conditions for Found Fuel Containers (FFCs). The FFCs will be generated during ongoing Hanford Site cleanup efforts and will be temporarily stored on the CSB operating deck so

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[79] HNF-3553-ANXA, Rev 9, pg. viii

[80] HNF-3553-ANXA, Rev 9, pg. 2-12 and pg. 2-13. ASME, 2013, *Boiler and Pressure Vessel Code*, American Society of Mechanical Engineers, New York, New York.

[81] HNF-3553-ANXA, Rev 9, pg. 2-83

82 HNF-3553-ANXA, Rev 9, pg. 2-15

83 US Department of Energy (DOE) (2008). Yucca Mountain Repository Safety Analysis Report. DOE/RW-0573, Revision 0 (URL: http://pbadupws.nrc.gov/docs/ML0815/ML081560411.pdf): 424 pages.

they can be welded prior to transfer for interim storage at the ISA. The FFC is a specially fabricated storage container system consisting of an inner stainless-steel fuel canister and installed in an outer carbon steel shielding overpack. Each FFC holds up to 75 lb of Single Pass Reactor (SPR) or N Reactor fuel. The types of fuel and fuel fragments that are anticipated to be recovered from the 100 Area and 300 Area remediation sites are SPR fuel and N Reactor fuel. Depending on size, a loaded FFC weighs approximately 1,200, 2,500 or 4,400 lb.

There are three different sizes of FFCs. There were three basic designs for SPR fuel elements: solid-core cylinders, hollow-core cylinders, and aluminum-center tubes. Many variations of these basic SPR fuel designs were created to improve cooling, production, and failure rates or to simplify the fabrication process. N Reactor fuel elements consist of two concentric tubes made of uranium metal co-extruded into Zircaloy 2 cladding. There are two basic types of N Reactor fuel, Mark IV and Mark 1A elements, differentiated by their uranium enrichment and slightly different dimension.[84]

It is anticipated there will be approximately 20 FFCs generated during about a 10-year cleanup period. [85]

Transuranic Multiple Burial Containers (TMBCs): The TMBC is an existing storage container consisting of four steel pipe compartments embedded in a large concrete shielding block. The TMBC stores ceramic oxide fuel from the General Electric (GE) Vallecitos Nuclear Facility. There are two different height TMBC designs that contain different length GE waste liners. They are both rectangular concrete-shielded containers that are 65.5 in. square monoliths. One is 48 in. high, while the other is 75.5 in. high. Each container has four cavities to hold the GE waste liners. The shorter concrete cask holds a 7.5-in. diameter by 15 in. long waste liner, while the taller cask holds a 5.56-in. diameter by 42 in. long liner. The GE liners are aluminum tubes (5 and 7.5 in. in diameter) with a welded bottom and a threaded cap that includes a rubber O ring bore seal. The fuel pieces, segments, and mounted specimens were typically placed into screw-closed inner containers or sealed metal food cans prior to placement into the GE liner (ARH-3016, *Criticality Safety Analysis Receipt and Storage at U Plant of Waste Liners from General Electric Company*, Part I). The short and tall TMBCs weigh approximately 17,900 lb and 28,150 lb, respectively. Twenty-two (22) TMBCs will be received, handled, welded, and temporarily stored at CSB. Each TMBC holds less than 1,600 gm of fissile material from plutonium and uranium oxide specimens. It is planned that TMBCs will be transferred to the 200 Area ISA after welding in batches.[86]

ISA: The barriers of radiological material release are the various canisters and engineered containers that hold the spent nuclear fuel. The following tables (Table H.7-13 through Table H.7-19) describe the boundaries and defense-in-depth safety functions (confinement, shielding, and criticality control) for each canister holding a particular type of spent nuclear fuel.

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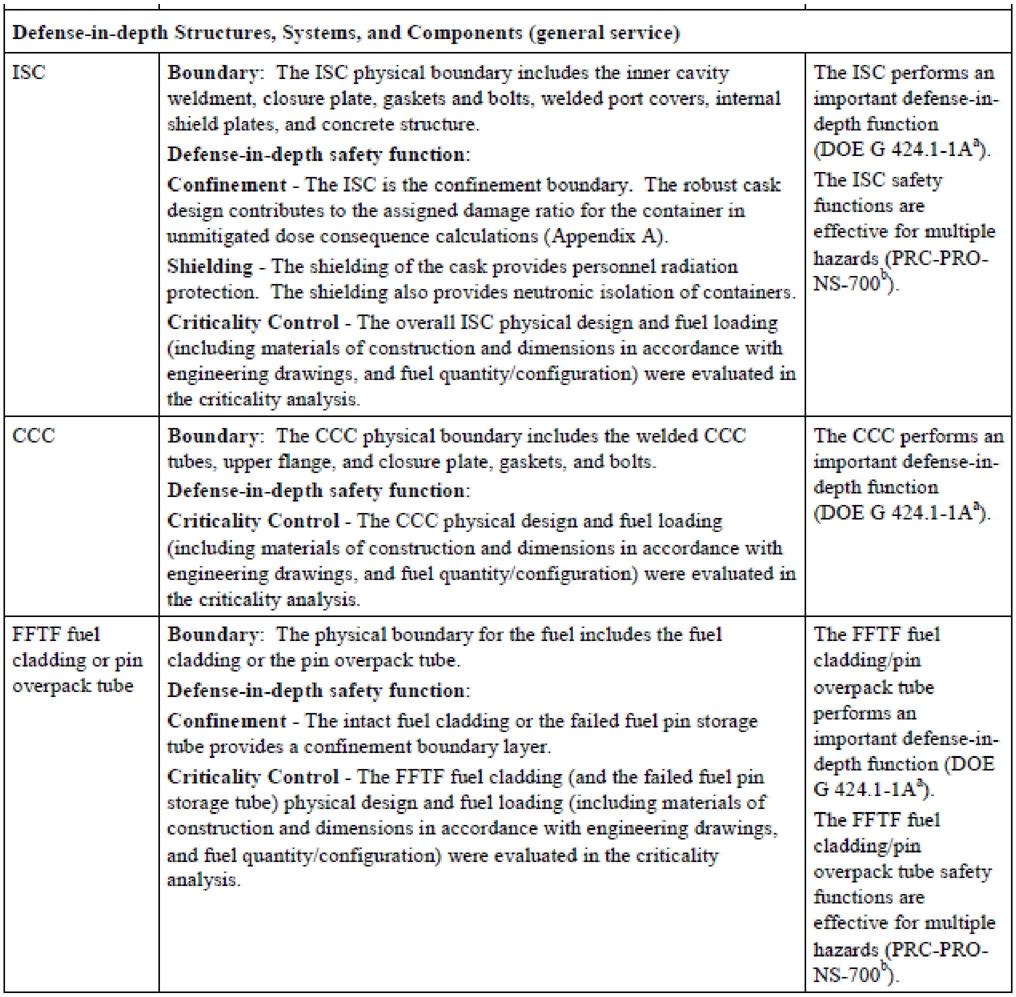
[84] HNF-3553-ANXA, Rev 9, pg. 2-15

