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Design Requirements Document for the Interim Store Phase I Solidified High-Level Waste, Function 4.2.4.1.2

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Abstract: The U.S. Department of Energy (DOE) has embarked upon a course to acquire Hanford Site tank waste treatment and immobilization services using privatized facilities. This plan contains a two-phased approach. Phase I is a "proof-of-principle/commercial demonstration-scale" effort and Phase II is a full-scale production effort. In accordance with the planned approach, interim storage and disposal of various products from privatized facilities are to be DOE furnished. The path forward adopted for Phase I solidified high-level waste (HLW) interim storage entails use of Vaults 2 and 3 in the Hanford Site Spent Nuclear Fuels Canister Storage Building (CSB), to be located in the Hanford Site 200 East Area. This design requirements document establishes the functions, with associated requirements, allocated to the Phase I solidified HLW interim storage system. These requirements will be used as the basis for conceptual design of the CSB and supporting systems. This document will also provide the basis for preparation of a performance specification for design and construction activities necessary to achieve the overall project mission.

Approved for Public Release

DESIGN REQUIREMENTS DOCUMENT FOR THE INTERIM STORE PHASE I SOLIDIFIED HIGH-LEVEL WASTE, FUNCTION 4.2.4.1.2

September 10, 1996

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Prepared for

U.S. Department of Energy
Richland, Washington

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LIST OF ACRONYMS

A-E	Architect-Engineer
ALARA	as low as reasonably achievable
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
AWWA	American Water Works Association
CFR	*Code of Federal Regulations*
CMAA	Crane Maintenance Association of America
CSB	canister storage building
DBA	design basis accident
DOE	U.S. Department of Energy
DRD	design requirement documents
D&D	decontamination and decommissioning
ETF	Effluent Treatment Facility
HEPA	high-efficiency particulate air
HLW	high-level waste
HSRCM-1	*Hanford Site Radiological Control Manual*
HVAC	heating, ventilation, and air conditioning
ICBO	International Conference of Building Officials (Uniform Building Code)
IES	Illumination Engineering Society of America
ISO	International Standards Organization
LERF	Liquid Effluent Retention Facility
NEC	National Electric Code
NEPA	*National Environmental Policy Act*
NFPA	National Fire Protection Association
PNL	Battelle Pacific Northwest Laboratories
QAPP	Quality Assurance Program Plan
SGW	system-generated waste
RCRA	*Resource Conservation and Recovery Act*
RL	U.S. Department of Energy, Richland Operations Office
SNF	spent nuclear fuel
TBD	to be determined
TEDF	Treated Effluent Disposal Facility
TWRS	Tank Waste Remediation System
UPS	uninterruptible power supply
WAC	Washington Administrative Code
WAPS	Waste Acceptance Product Specifications
WASRD	Waste Acceptance System Requirements Document
WHC	Westinghouse Hanford Company

LIST OF DEFINITIONS

Canister: Synonymous with either a standard canister or a large canister containing either immobilized high-level waste or secondary high-level waste.

Container: Synonymous with a separated cesium container.

Design Life: The intended normal and reliable life of a structure, system, or component.

Interface: System boundary across which material, data, and/or energy passes.

Interim Storage: Post-production storage (up to 40 years) of solidified high-level waste before shipment to the federal geologic repository.

Immobilized HLW: High-level waste product from the immobilization plant that is presumed to be vitrified material (glass).

Large Immobilized Canister: A stainless steel canister 0.61 m in diameter by 4.50 m tall containing vitrified high-level waste.

Load-In/Load-Out Operational Mode: System and facility configuration during active receipt at or departure from the solidified high-level waste interim storage system.

Mission: The transformation of a set of unacceptable initial conditions to acceptable final conditions.

Rework: Placing a failed immobilized high-level waste canister or separated cesium container inside an overpack.

Separated Cesium: Dry, free-flowing cesium (^{137}Cs) product from the Phase I low-level waste demonstration plant.

Standard Immobilized HLW Canister: A stainless steel high-level waste canister that is 0.61 m in diameter by 3.00 m tall which contains vitrified high-level waste.

Solidified High-Level Waste: Generic reference to immobilized high-level waste canisters, immobilized transuranic waste canisters, separated cesium containers, and dispositioned cesium/strontium capsules.

Solidified High-Level Waste Interim Storage System: The assembly of the solidified high-level waste interim storage facility (i.e., Canister Storage Building) and associated support facilities (offices, overpack cell, etc.) for Phase I. Also referred to as the Phase I solidified high-level waste interim storage complex.

Storage Operational Mode: System and facility configuration during interim storage after receipt and before shipment to federal repository.

System-Generated Waste: Solid and liquid waste and untreated gaseous effluents generated during the operation of the Phase I Solidified HLW Interim Storage facility.

Transporter: Vehicle designed to move transportation casks.

DESIGN REQUIREMENTS DOCUMENT FOR THE INTERIM STORE PHASE I SOLIDIFIED HIGH-LEVEL WASTE, FUNCTION 4.2.4.1.2

1.0 SCOPE

This design requirements document (DRD) establishes the functions, with associated requirements, allocated to the Phase I solidified high-level waste (HLW) interim storage system. Solidified HLW encompasses immobilized HLW canisters and separated cesium containers. The purpose of this DRD is to fully identify the functions, performance requirements, and constraints necessary to define the Phase I Solidified HLW Interim Storage Project. Based on this information, a performance specification will be prepared for the design and construction activities necessary to achieve the overall project mission.

1.1 IDENTIFICATION

Program: Tank Waste Remediation System (TWRS), Interim Store Phase I Solidified Waste (Function 4.2.4.1.2)

Project: Phase I Solidified HLW Interim Storage Subproject (Project W464)

Mission: Transport, receive, and temporarily store canisters of immobilized HLW and any other identified HLW. Eventually retrieve immobilized HLW for shipment to a geologic repository, and load out other HLW for further processing or final disposal, as required.

1.2 SYSTEM OVERVIEW

The U.S. Department of Energy (DOE) has embarked upon a course to acquire Hanford Site tank waste treatment and immobilization services using privatized facilities (RL 1996). This plan contains a two-phased approach. Phase I is a "proof-of-principle/commercial demonstration-scale" effort, and Phase II is a full-scale production effort. In accordance with the planned approach, interim storage and disposal of various products from privatized facilities will be furnished by the DOE. The path forward adopted for Phase I solidified HLW interim storage involves using excess vaults in the existing spent nuclear fuel (SNF) Canister Storage Building (CSB) with added flexibility features to facilitate constructing one or more vaults at a later date (Calmus 1996). The architecture for Phase II solidified HLW interim storage has not yet been selected.

The systems engineering process, as implemented by the TWRS, has established the functions and requirements necessary to accomplish the TWRS mission. The initial TWRS functional baseline has been defined through four levels of functional decomposition (WHC 1995a). The TWRS functional baseline was further decomposed below the dispose waste function to a point where individual projects could be identified (WHC 1996a). This DRD is a continuation of the TWRS systems engineering process in accordance with established policy and guidance (WHC 1996b).

Functions that form the basis for Phase I solidified HLW interim storage are depicted in Figures 1-1 and 1-2. The functional hierarchy to the fourth level is taken from the TWRS baseline (WHC 1995a). Functions at the fifth level are taken from the technical requirements specification for dispose tank waste (WHC 1996a). Functions at the six level result from the functional decomposition undertaken as part of this DRD development effort.

1.3 DOCUMENT OVERVIEW

This DRD establishes the basis for developing the system, which is required to accommodate Phase I solidified HLW interim storage. This basis includes the system definition, characteristics, and interfaces. The performance requirements and constraints applicable to the system are also provided. Where source documents are not specified, this DRD is the authority for the requirement (i.e., the requirement is derived from higher-level functions, engineering judgment, good design practice, etc.).

Given that the Phase I solidified HLW interim storage system is an evolving and long-term endeavor, some physical characteristics of the system are unknown or are subject to change. Where information is to be provided at a later date, the information is labeled TBD" (to be determined). Where information is tentative, the information is labeled "Hold."