[85] HNF-3553-ANXA, Rev 9, pg. 2-15

[86] HNF-3553-ANXA, Rev 9, pg. 2-16

Table H.7-13. 200 Area Interim Storage Area (ISA) Equipment Important to Safety[87]



Defense-in-depth Structures, Systems, and Components (general service)		
ISC	**Boundary**: The ISC physical boundary includes the inner cavity weldment, closure plate, gaskets and bolts, welded port covers, internal shield plates, and concrete structure. **Defense-in-depth safety function**: **Confinement** - The ISC is the confinement boundary. The robust cask design contributes to the assigned damage ratio for the container in unmitigated dose consequence calculations (Appendix A). **Shielding** - The shielding of the cask provides personnel radiation protection. The shielding also provides neutronic isolation of containers. **Criticality Control** - The overall ISC physical design and fuel loading (including materials of construction and dimensions in accordance with engineering drawings, and fuel quantity/configuration) were evaluated in the criticality analysis.	The ISC performs an important defense-in-depth function (DOE G 424.1-1A[a]). The ISC safety functions are effective for multiple hazards (PRC-PRO-NS-700[b]).
CCC	**Boundary**: The CCC physical boundary includes the welded CCC tubes, upper flange, and closure plate, gaskets, and bolts. **Defense-in-depth safety function**: **Criticality Control** - The CCC physical design and fuel loading (including materials of construction and dimensions in accordance with engineering drawings, and fuel quantity/configuration) were evaluated in the criticality analysis.	The CCC performs an important defense-in-depth function (DOE G 424.1-1A[a]).
FFTF fuel cladding or pin overpack tube	**Boundary**: The physical boundary for the fuel includes the fuel cladding or the pin overpack tube. **Defense-in-depth safety function**: **Confinement** - The intact fuel cladding or the failed fuel pin storage tube provides a confinement boundary layer. **Criticality Control** - The FFTF fuel cladding (and the failed fuel pin storage tube) physical design and fuel loading (including materials of construction and dimensions in accordance with engineering drawings, and fuel quantity/configuration) were evaluated in the criticality analysis.	The FFTF fuel cladding/pin overpack tube performs an important defense-in-depth function (DOE G 424.1-1A[a]). The FFTF fuel cladding/pin overpack tube safety functions are effective for multiple hazards (PRC-PRO-NS-700[b]).

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[87] HNF-40627, Rev 2, Table 3-10, pgs. 3-27 through pg. 3-33

Table H.7-14. 200 Area Interim Storage Area (ISA) Equipment Important to Safety (cont.)[87]

Equipment	Boundary Definitions and Safety Functions	Basis for ITS and Applicability
NAC-1[c] cask	**Boundary**: The cask boundary includes the NAC-1[c] cask, bolted closure plate (not gaskets), and cover plates over test ports. **Defense-in-depth safety function**: **Confinement** - The NAC-1[c] cask is not designated as a confinement boundary for storage. The robust cask design contributes to the assigned damage ratio for the container in unmitigated dose consequence calculations (Appendix A). **Shielding** - The shielding of the NAC-1[c] cask provides personnel radiation protection. The shielding also provides neutronic isolation of containers. **Criticality Control** - The NAC-1[c] cask physical design and fuel loading (including materials of construction, dimensions in accordance with engineering drawings, and fuel quantity/configuration) were evaluated in the criticality analysis.	The NAC-1[c] cask performs an important defense-in-depth function (DOE G 424.1-1A[a]). The NAC-1[c] cask safety functions are effective for multiple hazards (PRC-PRO-NS-700[b]).
LWR canister	**Boundary**: The LWR canister boundary includes the outer canister pipe and the welded closure plates. **Defense-in-depth safety function**: **Confinement** - The LWR canister is the confinement boundary. In conjunction with the robust NAC-1[c] cask design, the LWR canister contributes to the assigned damage ratio for the container in unmitigated dose consequence calculations (Appendix A). **Criticality Control** - The LWR canister physical design and fuel loading (including materials of construction, dimensions in accordance with engineering drawings, and fuel quantity/configuration) were evaluated in the criticality analysis.	The LWR canister performs an important defense-in-depth function (DOE G 424.1-1A[a]). The LWR canister safety functions are effective for multiple hazards (PRC-PRO-NS-700[b]).
ISO container	**Boundary**: The ISO container boundary includes the ISO container structural steel and cask support structures. **Defense-in-depth safety function**: **Confinement** - The ISO container is not designated as a confinement boundary for storage. The ISO container provides structural support to the NAC-1[c] cask.	The ISO container performs an important defense-in-depth function (DOE G 424.1-1A[a]). The ISO container safety functions are effective for multiple hazards (PRC-PRO-NS-700[b]).

Table H.7-15. 200 Area Interim Storage Area (ISA) Equipment Important to Safety (cont.)[87]

Equipment	Boundary Definitions and Safety Functions	Basis for ITS and Applicability
Rad-Vault[d]	**Boundary**: The Rad-Vault[d] boundary includes the Rad-Vault body and Rad-Vault lid. **Defense-in-depth safety function**: **Confinement** - The Rad-Vault[d] is not designated as a confinement boundary for storage. **Shielding** - The concrete shielding of the Rad-Vault[d] provides personnel radiation protection. The concrete shielding also contributes to neutronic isolation of containers. **Criticality Control** - The overall Rad-Vault[d] physical design, including materials of construction and dimensions in accordance with engineering drawings, was evaluated in the criticality analysis.	The Rad-Vault[d] performs an important defense-in-depth function (DOE G 424.1-1A[a]). The Rad-Vault[d] safety functions are effective for multiple hazards (PRC-PRO-NS-700[b]).
NRF TRIGA[e] cask	**Boundary**: The NRF TRIGA[e] cask boundary includes the cask body, gaskets, closure plate, bolts, and cover plates and gaskets. **Defense-in-depth safety function**: **Confinement** - The NRF TRIGA[e] cask is the confinement boundary. The robust cask design contributes to the assigned damage ratio for the container in unmitigated dose consequence calculations (Appendix A). **Shielding** - The shielding of the cask provides personnel radiation protection. The shielding also contributes to neutronic isolation of containers. **Criticality Control** - The overall NRF TRIGA[e] cask physical design and fuel loading (including materials of construction, dimensions in accordance with engineering drawings, and fuel quantity/configuration) were evaluated in the criticality analysis.	The NRF TRIGA[e] cask performs an important defense-in-depth function (DOE G 424.1-1A[a]). The NRF TRIGA[e] cask safety functions are effective for multiple hazards (PRC-PRO-NS-700[b]).
DOT-6M[f] container	**Boundary**: The DOT-6M[f] container boundary includes the outer drum weldment, internal impact absorbent and plywood materials, drum lid, and closure ring and bolt. **Defense-in-depth safety function**: **Confinement** - The DOT-6M[f] is not designated as a confinement boundary for storage. The DOT-6M[f] container provides passive protection for the 2R container. The container design impact absorption capability contributes to the assigned damage ratio for the container system in unmitigated dose consequence calculations (Appendix A). **Shielding** - The shielding of the container provides minimal personnel radiation protection. **Criticality Control** - The DOT-6M[f] container physical design and fuel loading (including materials of construction, dimensions in accordance with engineering drawings, and fuel quantity/configuration) were evaluated in the criticality analysis.	The DOT-6M[f] container performs an important defense-in-depth function (DOE G 424.1-1A[a]). The DOT-6M[f] container safety functions are effective for multiple hazards (PRC-PRO-NS-700[b]).

Table H.7-16. 200 Area Interim Storage Area (ISA) Equipment Important to Safety (cont.)[87]

Equipment	Boundary Definitions and Safety Functions	Basis for ITS and Applicability
2R container	**Boundary**: The 2R container physical boundary includes the 2R container shell weldment, top flange, gaskets, closure plate and bolts, and test port plugs and gaskets. **Defense-in-depth safety function:** **Confinement** - The 2R container is the confinement boundary. The 2R container, as part of the DOT-6M[f] storage system design, contributes to the assigned damage ratio for the container in unmitigated dose consequence calculations (Appendix A). **Shielding** - The shielding of the container provides minimal personnel radiation protection. **Criticality Control** - The 2R container physical design and fuel loading (including materials of construction, dimensions in accordance with engineering drawings, and fuel quantity/configuration) were evaluated in the criticality analysis.	The 2R container performs an important defense-in-depth function (DOE G 424.1-1A[a]). The 2R container safety functions are effective for multiple hazards (PRC-PRO-NS-700[b]).
OSU TRIGA[e] overpack container	**Boundary**: The OSU TRIGA[e] overpack container physical boundary includes the outer pipe shell, and top and bottom welded flat heads. **Defense-in-depth safety function:** **Confinement** - The OSU TRIGA[e] overpack container is the confinement boundary. The overall robust container system design, including the OSU TRIGA drum, contributes to the assigned damage ratio for the container in unmitigated dose consequence calculations (Appendix A). **Shielding** - The shielding of the container system, including the OSU TRIGA drum, provides personnel radiation protection. The shielding of the storage system also provides neutronic isolation of containers. **Criticality Control** - The overall OSU TRIGA[e] overpack container system (with the inner OSU TRIGA drum) physical design and fuel loading (including materials of construction, dimensions in accordance with engineering drawings, and fuel quantity/configuration) were evaluated in the criticality analysis.	The OSU TRIGA[e] overpack performs an important defense-in-depth function (DOE G 424.1-1A[a]). The OSU TRIGA[e] overpack safety functions are effective for multiple hazards (PRC-PRO-NS-700[b]).
FFC	**Boundary**: The FFC physical boundary includes the inner fuel canister with welded closure and shielding overpack assembly. **Defense-in-depth safety function:** **Confinement** - The FFC inner fuel canister with welded closure is the confinement boundary. The robust container design contributes to the assigned damage ratio for the container in unmitigated dose consequence calculations (Appendix A). **Shielding** - The shielding overpack assembly provides personnel radiation protection. The shielding also provides neutronic isolation of containers. **Criticality Control** - The overall FFC physical design and fuel loading (including materials of construction, dimensions in accordance with engineering drawings, and fuel quantity/configuration) were evaluated in the criticality analysis. Specific bounding dimensions are assumed in the CSER.	The FFC performs an important defense-in-depth function (DOE G 424.1-1A[a]). The FFC safety functions are effective for multiple hazards (PRC-PRO-NS-700[b]).