The use of the words "shall," "should," "may," and "will" within this DRD express the following meaning. "Shall" indicates a provision that is binding. "Should" and "may" indicate nonmandatory, but conceptually desirable, provisions. Design development could render the "should' and "may" provisions infeasible, impractical, excessively costly, or otherwise unimplementable from the designer's perspective. "Will" is a simple declaration of purpose or futurity.

Figure 1-1. Function Hierarchy to Level 4.

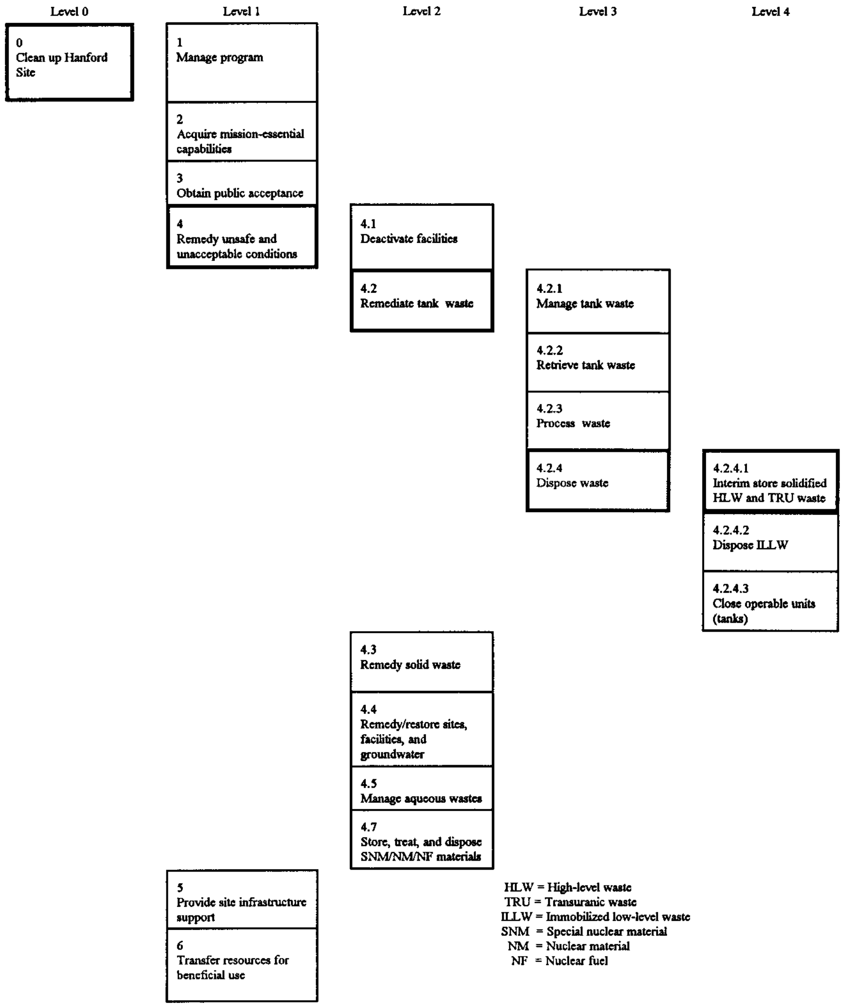
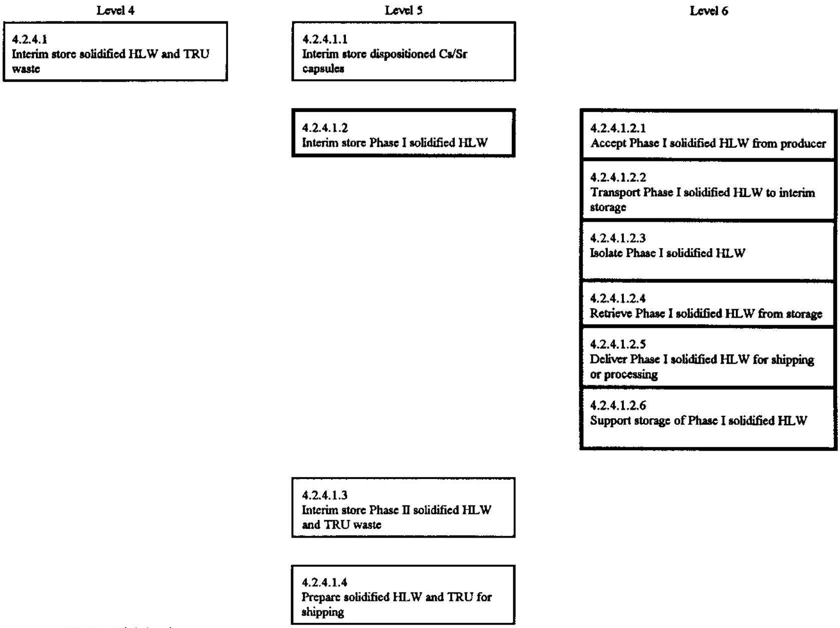


Figure 1-2. Decomposition of Function 4.2.4.1.



HLW = High-level waste
TRU = Transuranic waste

2.0 APPLICABLE DOCUMENTS

The following documents form a part of the DRD to the extent specified in the applicable sections where cited. Any conflicts between this DRD and the documents referenced in the applicable sections shall be brought to the buyer's attention for resolution.

2.1 GOVERNMENT DOCUMENTS

Federal government regulations, Washington State regulations, and DOE Orders have been reviewed to determine constraints applicable to the design, construction, and operation of the Phase I solidified HLW interim storage system. To the extent specified in the sections where cited, the references listed in Table 2-1 represent requirements imposed on solidified HLW interim storage by sources external to the TWRS Program.

2.2 NON-GOVERNMENT DOCUMENTS

Selected federal government regulations, Washington State regulations, and DOE Orders have been interpreted for implementation to establish a uniform policy for the Hanford Site. The U.S. Department of Energy, Richland Operations Office (RL) has prepared a collection of Hanford Site-specific requirements and specifications. This Site-specific information supplements nationally recognized codes and standards. To the extent specified in the sections where cited, the references listed in Table 2-2 represent requirements imposed on solidified interim storage by sources internal to the TWRS Program.

The CSB was designed and constructed primarily for storage of SNF. New installations and retrofit modifications are required to accommodate a Phase I solidified HLW interim storage mission. The documents listed in Table 2-3 identify design details of the existing CSB.

Table 2-1. Applicable Constraint Documents. (2 sheets)

Document identifier	Title
United States statutes	
29 USC 655, et. seq.	*Occupational Safety and Health Act of 1970*
42 USC 4321, et. seq.	*National Environmental Policy Act (NEPA) of 1969*
42 USC 6901, et. seq.	*Resource Conservation and Recovery Act (RCRA) of 1976*
Code of Federal Regulations (CFR)	
10 CFR 20 (1994)	"Standards for Protection Against Radiation"
10 CFR 50 (1994)	"Domestic Licensing of Production and Utilization Facilities"
10 CFR 72 (1994)	"Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste"
10 CFR 435 (1994)	"Energy Conservation Voluntary Performance Standards for New Buildings; Mandatory for Federal Buildings"
10 CFR 830 (1994)	Nuclear Safety Management, Subpart a, General Provisions, Section 830.120, "Quality Assurance Requirement"
10 CFR 835 (1993)	"Occupational Radiation Protection"
10 CFR 1021 (1994)	"National Environmental Policy Act Implementation Procedures"
29 CFR 1910 (1994)	"Occupational Safety and Health Standards"
40 CFR 61 (1994)	"National Emissions Standards for Hazardous Air Pollution"
40 CFR 264 (1986)	"Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities"
40 CFR 1500-1508 (1986)	"Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act"
Washington Administrative Code (WAC)	
WAC 173-303	"Dangerous Waste Regulations"
WAC 173-400	"General Air Regulations"
WAC 173-460	"Toxic Air Pollutants"
WAC 173-480	"Ambient Air Quality Standards and Emission Limits for Radionuclides"
WAC 246-247	"Radiation Protection - Air Emissions"
WAC 246-272	"On Site Sewage System"
WAC 246-290	"Public Water Supplies"
U.S. Department of Energy (DOE) Directives and Standards	
DOE Order 460.1 (1995a)	*Packaging and Transportation Safety*
DOE Order 5300.1C (1992a)	*Telecommunications*
DOE Order 5400.5 (1990)	*Radiation Protection of the Public and the Environment*
DOE Order 5480.4 (1984)	*Environmental Protection, Safety, and Health Protection Standards*
DOE Order 5480.7A (1993a)	*Fire Protection*