Table H.7-17. 200 Area Interim Storage Area (ISA) Equipment Important to Safety (cont.)[87]

Equipment	Boundary Definitions and Safety Functions	Basis for ITS and Applicability
EBR-II cask	**Boundary:** The EBR-II cask physical boundary includes the inner fuel canister with welded closure and the EBR-II cask assembly, including spacer rings. **Defense-in-depth safety function:** **Confinement** - The EBR-II inner 5-in. canister is the confinement boundary. The robust cask system design contributes to the assigned damage ratio for the container in unmitigated dose consequence calculations (Appendix A). **Shielding** - The shielding of the EBR-II cask provides personnel radiation protection. The shielding also provides neutronic isolation of containers. **Criticality Control** - The overall EBR-II cask system physical design and fuel loading (including materials of construction, dimensions in accordance with engineering drawings, and fuel quantity/configuration) were evaluated in the criticality analysis.	The EBR-II cask performs an important defense-in-depth function (DOE G 424.1-1A[a]). The EBR-II cask safety functions are effective for multiple hazards (PRC-PRO-NS-700[b]).
EBR-II vault	**Boundary:** The EBR-II vault physical boundary includes the concrete vault body and vault lid. **Defense-in-depth safety function:** **Confinement** - The EBR-II vault is not designed as a confinement boundary for storage. **Shielding** - The concrete shielding of the EBR-II vault provides personnel radiation protection. The shielding also provides neutronic isolation of containers. **Criticality Control** - The overall EBR-II vault physical design and fuel loading (including materials of construction, dimensions in accordance with engineering drawings, and fuel quantity/configuration) were evaluated in the criticality analysis.	The EBR-II vault performs an important defense-in-depth function (DOE G 424.1-1A[a]). The EBR-II vault safety functions are effective for multiple hazards (PRC-PRO-NS-700[b]).
TMBC	**Boundary:** The TMBC physical boundary includes the TMBC compartments with welded closure, and the concrete TMBC assembly and weather cover. **Defense-in-depth safety function:** **Confinement** - Each TMBC compartment with welded closure is the confinement boundary. The robust TMBC design contributes to the assigned damage ratio for the container in unmitigated dose consequence calculations (Appendix A) **Shielding** - The concrete shielding of the TMBC provides personnel radiation protection. The shielding also provides neutronic isolation of containers. **Criticality Control** - The overall TMBC physical design and fuel loading (including materials of construction, dimensions in accordance with engineering drawings, and fuel quantity/configuration) were evaluated in the criticality analysis.	The TMBC performs an important defense-in-depth function (DOE G 424.1-1A[a]). The TMBC safety functions are effective for multiple hazards (PRC-PRO-NS-700[b]).

Table H.7-18. 200 Area Interim Storage Area (ISA) Equipment Important to Safety (cont.)[87]

Equipment	Boundary Definitions and Safety Functions	Basis for ITS and Applicability
LAMPRE EBR-II cask	**Boundary:** The LAMPRE EBR-II cask physical boundary includes the 5-in. inner fuel canister with welded closure and the EBR-II cask assembly, including spacer rings. **Defense-in-depth safety function:** **Confinement** - The LAMPRE EBR-II inner 5-in. diameter fuel canister is the confinement boundary. The robust EBR-II cask system design contributes to the assigned damage ratio for the container in unmitigated dose consequence calculations (Appendix A). **Shielding** - The shielding of the cask provides personnel radiation protection. The shielding also provides neutronic isolation of containers. **Criticality Control** - The overall LAMPRE EBR-II cask physical design and fuel loading (including materials of construction, dimensions in accordance with engineering drawings, and fuel quantity/configuration) were evaluated in the criticality analysis.	The LAMPRE EBR-II cask performs an important defense-in-depth function (DOE G 424.1-1A[a]). The LAMPRE EBR-II cask safety functions are effective for multiple hazards (PRC-PRO-NS-700[b]).
Outside Storage Unit	**Boundary:** The concrete Outside Storage Unit physical boundary includes the concrete structure, base slab, interior storage cavities, closure plug, and exterior steel skin. **Defense-in-depth safety function:** **Confinement** - The Outside Storage Unit is not designed as a confinement boundary for storage. **Shielding** - The concrete shielding of the Outside Storage Unit provides personnel radiation protection. The shielding also provides neutronic isolation of containers. **Criticality Control** - The overall Outside Storage Unit physical design and fuel loading (including materials of construction, dimensions in accordance with engineering drawings, and fuel quantity/configuration) were evaluated in the criticality analysis. A minimum of 12 in. of concrete, steel, and polyethylene-type material above, below, and around each storage position was evaluated in the analysis.	The Outside Storage Unit performs an important defense-in-depth function (DOE G 424.1-1A[a]). The Outside Storage Unit safety functions are effective for multiple hazards (PRC-PRO-NS-700[b]).
ISC Pad 3 Container Restraint System	**Boundary:** The ISC Pad 3 container restraint system physical boundary includes the concrete pad, embedded steel, and aboveground structure. **Defense-in-depth safety function:** **Confinement** - The ISC Pad 3 container restraint system is not designed as a confinement boundary for storage. The ISC Pad 3 above-grade structure provides passive protection to preclude seismic collapse (seismically qualified) onto ISCs in storage.	The container restraint system performs an important defense-in-depth function (DOE G 424.1-1A[a]).