Table 2-1. Applicable Constraint Documents. (2 sheets)

Document identifier	Title
DOE Order 5480.10 (1985)	*Contractor Industrial Hygiene Program*
DOE Order 5480.20A (1994a)	*Personnel Selection, Qualification, Training and Staffing Requirements at DOE Reactor and Non-Reactor Facilities*
DOE Order 5480.23 (1992b)	*Nuclear Safety Analysis Reports*
DOE Order 5480.24 (1992c)	*Nuclear Criticality Safety*
DOE Order 5480.28 (DOE 1993b)	*Natural Phenomena Hazards Mitigation*
DOE Order 5480.31 (1993c)	*Startup and Restart of Nuclear Facilities Operational Readiness Review and Readiness Assessments*
DOE Order 5483.1A (1983)	*Occupational Safety and Health Program for DOE Contractor Employees at Government-Owned Contractor-Operated Facilities*
DOE Order 5484.1 (1981)	*Environmental Protection, Safety, and Health Protection Information Reporting Requirements*
DOE Order 5500.7B (1991)	*Emergency Operations Record Protection Program*
DOE Order 5632.1C (1994b)	*Protection and Control of Safeguards and Security Interests*
DOE-M 5632.1C-1 (1994)	*Manual for Protection and Control of Security Interests*
DOE Order 5820.2A (1988)	*Radioactive Waste Management*
DOE Order 6430.1A (1989)	*General Design Criteria*
DOE-STD-1020-94 (1994d)	*Natural Phenomena Hazard Design and Evaluation Criteria for Department of Energy Facilities*
DOE-STD-1021-93 (1993d)	*Performance Categorization Criteria for Structures, Systems, and Components at DOE Facilities Subject to Natural Phenomena Hazards*
DOE-STD-1022-94 (1994e)	*Natural Phenomena Hazards Site Characterization Criteria*
DOE-STD-1023-95 (1995b)	*Natural Phenomena Hazards Assessment Criteria*
DOE-STD-3009-94 (1994f)	*Preparation Guide for U.S. Department of Energy Non-reactor Nuclear Facilities Safety Analysis Report*
Miscellaneous DOE requirements	
DOE-95-SWT-186 (1995c)	*Hazardous Material Packaging and Shipping*
DOE/EM-0093 (DOE/EM 1995)	*Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms (WAPS)*
DOE/RL-92-36 (RL 1993a)	*Hanford Site Hoisting and Rigging Manual*
DOE/RW-0333P (DOE/RW 1995)	*Quality Assurance Requirements and Description for Civilian Radioactive Waste Management (QARD)*
DOE/RW-0351P (DOE/RW 1996)	*Waste Acceptance System Requirements Document (WASRD)*

Table 2-2. Applicable Requirement Documents. (2 sheets)

Document identifier	Title
Codes and standards	
ANSI/ANS-3.2-88 (ANSI/ANS 1988)	*Administrative Controls and Quality Assurance for the Operational Phase of Nuclear Power Plants*
ANSI/ASHRAE/IES 90A-1980 (ANSI/ASHRAE/IES 1980)	*Energy Conservation in New Building Design*
ANSI N300-1975 (ANSI 1975)	*Design Criteria for Decommission of Nuclear Fuel Reprocessing Plants*
API Standard 650 (API 1993)	*Welded Steel Tanks for Oil Storage*
ASHRAE HANDBOOK (ASHRAE 1993)	*ASHRAE Handbook--Fundamentals*
ASHRAE 52.1-1992 (ASHRAE 1992)	*Gravimetric and Dust-Spot Procedures for Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter*
ASME Section III (ASME 1995a)	*Boiler and Pressure Vessel Codes, Section III, Rules for Construction of Nuclear Power Plant Components*
ASME Section VIII (ASME 1995b)	*Boiler and Pressure Vessel Codes, Section VIII, Rules for Construction of Pressure Vessels*
ASME/ANSI B31.9-1988 (ASME/ANSI 1988)	*Building Services Piping Code*
ASME B30 Series (ASME 1994a)	*Miscellaneous Specifications for Cranes, Hoists, and Hooks*
ASME B31.1-1992 (ASME 1992)	*Power Piping*
ASME B31.3-1990 (ASME 1990)	*Chemical Plant and Petroleum Refinery Piping*
ASME N509-1989 (ASME 1989a)	*Nuclear Power Plant Air-Cleaning Units and Components*
ASME N510-1989 (ASME 1989b)	*Testing of Nuclear Air Treatment Systems*
ASME NOG-1-1989 (ASME 1989c)	*Rules for Construction of Overhead and Gantry Cranes (top Running Bridge, Multiple Girder)*
ASME NQA-1-1994-IA (ASME 1994b)	*Quality Assurance Program Requirements for Nuclear Facility Applications*
AWWA	*American Water Works Association*
CGA P-1-1991 (CGA 1991)	*Safe Handling of Compressed Gas in Containers*
CMAA Specification #70 (CMAA 1994)	*Specifications for Top Running Bridge and Gantry Type Multiple Girder Electric Overhead Traveling Cranes*
ICBO (ICBO 1991)	*Uniform Plumbing Code*
ICBO (ICBO 1994)	*Uniform Building Code*

Table 2-2. Applicable Requirement Documents. (2 sheets)

Document identifier	Title
IEEE C2-1993 (IEEE 1993)	*National Electrical Safety Code*
IES Standards (IES 1993)	*Illumination Engineering Society of America*
ISO 9000 Series (ISO 1994)	*Quality Management and Quality Assurance Standards*
NEMA	*National Electrical Manufacturers Association*
NFPA 13 (NFPA 1994a)	*Installation of Sprinkler Systems*
NFPA 70 (NFPA 1993a)	*National Electrical Code*
NFPA 72 (NFPA 1993b)	*National Fire Alarm Code*
NFPA 101 (NFPA 1994b)	*Life Safety Code*
NUREG-0554 (NRC 1979)	*Single Failure-Proof Cranes for Nuclear Power Plants*
NUREG-0700 (NRC 1981)	*Guidelines for Control Room Design Reviews*
Hanford Site standards and miscellaneous documents	
A/E Standard, GC-LOAD-01 (Kaiser 1996a)	*Standard Architectural-Civil Design Criteria, Design Loads for Facilities*
A/E Standard, GH-CLIM-01 (Kaiser 1996b)	*Standard Mechanical Design Criteria for Heating, Ventilation, and Air Conditioning*
HSRCM-1 (RL 1993b)	*Hanford Site Radiological Control Manual*
MIL-STD-1472D (DOD 1993)	*Human Engineering Design Criteria for Military System Equipment and Facilities*
PNL-6577 (PNL 1988)	*Health Physics Manual of Good Practices for Reducing Exposure to Levels that are ALARA*
WHC-CM-2-14	*Hazardous Materials Packaging and Shipping*
WHC-CM-4-3	*Industrial Safety Manual*
WHC-CM-4-29	*Nuclear Criticality Safety Manual*
WHC-CM-4-46	*Safety Analysis Manual*
WHC-CM-7-5	*Environmental Compliance*
WHC-EP-0063-04 (Willis 1993)	*Hanford Site Solid Waste Acceptance Criteria*
WHC-IP-1043 (WHC 1995b)	*WHC Occupational ALARA Program*
WHC-SD-GN-DGS-30011 (WHC 1994)	*Radiological Design Guide*

Table 2-3. Canister Storage Building Documents.