Notes:

[a] DOE G 424.1-1A, *Implementation Guide for Use in Addressing Unreviewed Safety Question Requirements*

[b] PRC-PRO-NS-700, *Safety Basis Development*

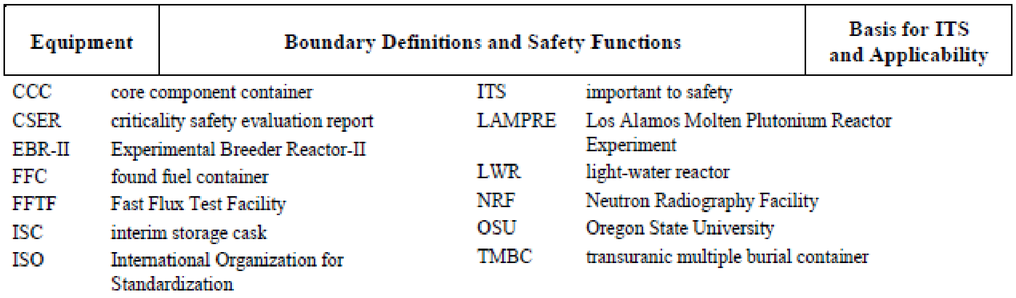
[c] NAC-1 casks are manufactured by Nuclear Assurance Corporation.

[d] Rad-Vault is a trademark of Chem-Nuclear Systems, Inc.

[e] TRIGA is a registered trademark of General Atomics.

[f] DOT-6M containers are manufactured to the standards of the U.S. Department of Transportation.

Table H.7-19. 200 Area Interim Storage Area (ISA) Equipment Important to Safety (cont.)[87]



Equipment	Boundary Definitions and Safety Functions	Basis for ITS and Applicability

CCC	core component container	ITS	important to safety
CSER	criticality safety evaluation report	LAMPRE	Los Alamos Molten Plutonium Reactor Experiment
EBR-II	Experimental Breeder Reactor-II	LWR	light-water reactor
FFC	found fuel container	NRF	Neutron Radiography Facility
FFTF	Fast Flux Test Facility	OSU	Oregon State University
ISC	interim storage cask	TMBC	transuranic multiple burial container
ISO	International Organization for Standardization		

5. What forms of initiating events may lead to degradation or failure of each of the barriers?

CSB: These analyses form a safety basis for the final safety analysis report (FSAR) and present a comprehensive evaluation of the CSB handling- and storage-related activities, natural phenomena, and external hazards that can affect the public, workers, and environment. Single and multiple initiating events from equipment and human error failures in the facility, and human and natural events (i.e., common mode failure) outside of the facility have been considered. The evaluated hazards were documented within the Final Hazards Analysis [HNF-SD-SNF-HIE-001, Rev 3b]. [88]

Some analyzed fires may result in a release of radiological material from an MCO by initiating a drop of the MCO or initiating a structural collapse onto the MCO. No analyzed fires expose the MCO to sufficient heat to cause a breach; however, fire may be present in proximity of an MCO after it is breached by the fire initiated structural collapse or drop. Dose consequences were calculated for one MCO exposed to an external impact (drop or structural collapse). For the analyzed scenarios that result in MCO breach from drop or structural collapse, dose calculations were performed to determine the dose consequence from a fire. [89]

The three (3) accident scenarios resulting in the highest unmitigated doses to the co-located person that are further discussed within this EU document are the following [90]:

MCO internal hydrogen deflagration (54 rem); Mechanical damage of MCO (49 rem); Fires (35.6 rem)

MCO Internal Hydrogen Deflagration: Three design basis events could result in the formation of flammable mixtures of hydrogen and oxygen within an MCO, which, if ignited, could result in a deflagration. The events are (1) radiolytic decomposition of the oxygen containing compounds, (2) introducing oxygen into the MCO during charging, and (3) ingress of oxygen following an MCO breach. The first two events, radiolytic decomposition and introduction of oxygen, have been evaluated further. The third event, ingress of oxygen, is similar to the second event; however, when comparing accident frequencies and consequences, the introduction of oxygen during charging is considered to present a substantially greater risk. **Radiolytic Decomposition**. This scenario involves the radiolytic decomposition of the aluminum hydroxide, aluminum and iron hydrates, free water and water bound as hydrates in the uranium oxide and the potential for flammable mixtures of hydrogen and oxygen in an MCO. Of particular interest is the concentration of oxygen within the MCO. **Introduction of Oxygen into a Multi-**

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[88] HNF-3553-ANXA, Rev 9, pg. 3-5, Carrell, R. D. (2004). Canister Storage Building Hazard Analysis Report, Fluor Hanford. **HNF-SD-SNF-HIE-001, Rev. 3B:** 63 pages.

[89] HNF-3553-ANXA, Rev 9, pg. 3-131

[90] HNF-3553-ANXA, Rev 9, pg. 3-35, and Table 3-8 “Summary of Consequences for Bounding Design Basis Accidents” pg. 3-47

Canister Overpack. This accident involves insertion of inert gas contaminated with oxygen into an MCO being sampled.[91]

MCO Mechanical Damage: Three classifications of accidents have been selected for further evaluation under the Mechanical damage of MCO accident scenario: drop of the MCO or cask–MCO, shear of the MCO by the MHM, and impacts to the MCO other than drops and shears. MCO drops initiated by fire accidents and impacts to an MCO from structural collapse initiated by fire accidents are analyzed in Section 3.4.2.7 within the CSB DSA.[92] The 14 MCO drop scenarios vary which handling equipment (i.e., receiving crane, MCO handling machine) fails to securely hold the MCO, which configuration the drop occurs (i.e., edge, side, or back), and location of the MCO drop (maintenance pit, sampling/weld station, etc.). At CSB, the MCO is hoisted by both the receiving crane and the MHM. The MCO could be sheared, either when it is inside the transportation cask or when it is outside the cask. Several different scenarios that could cause an MCO shear (which would be a localized breach or tear and not complete severance of the MCO) have been considered within the CSB DSA.[93]

Fires involving MCOs: Some analyzed fires may result in a release of radiological material from an MCO by initiating a drop of the MCO or initiating a structural collapse onto the MCO. No analyzed fires expose the MCO to sufficient heat to cause a breach; however, fire may be present in proximity of an MCO after it is breached by the fire initiated structural collapse or drop. [94]

For the analyzed scenarios below, potential MAR is contained in MCOs (inside a cask with the lid off, inside a cask with the lid on, in the receiving or sampling/weld pit, or in the MHM turret). In the analysis of the fire scenarios, below, it is considered that SNF containers may be breached in the following ways[95].