Document identifier	Title
Drawings	
TBD	TBD
Specifications	
TBD	TBD
Safety Documents	
TBD	TBD

3.0 SYSTEM REQUIREMENTS

3.1 SYSTEM DEFINITION

This section briefly describes the functions and external interfaces for the Phase I Solidified HLW Interim Storage Project. Major program assumptions are also identified and the associated risks are discussed.

3.1.1 Interface Description

A description of the system that addresses the Phase I Solidified HLW Interim Storage Project is provided in the following sections, including functions and interfaces.

3.1.1.1 Functional Definition. The initial TWRS functional baseline established Function 4.2.4.1, Interim store solidified HLW and transuranic (TRU) waste (WHC 1995a). The interim store HLW and TRU waste function has been further decomposed as a result of this DRD development effort. The results of this process are presented in Table 3-1. Table 3-2 defines the inputs and outputs to the Phase I solidified HLW interim storage functions. The primary scope of these functions is to provide safe, economic, environmentally sound receipt and storage of solidified HLW until the solidified HLW is transferred offsite to the federal geologic repository for disposal or onsite to a treatment facility for further processing.

3.1.1.2 Interface Definition. This section provides a description of external interfaces for the Phase I solidified HLW interim storage function.

3.1.1.2.1 Other TWRS Elements Interfaces. The Phase I privatization production facilities provide the features required to prepare and package solidified HLW. The canisters and containers are furnished by the production facility contractor(s). At the production facilities, a solidified HLW package (i.e., immobilized HLW canister or separated cesium container) is placed in a transportation cask and the cask is loaded onto a transportation vehicle.

Upon acceptance of the product by the DOE, responsibility for solidified HLW transfers to the Solidified HLW Interim Storage Program and the casks are transported to the CSB. Transportation casks and transporters shall be provided by the Phase I Solidified HLW Interim Storage System Project and operated by the Storage and Disposal Program. Basis: RL 1996.

Table 3-1. Function Description. (4 sheets)

Inputs	Function	Outputs
• Cesium product for storage • Cesium product production information • Infrastructure support for interim storage (IS) Phase I solidified high-level waste (HLW) • Phase I immobilized HLW (IHLW) for storage • Phase I IHLW production information • Raw materials for IS Phase I solidified HLW	**4.2.4.1.2** **Interim store Phase I solidified HLW** Accept onsite transport casks loaded with Phase I solidified HLW (i.e., IHLW canisters or cesium product containers). Transport the casks from the production facilities to the interim storage site. Remove Phase I solidified HLW from the onsite transport casks and emplace in their designated storage locations. Control Phase I solidified HLW storage environment and monitor for containment integrity. Retrieve Phase I solidified HLWs from their storage locations and prepare them for loading into onsite transport casks. Load Phase I solidified HLW into casks, and load the casks onto transport vehicles. Transport casks containing cesium product to the HLW immobilization facility, and transfer cesium product container responsibility to the HLW immobilization process. Transport casks containing IHLW canisters to an onsite shipping cask loading station. Provide support services for the IS Phase I HLW function. Subfunctions: • Accept Phase I solidified HLW from producers • Transport Phase I solidified HLW to interim storage • Isolate Phase I solidified HLW • Retrieve Phase I solidified HLW from storage • Deliver Phase I solidified HLW for shipping or processing • Support IS Phase I solidified HLW	• Cesium product for processing • Cesium product storage information • Cesium product transport mechanism • IS Phase I solidified HLW excess facilities • IS Phase I solidified HLW garbage • IS Phase I solidified HLW hazardous waste • IS Phase I solidified HLW prepared solid waste • IS Phase I solidified HLW treated gaseous effluents • IS Phase I solidified HLW treated liquid effluents • IS Phase I solidified HLW untreated liquid effluents • Phase I IHLW for disposal • Phase I IHLW storage information • Phase I IHLW transport mechanism

Table 3-1. Function Description. (4 sheets)

Inputs	Function	Outputs
• Cesium product for storage • Cesium product production information • Phase I IHLW for storage • Phase I IHLW production information	**4.2.4.1.2.1** **Accept Phase I solidified HLW from producers** Verify that producer-generated certification documents for Phase I solidified HLW satisfy interim storage acceptance requirements and repository acceptance requirements. Verify that producer-generated certification documents for the sealed transport cask meets onsite transportation requirements. Accept responsibility for the Phase I solidified HLW from the producer. Collect system-generated waste (SGW) for disposition by the support interim store Phase I solidified HLW function.	• Accept Phase I solidified HLW from producers SGW • Accepted cesium product for transport • Accepted Phase I IHLW for transport • Cesium product acceptance documentation • Phase I IHLW acceptance documentation
• Accepted cesium product for transport • Accepted Phase I IHLW for transport	**4.2.4.1.2.2** **Transport Phase I solidified HLW to interim storage** Transport onsite transportation casks, loaded with Phase I solidified HLW, from the production facilities to the Phase I solidified HLW interim storage facility. Collect SGW for disposition by the support interim store Phase I solidified HLW function.	• Cesium product for isolation • Phase I IHLW for isolation • Transport Phase I solidified HLW to IS SGW

Table 3-1. Function Description. (4 sheets)

Inputs	Function	Outputs
• Cesium product for isolation • Phase I IHLW for isolation	**4.2.4.1.2.3** **Isolate Phase I solidified HLW** Remove Phase I solidified HLW from the onsite transportation casks, and release the casks and vehicle to the support interim store Phase I solidified HLW function for reconditioning. Prepare Phase I solidified HLW for interim storage. Move Phase I solidified HLW to interim storage locations, emplace, and isolate from the environment. Control and monitor the storage environment and integrity of storage location. Prevent and recover from accidents and abnormal situations during the interim storage period. Collect SGW for disposition by the support interim store Phase I solidified HLW function.	• Cesium product for retrieval • Cesium product isolation data • Cesium product transport mechanism for reconditioning • Isolate Phase I solidified HLW SGW • Phase I IHLW for retrieval • Phase I IHLW isolation data • Phase I IHLW transport mechanism for reconditioning
• Cesium product for retrieval • Phase I IHLW for retrieval	**4.2.4.1.2.4** **Retrieve Phase I solidified HLW from storage** Remove Phase I solidified HLWs from their storage locations and move them to the transport cask loading location. Collect SGW for disposition by the support interim store Phase I solidified HLW function.	• Retrieve Phase I solidified HLW from storage SGW • Retrieved cesium product • Retrieved Phase I IHLW

Table 3-1. Function Description. (4 sheets)

Inputs	Function	Outputs
• Cesium product transport mechanism for loading • Phase I IHLW transport mechanism for loading • Retrieved cesium product • Retrieved Phase I IHLW	**4.2.4.1.2.5** **Deliver Phase I solidified HLW for shipping or processing** Prepare Phase I solidified HLW for transport to an onsite HLW immobilization facility or shipping facility. Load Phase I solidified HLW into onsite transport casks, load the casks onto transport vehicle, and transport the casks to the designated receipt facility. Collect SGW for disposition by the support interim store Phase I solidified HLW function.	• Cesium product for processing • Cesium product transport mechanism for reuse • Deliver Phase I solidified HLW for shipping or processing SGW • Phase I IHLW for disposal • Phase I IHLW transport mechanism for reuse
• Accept Phase I solidified HLW from producers SGW • Cesium product acceptance documentation • Cesium product isolation data • Cesium product transport mechanism for reconditioning • Cesium product transport mechanism for reuse • Deliver Phase I solidified HLW for shipping or processing SGW • Infrastructure support for IS Phase I solidified HLW • Isolate Phase I solidified HLW SGW • Phase I IHLW acceptance documentation • Phase I IHLW isolation data • Phase I IHLW transport mechanism for reconditioning • Phase I IHLW transport mechanism for reuse • Raw materials for IS Phase I solidified HLW • Retrieve Phase I solidified HLW from storage SGW • Transport Phase I solidified HLW to interim storage SGW	**4.2.4.1.2.6** **Support Interim Store Phase I Solidified HLW** Provide support services required for Phase I solidified HLW interim storage (IS). Services could include heating, ventilation, and air conditioning; electrical power distribution; instrument and service air; service water; maintenance services; receiving and storage of supplies and equipment; health physics/operations support; contaminated equipment repair shop; records management; and treatment, preparation, packaging, discharge, etc., of system-generated solid, liquid, and gaseous effluents.	• Cesium product storage information • Cesium product transport mechanism • Cesium product transport mechanism for loading • IS Phase I solidified HLW excess facilities • IS Phase I solidified HLW garbage • IS Phase I solidified HLW hazardous waste • IS Phase I solidified HLW prepared solid waste • IS Phase I solidified HLW treated gaseous effluents • IS Phase I solidified HLW treated liquid effluents • IS Phase I solidified HLW untreated liquid effluents • Phase I IHLW storage information • Phase I IHLW transport mechanism • Phase I IHLW transport mechanism for loading

Table 3-2. Input/Output Description. (4 sheets)

Input/output	Description	Output from function(s)	Input to function(s)
Accept Phase I solidified high-level waste (HLW) from producers system-generated waste (SGW)	Solid, liquid, and gaseous waste generated by system operation.	4.2.4.1.2.1	4.2.4.1.2.6
Accepted cesium product for transport	Cesium product that is acceptable for interim storage and ready for transport from the Phase I low-level waste (LLW) immobilization facility.	4.2.4.1.2.1	4.2.4.1.2.2
Accepted Phase I immobilized high-level waste (IHLW) for transport	IHLW that is acceptable for interim storage and ready for transport from the Phase I HLW immobilization facility.	4.2.4.1.2.1	4.2.4.1.2.2
Cesium product acceptance documentation	Documentation certifying that, at the time of transport to interim storage, the cesium product meets the interim storage acceptance requirements.	4.2.4.1.2.1	4.2.4.1.2.6
Cesium product for isolation	Cesium product that has been transported from the production facility and is ready for unloading from the transport casks and emplacement in interim storage location.	4.2.4.1.2.2	4.2.4.1.2.3
Cesium product for processing	Containers of solid cesium material sealed in onsite transport casks and delivered to a HLW immobilization facility.	4.2.4 4.2.4.1 4.2.4.1.2 4.2.4.1.2.5	4.2.3 4.2.3.5
Cesium product for retrieval	Cesium product that is scheduled for retrieval from interim storage.	4.2.4.1.2.3	4.2.4.1.2.4
Cesium product for storage	Solidified cesium sealed in a container, ready for transport to onsite interim storage (i.e., loaded into a cask placed on a transport vehicle). At time of transport to the interim storage facility the waste will be certified to meet interim storage requirements.	4.2.3 4.2.3.3	4.2.4 4.2.4.1 4.2.4.1.2 4.2.4.1.2.1
Cesium product isolation data	Data generated by the monitoring of cesium product containers during isolation in the interim storage facility.	4.2.4.1.2.3	4.2.4.1.2.6
Cesium product production information	Documentation supplied by Phase I LLW immobilization facility certifying that the cesium product complies with interim storage facility acceptance specifications.	--	4.2.4.1.2 4.2.4.1.2.1
Cesium product storage information	Documentation supplied by the Phase I solidified HLW interim storage facility certifying that the cesium product was stored in accordance with interim storage specifications.	4.2.4.1.2 4.2.4.1.2.6	--

Table 3-2. Input/Output Description. (4 sheets)

Input/output	Description	Output from function(s)	Input to function(s)
Cesium product transport mechanism	The ready-to-use cask and vehicle for onsite transport of cesium product from the Phase I LLW Immobilization Facility to the interim storage facility. The transport mechanism is provided by the Interim store solidified HLW and transuranic (TRU) waste function (4.2.4.1).	4.2.4 4.2.4.1 4.2.4.1.2 4.2.4.1.2.6	4.2.3 4.2.3.3
Cesium product transport mechanism for loading	Empty cesium product transport vehicle and casks, ready for loading with retrieved cesium product.	4.2.4.1.2.6	4.2.4.1.2.5
Cesium product transport mechanism for reconditioning	Empty cesium product transport vehicle and casks, ready for maintenance after transporting the product from the producer's facility to interim storage.	4.2.4.1.2.3	4.2.4.1.2.6
Cesium product transport mechanism for reuse	Empty cesium product transport vehicle and casks, ready for maintenance after transporting the product from interim storage to the HLW immobilization facility.	4.2.4.1.2.5	4.2.4.1.2.6
Deliver Phase I solidified HLW for shipping or processing SGW	Solid, liquid, and gaseous waste generated by system operation.	4.2.4.1.2.5	4.2.4.1.2.6
Infrastructure support for IS Phase I solidified HLW	General infrastructure support needed to interim store Phase I solidified HLW. This will include, but is not limited to, fire protection, police, emergency preparedness, medical services, road services, telecommunications, radiological services, transportation, and sewer. This includes land for siting facilities.	--	4.2.4.1.2 4.2.4.1.2.6
IS Phase I solidified HLW excess facilities	Facilities that, having fulfilled their original purposes and completed the function/processes described in the interim store Phase I solidified HLW function, are now available and appropriate for reuse or deactivation.	4.2.4.1.2 4.2.4.1.2.6	--
IS Phase I solidified HLW garbage	Ordinary nonradioactive, nonhazardous solid waste generated within the Interim Store Phase I Solidified HLW function, suitable for disposal in a sanitary landfill.	4.2.4.1.2 4.2.4.1.2.6	--
IS Phase I solidified HLW hazardous waste	Solid waste generated within the interim store Phase I solidified HLW function that is classified as hazardous (dangerous) per U.S. Environmental Protection Agency or State of Washington regulations.	4.2.4.1.2 4.2.4.1.2.6	--
IS Phase I solidified HLW prepared solid waste	Solid waste, generated from the interim store Phase I solidified HLW function, that has been segregated, packaged, assayed, and certified for transfer to Hanford Site function 4.3 (remedy solid waste), for further treatment or disposal. This includes mixed and radioactive wastes.	4.2.4.1.2 4.2.4.1.2.6	--

Table 3-2. Input/Output Description. (4 sheets)

Input/output	Description	Output from function(s)	Input to function(s)
IS Phase I solidified HLW treated gaseous effluents	Treated gaseous waste from functions associated with the interim storage of Phase I solidified HLW. Treated gaseous effluents are discharged to the atmosphere.	4.2.4.1.2 4.2.4.1.2.6	--
IS Phase I solidified HLW treated liquid effluents	Liquid effluents which meet interface acceptance criteria for discharge directly to the 200 Area Treated Effluent Disposal Facility (TEDF).	4.2.4.1.2 4.2.4.1.2.6	--
IS Phase I solidified HLW untreated liquid effluents	Generated liquid effluents which require treatment and meet interface acceptance criteria for discharge directly to the Liquid Effluent Retention Facility (LERF) and subsequent treatment in the Effluent Treatment Facility (ETF).	4.2.4.1.2 4.2.4.1.2.6	--
Isolate Phase I Solidified HLW SGW	Solid, liquid, and gaseous waste generated by system operation.	4.2.4.1.2.3	4.2.4.1.2.6
Phase I IHLW acceptance documentation	Documentation certifying that, at the time of transport to interim storage, the Phase I IHLW meets the repository acceptance requirements and interim storage acceptance requirements.	4.2.4.1.2.1	4.2.4.1.2.6
Phase I IHLW for disposal	Phase I IHLW delivered from the interim storage facility to the shipping cask loading station.	4.2.4.1.2 4.2.4.1.2.5	4.2.4.1.4
Phase I IHLW for isolation	Phase I IHLW that has been transported from the production facility and is ready for unloading from the transport casks and emplacement in interim storage location.	4.2.4.1.2.2	4.2.4.1.2.3
Phase I IHLW for retrieval	Phase I IHLW that is scheduled for retrieval from interim storage.	4.2.4.1.2.3	4.2.4.1.2.4
Phase I IHLW for storage	IHLW from the Phase I HLW immobilization facility, sealed in canisters suitable for interim onsite storage and eventual emplacement in HLW geologic repository. At time of transport to the interim storage facility the waste will be certified to meet repository acceptance requirements.	--	4.2.4.1.2 4.2.4.1.2.1
Phase I IHLW isolation data	Data generated by the monitoring of Phase I IHLW canisters during isolation in the interim storage facility.	4.2.4.1.2.3	4.2.4.1.2.6
Phase I IHLW production information	Documentation supplied by Phase I HLW immobilization facility certifying that the product complies with interim storage facility acceptance specifications. Those specifications will include HLW geologic repository acceptance criteria.	--	4.2.4.1.2 4.2.4.1.2.1
Phase I IHLW storage information	Documentation supplied by the Phase I solidified HLW interim storage facility certifying that the Phase I IHLW was stored in accordance with interim storage specifications.	4.2.4.1.2 4.2.4.1.2.6	--