- Excessive Heat: Flame impingement, radiant heat, or smoke layers from a fire may expose SNF containers to excessive heat, which can lead to container breach.

- HNF-S-0426 specifies the MCO/cask is designed to withstand an 800°C fire for 30 min. Fire analysis provided in the CSB FHA indicates that no postulated fire scenario exposes the MCO to temperatures beyond the MCO design capacity, and therefore, no fires result in MCO breach from thermal related stresses.

- Structural Collapse: Flame impingement, radiant heat, or smoke layers from a fire may expose a structural column or beam to excessive heat, degrading its strength. With sufficient heat and duration, the structural member may fail and cause a localized structural collapse of the operating area shelter onto an SNF container, breaching it. Structural columns loose approximately 50 percent of their design strength when heated to 538°C (1000°F); for structural beams, this critical temperature is 593°C (1100°F) (ASTM E119-88, *Standard Test Methods for Fire Tests of Building Construction and Materials*). For conservatism, this analysis assumes structural steel may fail if exposed to smoke layer temperatures in excess of 500°C for five minutes or more. Structural collapse is assumed to breach an MCO (in a cask, a pit, or the turret) when it is in proximity to the collapse. MCOs in storage tubes are protected from structural collapse by the safety-class operations deck, storage tubes, carbon steel basemat embeds, tube base, and vault and, therefore, are assumed to not be breached in a localized structural collapse. In

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[91] HNF-3553-ANXA, Rev 9, pg. 3-94 through pg. 3-96

[92] HNF-3553-ANXA, Rev 9, pg. 3-54

[93] HNF-3553-ANXA, Rev 9, pg. 3-63

[94] HNF-3553-ANXA, Rev 9, pg. 3-131

[95] HNF-3553-ANXA, Rev 9, pg. 3-121 and pg. 3-122

all analyzed scenarios that result in structural collapse onto an MCO, fire may be present in proximity to the breached container.

- MCO Drop: Flame impingement, radiant heat, or smoke layers from a fire may expose crane control systems or mechanical components to excessive heat, causing failures that allow the MCO to be dropped from the crane (receiving crane or MHM). It is assumed that an MCO dropped from the MHM or receiving crane may be breached. In all analyzed scenarios that result in an MCO drop, fire may be present in proximity to the breached MCO.

The CSB accident scenario with the longest duration of time for a fire to burn was around 75 minutes. Most other scenarios had fire times in the order of a couple of minutes to hours.[96]

ISA: See Question 1, Table H.7-11 and Table H.7-12.

6. What are the primary pathways and populations or resources at risk from this source?

CSB: Travel of airborne particulates of spent nuclear fuel contained within the MCOs and an exposure to both radiological and chemical content are of concern via the inhalation exposure pathway. The primary material released under accident conditions is SNF particulate matter, which the majority of this material is oxides of uranium. [97]

ISA: The hazard to the environment from 200 Area ISA operations involves the potential release of contaminants. The release pathway for these contaminants is only via the air to the boundaries and receptors. No liquid release hazards have been identified, and no contaminant releases to the ground or groundwater are involved for the 200 Area ISA. Normal ISA handling or storage activities are expected to have a minor impact on the local and regional environment.[98]

7. What is the time frame from each of the initiating events to human exposure or impacts to resources?

CSB: Because SNF contains no corrosive chemicals, a conservative exposure averaging time of 15 minutes was used in the calculation of average air concentration.[97]

ISA: Not specified in the ISA DSA.

8. Are there current on-going releases to the environment or receptors?

CSB: No.

ISA: No.

POPULATIONS AND RESOURCES CURRENTLY AT RISK OR POTENTIALLY IMPACTED

Facility Worker

CSB: See Co-located Person below.

ISA: See Co-located Person below.

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[96] HNF-3553-ANXA, Rev 9, pgs. 3-123 through 3-130. Table 3-32 on pg. 3-124 shows the fire durations for varying scenarios involving the trailer vestibule area within the CSB – in which scenario F1(b) has an estimated fire time of 75 minutes. Scenario F1(b) considers a transporter trailer inside the vestibule where a tractor is disconnected and not present while the outer vestibule door is closed and megadoor is closed. The tractor brakes overheat/already are overheated at arrival and the transporter ignites the 12 trailer tires.

[97] HNF-3553-ANXA, Rev 9, pg. 3-48

[98] HNF-40627, Rev 2, pg. 3-25

Co-Located Person (CP)

CSB: Of the 7 DBAs evaluated within the CSB DSA[99,100], the three (3) accident scenarios resulting in the highest unmitigated doses to the co-located person[101]. The unmitigated dose calculates were considered "High" accordingly if the unmitigated dose calculated is greater than or equal to 25 rem. The Fires accident scenario was used to populate the risk rating tables due to availability of data for both unmitigated and mitigated doses were provided in the CSB DSA[102]. Mitigated Doses to the CP from fire accident scenarios were the same as the unmitigated doses[103] (35.6 rem).

ISA: Two accident scenarios were evaluated with calculated doses for: An external Impact/Drop Accident Scenarios Involving Aboveground Storage of Spent Nuclear Fuel Containers with an estimated unmitigated dose to the co-located person of approximately 0.18 rem which is considered "Low"; and a Vehicle Fuel Fire Accident Scenarios Involving Aboveground Storage of Spent Nuclear Fuel Containers with an estimated unmitigated dose to the co-located person is approximately 0.0008 rem which is considered, "Non-discernible, ND".

Public

CSB: Calculated unmitigated dose consequences at the Hanford site boundary receptor were used as the basis for the MOI risk ratings[104]. Unmitigated Dose to the MOI for the top 3 accident scenarios were: MCO internal hydrogen deflagration (0.06 rem); Mechanical damage of MCO (0.055 rem); Fires (0.0206 rem). The human health ratings for all three scenarios are considered "Non-discernible, ND" for a MOI if the unmitigated dose calculated is less than 0.1 rem.

ISA: Two accident scenarios were evaluated with calculated doses: An External Impact/Drop Accident Scenarios Involving Aboveground Storage of Spent Nuclear Fuel Containers with an estimated

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99 HNF-3553-ANXA, Rev 9, pg. vi, Dose calculation methodology to the hypothetical human receptor at 100 m away from the CSB facility was defined by risk evaluation guidelines and selection of safety-significant features according to PRC-PRO-NS-700, Safety Basis Development [HNF-3553-ANXA, Rev 9, pg. 1-4 and pg. 1-5]

[100] Other estimated unmitigated doses were: MCO internal hydrogen deflagration (54 rem); Mechanical damage of MCO (49 rem); Fires (35.6 rem). Calculated estimations of dose to a receptor 100m away from the source term were also provided for accidents at the CSB that involved MCOs containing Shippingport spent fuel canister (SSFC) material. Mechanical damage and gaseous release accidents were selected for further analysis (SNF-5973). It was determined that the consequences (6.3 rem CW and 7.1E-03 rem MOI for mechanical damage; 8.5E-03 rem CW and 9.7E-06 rem MOI for gaseous release) were bounded by the MCO accident analyses and the controls specified for scrap/fuel MCOs are appropriate to prevent/mitigate SSFC accidents. [100]

Unmitigated dose estimations were also performed within the CSB Final Hazards Analysis. The FFC and TMBC hazard evaluation documented in HNF-SD-SNF-HIE-001 concluded that all radiological dose consequences were "low" for the FFC and TMBC activities. Preliminary scoping calculations for FFCs/TMBCs in Attachment D of HNF-SD-SNF-HIE-001showed that the maximum unmitigated CW dose consequence was approximately 0.4 rem and the maximum MOI dose consequence was approximately 2.5E-04 rem. Therefore, no formal accident analysis was required for these spent fuel canisters. Reference: HNF-3553-ANXA, Rev 9, Table 3-34, pgs.3-133 through 3-139 and HNF-3553-ANXA, Rev 9, pg. 3-35

101HNF-3553-ANXA, Rev 9, pg. 3-35, and Table 3-8 "Summary of Consequences for Bounding Design Basis Accidents" pg. 3-47

[102] HNF-3553-ANXA, Rev 9, Table 3-34, pgs.3-133 through 3-139

103 HNF-3553-ANXA, Rev 9, Table 3-34, pgs.3-133 through 3-139

[104] Two locations were evaluated within the CSB DSA: Hanford Site boundary receptor (offsite), defined at a distance of 17,390 m east of the CSB; and the Highway 240 receptor, defined at a distance of 9,280 m west of the CSB (from HNF-3553-ANXA, Rev 9, pg. 1-4 and pg. 1-5. Letter 9504327, 1995, "Clarification of Hanford Site Boundaries for Current and Future Use in Safety Analyses," (Letter to Contractors, Richland, Washington; Director, Pacific Northwest Laboratory; President, Westinghouse Hanford Company; September 26), U.S. Department of Energy, Richland, Operations Office, Richland, Washington.). Highway 240 (onsite, approximately 9,280 m west of CSB)—no defined evaluation guideline; doses calculated for informational purposes only (Letter 9504327, "Clarification of Hanford Site Boundaries for Current and Future Use in Safety Analyses.") [HNF-3553-ANXA, Rev 9, pg. 3-35]

unmitigated dose to the MOI as approximately 0.00009 rem which is considered, “Non-discernible, ND”; and a Vehicle Fuel Fire Accident Scenarios Involving Aboveground Storage of Spent Nuclear Fuel Containers with an estimated unmitigated dose to the MOI as approximately 0.00004 rem which is considered “Non-discernible, ND”.

Groundwater and Columbia River

Not applicable

Ecological Resources

Summary of Ecological Review:

- 95% of the EU consists of level 0 habitat; level 2 habitat in the EU is located on the south and southwest margin of the EU.
- Loss of level 2 habitats associated with remediation actions within the EU will not alter connectivity of habitat.
- In 2009 the presence of black-tailed jackrabbits, a Washington state candidate species, was noted in habitats within the buffer area.

Cultural Resources

The CP-OP-5, CSB EU is located within the 200-East Area of the Hanford Site, an area known to have low potential to contain Native American Precontact and Ethnographic archaeological resources and Pre-Hanford Early Settlers/Farming resources. Much of the 200 Areas were addressed in a cultural resources report entitled *Archaeological Survey of the 200 East and 200 West Areas, Hanford Site* (Chatters and Cadoret 1990). The focus of this archaeological survey was on inventorying all undisturbed portions of the 200-East and 200-West Areas. This report concluded that much of the 200-East and 200-West Areas can be considered areas of low archaeological potential with the exception of intact portions of an historic/ethnohistoric trail/road corridor which runs through the 200-West Area.