Table 3-2. Input/Output Description. (4 sheets)

Input/output	Description	Output from function(s)	Input to function(s)
Phase I IHLW transport mechanism	The ready-to-use cask and vehicle for onsite transport of IHLW from the Phase I HLW immobilization facility to the interim storage facility. The transport mechanism is provided by the interim store solidified HLW and TRU waste function (4.2.4.1).	4.2.4 4.2.4.1 4.2.4.1.2 4.2.4.1.2.6	4.2.3 4.2.3.5 4.2.3.5.4
Phase I IHLW transport mechanism for loading	Empty Phase I IHLW transport vehicle and casks, ready for loading with retrieved Phase I IHLW.	4.2.4.1.2.6	4.2.4.1.2.5
Phase I IHLW transport mechanism for reconditioning	Empty Phase I IHLW transport vehicle and casks, ready for maintenance after transporting the product from the producer's facility to interim storage.	4.2.4.1.2.3	4.2.4.1.2.6
Phase I IHLW transport mechanism for reuse	Empty Phase I IHLW transport vehicle and casks, ready for maintenance after transporting the product from interim storage to the shipping cask loading station.	4.2.4.1.2.5	4.2.4.1.2.6
Raw materials for IS Phase I solidified HLW	Chemicals, containers, utilities, replacement equipment, spare parts, supplies, etc., necessary for the interim storage of Phase I solidified HLW.	--	4.2.4.1.2 4.2.4.1.2.6
Retrieve Phase I solidified HLW from storage SGW	Solid, liquid, and gaseous waste generated by system operation.	4.2.4.1.2.4	4.2.4.1.2.6
Retrieved cesium product	Cesium product that has been retrieved from its interim storage location and moved to the transport cask loading location.	4.2.4.1.2.4	4.2.4.1.2.5
Retrieved Phase I IHLW	Phase I IHLW that has been retrieved from its interim storage location and moved to the transport cask loading location.	4.2.4.1.2.4	4.2.4.1.2.5
Transport Phase I solidified HLW to interim storage SGW	Solid, liquid, and gaseous waste generated by system operation.	4.2.4.1.2.2	4.2.4.1.2.6

3.1.1.2.2 The SNF CSB Interfaces. The Phase I Solidified HLW Interim Storage Project shall use the existing CSB and the SNF hot vacuum conditioning annex services to the maximum extent possible. During the load-in/load-out mode of operation, the following major CSB services are candidates for use: load-in/load-out pit, multi-canister overpack handling machine, and the vault #2 and #3 storage locations. During the interim storage mode of operation, the hot vacuum conditioning annex may be used to support canister/container rework operations.

Use of the CSB for Phase I solidified HLW interim storage requires an interface with the SNF Project (Project 97A-EWW-379). This interface consists of coordination of design and retrofit construction efforts with the SNF Program schedule presented in Table 3-3. The receipt and conditioning of SNF at the CSB is scheduled to be completed approximately 2 years before the receipt of solidified HLW at the CSB (Calmus 1996). Therefore, further interface with the SNF Program is minimal beyond July 2000. However, new installations and retrofit modifications to the CSB shall not preclude the eventual removal of SNF from storage.

Table 3-3. Spent Nuclear Fuel Program Schedule.

Activity	From	To
Construction	--	September 1997
Receive spent nuclear fuel	December 1997	December 1999
Hot vacuum conditioning	December 1999	July 2000
Interim storage	July 2000	--

3.1.1.2.3 Hanford Site Infrastructure and Utilities Interface. The Phase I solidified HLW interim storage facility connects to elements of the Hanford Site infrastructure and receives services needed for its operation from the Hanford Site utilities. The Hanford Site infrastructure and utilities required to support Phase I solidified HLW interim storage may include the following: rail lines, roadways, security system, communications network, electrical power grid, water and sewage systems, and transportation services.

3.1.1.2.4 Other Hanford Site Programs Interface. Other Hanford Site programs provide support to the Phase I solidified HLW interim storage by receiving the solid and liquid effluents generated throughout operations and maintenance.

3.1.2 Assumptions and Risk

Not applicable.

3.2 CHARACTERISTICS

Requirements for system performance and physical characteristics are provided in this section.

3.2.1 Performance Characteristics

The following performance characteristics describe the generalized capabilities and expected performance of the overall Phase I solidified HLW interim storage system.

3.2.1.1 Design Life. The minimum design life shall be 40 years for nonreplaceable Phase I solidified HLW interim storage system structures and components. A design life of less than 40 years is acceptable for replaceable components, but should be maximized to the extent practical. Basis: WHC 1995a.

Structures and components required to support the Phase I solidified HLW interim storage mission during the interim storage operating mode shall be designed for permanent installation to the extent practical. Any additional structures or components needed to accomplish the Phase I solidified HLW interim storage mission during the load-in/load-out operating mode could be designed for temporary installation and eventual removal.

3.2.1.2 Storage Capacity (Hold). The Phase I solidified HLW interim storage system shall accommodate 599 standard immobilized HLW canisters (0.61 m diameter by 3.0 m tall) based on the minimum order quantity of 245 MT waste oxides (exclusive of silicon and sodium) or 1,137 canisters based on the maximum order quantity of 465 MT waste oxides (exclusive of silicon and sodium). The number of separated cesium containers ranges from 53 containers at 1.5 kW/container to 158 containers at 0.5 kW/container. Basis: WHC 1996a.

3.2.1.3 Storage Temperature Control. The Phase I solidified HLW interim storage system shall be designed to ensure that the immobilized HLW canister centerline temperature never exceeds 400 °C, and the separated cesium container centerline temperature never exceeds (TBD) °C. Basis: WHC 1995a.

The design basis thermal load per vault shall be based on 245 standard immobilized HLW canisters at 0.4 kW each, 316 standard immobilized HLW canisters at 1.0 kW each, and 66 separated cesium containers at 1.5 kW each (Hold).

3.2.1.4 Preservation of Producer-Generated Certification Data. Solidified HLW (i.e., immobilized HLW canisters and separated cesium containers) handling and storage features shall be designed so that during facility operation they do not intentionally invalidate certification data provided by the production facilities relative to solidified HLW compliance with applicable acceptance specifications in DOE/RW-0351P, *Waste Acceptance System Requirements Document (WASRD)* (DOE/RW 1996), DOE/EM-0093, *Waste Acceptance Product Specification for*

Vitrified High-Level Waste Form (WAPS) (DOE/EM 1995), and DE-RP06-96RL13308, *TWRS Privatization Request for Proposals* (RL 1996). Basis: WHC 1995a.