The entire EU was inventoried for cultural resources under HCRC#87-200-004 (Chatters 1987). This review did not result in the identification of any cultural resources within the EU. It is unknown if an NHPA Section 106 review has been completed specifically for remediation of the CP-OP-5, CSB EU. It is unlikely that intact archaeological resources are present within the surface and subsurface of the EU due to the extensive ground disturbance from Hanford Site activities.

Archaeological sites, buildings and Traditional Cultural Properties (TCPs) located within the EU[105]

- There are no known archaeological sites, inventoried historic buildings, or TCPs located within the CP-OP-5, CSB EU.

Archaeological sites, buildings and TCPs located within 500 meters of the EU

- One archaeological site, associated with the Manhattan Project and Cold War Era Landscape, is located within 500 meters of the EU. This site has been determined a National Register-eligible property, and is considered a contributing property within the Manhattan Project and Cold War Era Historic District. In accordance with the *Hanford Site Manhattan Project and Cold War Era Historic*

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[105] Traditional cultural property has been defined by the National Park Service as “a property, a place, that is eligible for inclusion on the National Register of Historic Places because of its association with cultural practices and beliefs that are (1) rooted in the history of a community, and (2) are important to maintaining the continuity of that community’s traditional beliefs and practices” (Parker and King 1998).

District Treatment Plan (DOE/RL-97-56) (DOE-RL 1998), all documentation requirements have been completed for this property. Direct impacts to contributing components of the archaeological site however have not been addressed and are dealt with on a project-by-project basis.

- Segments of the National Register-eligible Hanford Site Plant Railroad, a contributing property within the Manhattan Project and Cold War Era Historic District, with documentation required, are located within 500 meters of the CP-OP-5 CSB EU. In accordance with the *Hanford Site Manhattan Project and Cold War Era Historic District Treatment Plan (*DOE/RL-97-56) (DOE-RL 1998), all documentation requirements have been completed for this property.
- There are 12 National Register-eligible buildings that are contributing properties within the Manhattan Project and Cold War Era Historic District that are located within 500-meters of the CP-OP-5, CSB EU (all 12 are contributing within the Manhattan Project and Cold War Era Historic District, 3 with individual documentation required, and 9 with no additional documentation required) In accordance with the *Hanford Site Manhattan Project and Cold War Era Historic District Treatment Plan (*DOE/RL-97-56) (DOE-RL 1998), all documentation requirements have been completed for these properties. These include:

Appendix K, Table 56, has additional information about the 12 buildings that are National Register-eligible Manhattan Project and Cold War Era buildings located within 500-meters of the CP-OP-5, CSB EU.

Closest Recorded TCP

There are two recorded TCPs associated with the Native American Precontact and Ethnographic Landscape that are visible from the CP-OP-5, CSB EU.

CLEANUP APPROACHES AND END-STATE CONCEPTUAL MODEL

Selected or Potential Cleanup Approaches

Insufficient information.

Contaminant Inventory Remaining at the Conclusion of Planned Active Cleanup Period

Insufficient information.

Risks and Potential Impacts Associated with Cleanup

Insufficient information.

POPULATIONS AND RESOURCES AT RISK OR POTENTIALLY IMPACTED DURING OR AS A CONSEQUENCE OF CLEANUP ACTIONS

Facility Worker

Dependent on D&D Methods yet to be determined. (Unknown)

Co-located Person

Dependent on D&D Methods yet to be determined. (Unknown)

Public

Dependent on D&D Methods yet to be determined. (Unknown)

Groundwater and Columbia River

Not applicable

Ecological Resources

No cleanup decisions have been made for this EU. As a result, the potential effects of cleanup on ecological resources cannot be made for the active cleanup evaluation period.

Cultural Resources

No cleanup decision for the remaining waste treatment, storage and disposition facilities.

ADDITIONAL RISKS AND POTENTIAL IMPACTS IF CLEANUP IS DELAYED

Dependent on D&D Methods yet to be determined. (Unknown)

NEAR-TERM, POST-CLEANUP STATUS, RISKS AND POTENTIAL IMPACTS

Dependent on D&D Methods yet to be determined. (Unknown)

POPULATIONS AND RESOURCES AT RISK OR POTENTIALLY IMPACTED AFTER CLEANUP ACTIONS (FROM RESIDUAL CONTAMINANT INVENTORY OR LONG-TERM ACTIVITIES)

Table H.7-20. Summary of Populations and Resources at Risk or Potentially Impacted after Cleanup.

Population or Resource		Risk/Impact Rating	Comments
Human	Facility Worker	IS	(IS = insufficient information)
	Co-located Person	IS	
	Public	IS	
Environmental	Groundwater	*Not Discernible* (*ND*)	No risks because of the nature of the facilities that comprise the EU.
	Columbia River	*ND*	
	Ecological Resources[a]	No cleanup decisions have been made for this EU. Estimated to be ND to Low	Post-cleanup monitoring might pose a risk to level 3 and above resources in the buffer area. Possible disruption of migratory birds.
Social	Cultural Resources[a]	No cleanup decisions have been made for this EU. Estimated to be: **Native American** Direct: Unknown Indirect: Known **Historic Pre-Hanford** Direct: Unknown Indirect: None **Manhattan/Cold War** Direct: None Indirect: None	Permanent direct effects are possible if residual contamination remains after remediation. National Register eligible Manhattan Project/Cold War Era significant resources located within 500 meters of the EU will be demolished, but they have already been mitigated.

a. For both Ecological and Cultural Resources see Appendices J and K, respectively, for a complete description of Ecological Field Assessments and literature review for Cultural Resources. Ecological ratings are described in Table 4-11 of the Final Report. (IS = insufficient information)

LONG-TERM, POST-CLEANUP STATUS – INVENTORIES AND RISKS AND POTENTIAL IMPACT PATHWAYS

Dependent on D&D Methods yet to be determined. (Unknown)

PART VII. SUPPLEMENTAL INFORMATION AND CONSIDERATIONS

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