3.2.1.5 Solidified HLW Rework. If primary containment (i.e., the canister or container wall) is breached during interim storage, the solidified HLW shall be overpacked. An overpacked immobilized HLW canister may violate the repository waste acceptance specification for canister dimension and the overpacked canister will be addressed by the DOE under the nonstandard waste form clause in accordance with DOE/RW-0351P (DOE/RW 1996). Basis: WHC 1995a.

3.2.1.6 Solidified HLW Interim Storage Design Philosophy. The Phase I solidified HLW interim storage facility shall be designed to minimize monitoring and maintenance. Basis: WHC 1995a.

3.2.2 System Capability Relationships

This section describes the relationship among operating modes of the solidified HLW interim storage system.

3.2.2.1 Definition of Operating Modes. The solidified HLW interim storage system entails three general operating modes. These operating modes are load-in/load-out, interim storage, and decontamination and decommissioning (D&D). The following provides a brief description of each operating mode.

- In the **load-in/load-out mode** of operation, the solidified HLW interim storage facility is either actively receiving solidified HLW for storage or actively retrieving solidified HLW from storage. The load-out process is essentially the reverse of the load-in process. Solidified HLW retrieved from the CSB is transported to either a staging and load-out facility (for the case of immobilized HLW canisters and SNF multi-canister overpacks) or a treatment facility (for the case of cesium containers). At the staging and load-out facility, the immobilized HLW canisters are prepared for shipment and load on to the shipping mechanism.

- In the **interim storage mode** of operation, no further solidified HLW is received at the interim storage facility. The entire inventory of solidified HLW is in passive interim storage; during this period, the only activities required are monitoring storage locations to verify containment integrity and sufficient cooling. The facility will experience a brief but intense period of emergency response activity should the integrity of a solidified HLW package become compromised; otherwise, operational staff support is minimal. The bulk of solidified HLW will remain in interim storage (up to 40 years) until final disposition has been determined and the federal geologic repository is available.

- Following the retrieval of all solidified HLW and SNF, the CSB is placed in a **D&D operating mode**. When completed, the CSB is turned over to the excess facility system.

3.2.2.2 Operating Modes Schedule. Based on the TWRS Program schedule (Section 3.2.5.3), the Phase I solidified HLW interim storage system receives immobilized HLW canisters and separated cesium containers beginning June 1, 2002, and ending June 1, 2007. The end date could extend to June 1, 2011, at the option of the DOE. During the period when the containers are being received, the Phase I solidified HLW interim storage facility is in a load-in operating mode.

After June 1, 2007 (or June 1, 2011, if the DOE option is invoked), the Phase I solidified HLW interim storage facility enters into a passive interim storage operating mode. The facility remains in this operating mode until 2013 when the separated cesium containers are retrieved for further processing. During retrieval, the Phase I solidified HLW interim storage facility is in a load-out operating mode. The duration of the separated cesium retrieval is (TBD). It is possible that the Phase I solidified HLW interim storage facility will cycle numerous times between load-out and interim storage operating modes during this period. After all the separated cesium containers have been retrieved, the Phase I solidified HLW interim storage system will revert to an interim storage operating mode and may remain in this operating mode until at least 2023 (DOE/RW 1996). However, the Phase I solidified HLW interim storage system could experience an additional period of load-in operating mode after 2013 for receipt of Phase II immobilized HLW, if excess CSB storage capacity is available.

After the repository program issues authorization for the Hanford Site to initiate shipments of solidified HLW, the Phase I solidified HLW interim storage system enters a load-out operating mode. During this period, immobilized HLW and SNF are retrieved and transferred to the staging and load-out facility. This operating period is expected to be relatively short in duration, beginning no earlier than 2023 and ending by 2040. When the retrieval is completed, the Phase I solidified HLW interim storage system enters into a D&D operating mode. By 2045, the Phase I solidified HLW interim storage system is expected to have completed D&D.

3.2.3 External Interface Requirements

This section describes the physical characteristics of external interfaces associated with the solidified HLW interim storage system. Constraints and performance requirements imposed on these interfaces also are described. The major interfaces are a result of the solidified HLW interim storage system mission to provide interim storage for standard canisters that contain immobilized HLW and containers that contain separated cesium as a dry, free-flowing product. Additional external interfaces encompass raw materials, system-generated waste, and gaseous effluents.

3.2.3.1 Immobilized HLW Canisters (Hold). The solidified HLW interim storage system shall provide all design features required to handle immobilized HLW canisters. Tables 3-4 and 3-5 provide the estimated radionuclide and chemical composition, respectively, of immobilized HLW (glass). Table 3-6 contains the physical characteristics of immobilized HLW and Table 3-7 contains physical attributes of a standard immobilized HLW canister. Immobilized HLW canisters (as received from the production facilities) will, in general, satisfy all applicable repository acceptance criteria (including certification data), as specified in DOE/RW-0351P (DOE/RW 1996) and DOE/EM-0093 (DOE/EM 1995). Figures 3-1 and 3-2 provide additional interface features of the immobilized HLW canister.

Table 3-4. Glass Maximum Radionuclide Composition.[a, b] Hold

Isotope	Ci/kg	Isotope	Ci/kg	Isotope	Ci/kg
^{55}Fe	1.6 E-02	^{121m}Sn	1.5 E-04	^{155}Eu	1.5 E-01
^{59}Ni	2.3 E-04	^{126}Sn	7.7 E-04	^{234}U	1.2 E-05
^{60}Co	4.8 E-02	^{124}Sb	4.2 E-08	^{235}U	5.2 E-07
^{63}Ni	2.6 E-02	^{126}Sb	7.8 E-05	^{236}U	1.3 E-06
^{79}Se	6.8 E-06	^{126m}Sb	5.5 E-04	^{238}U	9.4 E-06
^{90}Sr	5.0 E+01	^{125}Sb	1.6 E-01	^{237}Np	3.7 E-04
^{90}Y	5.0 E+01	^{125m}Te	4.8 E-02	^{238}Pu	1.8 E-03
^{93m}Nb	1.4 E-03	^{129}I	1.5 E-06	^{239}Pu	1.5 E-02
^{93}Zr	2.3 E-03	^{134}Cs	1.1 E-01	^{240}Pu	4.2 E-03
^{99}Tc	7.3 E-02	^{135}Cs	4.8 E-04	^{241}Pu	1.1 E-01
^{106}Ru	3.2 E-03	^{137}Cs	4.8 E+01	^{242}Pu	1.1 E-06
^{106}Rh	3.2 E-03	^{137m}Ba	4.8 E+01	^{241}Am	6.9 E-01
^{107}Pd	6.5 E-05	^{144}Ce	1.6 E-03	^{242}Am	5.0 E-04
^{110m}Ag	1.6 E-07	^{144}Pr	1.6 E-03	^{242m}Am	5.2 E-04
^{113m}Cd	1.8 E-02	^{144m}Pr	1.6 E-06	^{243}Am	8.1 E-05
^{113m}In	3.0 E-05	^{147}Pm	2.6 E+00	^{242}Cm	6.0 E-04
^{113}Sn	3.0 E-05	^{151}Sm	1.5 E+00	^{244}Cm	1.5 E-02
^{115m}Cd	1.1 E-08	^{152}Eu	2.4 E-03	--	--
^{119m}Sn	1.6 E-07	^{154}Eu	2.6 E-01	--	--

[a]Radionuclide composition values given in this table are based on an overall waste loading of 0.5 kg nonvolatile oxides/kg glass.
[b]Values based on Manuel et al. 1996. Values are indexed (decayed) to mid-2002. Some decay products (e.g., radon from uranium decay) are not shown. Trace isotopes below 1 E-08 Ci/kg are not shown.

Table 3-5. Glass Chemical Composition.[a] Hold

Oxide	kg oxide/kg glass	Oxide	kg oxide/kg glass
SiO_2	0.501	Fe_2O_3	0.108
B_2O_3	0.098	Al_2O_3	0.068
Na_2O	0.091	ZrO_2	0.016
Li_2O	0.060	P_2O_5	0.004
CaO	0.009	Others	0.040
MgO	0.005	--	--

[a]Values based on Manuel et al. 1996.

Table 3-6. Glass Physical Characteristic. Hold

Parameter	Unit	Minimum value	Maximum value
Thermal conductivity (250 °C)	watts/cm²-°C/cm	--	0.88
Heat capacity (250 °C)	watts/g-°C	--	1.07
Density	kg/m³	--	2,640

Table 3-7. Standard Canister Attributes.

Parameter	Unit	Nominal standard canister	Maximum standard canister
Surface gamma dose rate	Sv/h	--	10^3 [a]
Neutron dose rate	Sv/h	--	0.1 [a]
Removable surface contamination (alpha)	Bq/m²	--	367 [a]
Removable surface contamination (beta-gamma)	Bq/m²	--	3,670 [a]
Inert cover gas leak rate	atm-cc/sec	--	10^{-4} [a]
Heat	Watt	400 [b]	1,000 [b]
Length	m	3.00 [a]	3.005 [a]
Diameter	cm	61.0	62.5
Wall thickness	cm	0.95 [b]	0.95 [b]
Glass volume	m³	0.62 [b]	0.70 [b]
Glass fraction	%	85 [b]	95 [b]
Glass weight	kg	1,650 [b]	1,850 [b]
Shell weight	kg	454 [b]	454 [b]
Total canister weight	kg	2,100 [b]	2,300 [b]

[a]RL 1996.
[b]Hold.

Figure 3-1. Immobilized High-Level Waste Canister. TBD

Figure 3-2. Canister Neck and Lifting Flange. TBD

3.2.3.2 Separated Cesium Containers (Hold). The Phase I solidified HLW interim storage system shall provide all design features required to handle separated cesium containers. This section provides the properties of separated cesium containers. Tables 3-8 and 3-9 provide the estimated radionuclide and chemical composition, respectively, of the cesium waste form. Table 3-10 contains physical characteristics of cesium waste form, and Table 3-11 contains general attributes of a separated cesium container (as received from the Phase I production facility). Figure 3-3 provides additional interface features of the separated cesium container.

Table 3-8. Separated Cesium Container Radionuclide Content.

Isotope	Ci/container	Isotope	Ci/container
^{135}Cs	2.7 E+00 *	^{242}Pu	TBD
^{137}Cs	3.2 E+05 *	^{241}Am	TBD
^{137m}Ba	3.2 E+05 *	^{242}Am	TBD
^{237}Np	TBD	^{242m}Am	TBD
^{238}Pu	TBD	^{243}Am	TBD
^{239}Pu	TBD	^{242}Cm	TBD
^{240}Pu	TBD	^{244}Cm	TBD
^{241}Pu	TBD	--	--

*Hold
TBD = To be determined

Table 3-9. Cesium Waste Form Chemical Composition. Hold

Oxide	kg oxide/kg zeolite	Oxide	kg oxide/kg zeolite
SiO_2	0.667	MgO	0.011
Na_2O	0.038	Fe_2O_3	0.040
K_2O	0.011	Al_2O_3	0.177
CaO	0.040	Others	0.016

Table 3-10. Cesium Waste Form Physical Characteristics. Hold

Parameter	Unit	Minimum value	Maximum value
Thermal conductivity	watts/cm^2-°K/cm	0.0065	--
Heat capacity	J/g-°C	0.96	--
Density (bulk)	kg/m^3	690	2,640
Particle size	mesh	20 x 50	--
Vapor pressure (at TBD °C)	kPa	TBD	--
Decomposition temperature	°C	TBD	--

TBD = To be determined

Table 3-11. Separated Cesium Container Attributes.

Parameter	Unit	Average container	Maximum container
Surface gamma dose rate	Sv/h	--	10^3 [a]
Neutron dose rate	Sv/h	--	0.1 [a]
Removable surface contamination (alpha)	Bq/m²	--	367 [a]
Removable surface contamination (beta-gamma)	Bq/m²	--	3,670 [a]
Inert cover gas leak rate	atm-cc/sec	--	10^{-4} [a]
Heat	watt	500 [b]	1,500 [a]
Length	m	TBD	1.37 [a]
Diameter	cm	TBD	0.33 [a]
Wall thickness	cm	TBD	TBD
Waste form volume	m³	TBD	TBD
Waste from fraction	%	TBD	TBD
Waste form weight	kg	TBD	TBD
Shell weight	kg	TBD	TBD
Total container weight	kg	TBD	TBD

[a] RL 1996.
[b] Hold.

TBD = To be determined.

3.2.3.3 Repository Acceptance. The design and construction of the Phase I solidified HLW interim storage system shall provide all features required to comply with applicable criteria established in DOE/RW-0351P (DOE/RW 1996), and DOE/EM-0093 (DOE/EM 1995).

3.2.3.4 Gaseous Effluents. Planned or expected radiological releases from the Phase I solidified HLW interim storage system shall be combined with expected releases from other facilities at the Hanford Site, and the total releases and direct radiation shall be limited to Washington Administrative Code (WAC) 173-480, "Ambient Air Quality Standards and Emission Limits for Radionuclides." Air emissions shall be limited in accordance with 40 CFR 61, "National Emissions Standards for Hazardous Air Pollution;" WAC 173-400, "General Regulations for Air Pollution Sources;" WAC 173-460, "Controls for New Sources of Toxic Air Pollutants;" and WAC 173-480, as applicable.

Final airborne particulate treatment on all airborne effluents that have the potential to exceed 10% of the derived concentration guide's public value on an annual average basis as cited in WHC-CM-7-5, *Environmental Compliance*, shall use a high-efficiency particulate air (HEPA) filter or equivalent filter. An installed HEPA or HEPA-equivalent filter shall have an installed efficiency of 99.95%.

Figure 3-3. Separated Cesium Container. Hold

Provisions shall be made for representative sampling (shrouded Probe) and continuous monitoring of particulate gaseous effluents in accordance with DOE Order 5480.4, *Environmental Protection, Safety, and Health Protection Standards* (DOE 1984), and DOE Order 5484.1, *Environmental Protection, Safety, and Health Protection Information Reporting Requirements* (DOE 1981). Capability shall be provided for local and remote indication of gaseous effluent contamination levels and monitoring equipment alarm conditions.

The design, construction, and installation of equipment to control and monitor emissions shall use best available radionuclide control technology to meet the requirements of WAC 246-247, "Radiation Protection - Air Emissions."

3.2.3.5 Liquid Effluents. The following acceptance criteria shall be applied to liquid effluents from the Phase I solidified HLW interim storage system that are planned for discharge to the Effluent Treatment Facility (ETF).

a. The waste stream must be characterized to the degree established in the ETF's *Resource Conservation and Recovery Act of 1976* (RCRA) Part B Permit. The analytical procedures used must be consistent with the RCRA waste analysis plans.

b. Only the waste codes listed in the ETF delisting petition and the RCRA permit can be accepted for treatment at the ETF, unless the permit and the delisting petition are modified.

c. The absorbed radiation dose to a hypothetical individual at the site boundary cannot increase over permitted levels without a modification to the ETF radionuclide air emission program permit. Influent concentrations must remain low enough so this remains true. Radionuclides that have not previously been accounted for may also force a permit re-evaluation.

Acceptance criteria based on operability parameters are listed below. While the following criteria are not mandatory, each criterion must be considered when determining the acceptability of a waste stream that is sent to the Liquid Effluent Retention Facility (LERF) for storage and the ETF for treatment. These criteria may change in response to modifications made to the LERF and ETF.

d. Separable organics will not be accepted.

e. Colloidal matter shall be minimized to protect filters in the ETF from plugging.

f. Concentrations of scale-forming compounds (e.g., calcium sulfate, calcium phosphate, and metal silicates) shall be minimized.

g. Concentrations of corrosive constituents, such as chloride and fluoride, shall be minimized.

h. The concentration of constituents that can absorb ultraviolet light to the extent destruction of targeted organics is significantly compromised shall be minimized.

i. Significant concentrations of neutral radionuclide species cannot be accepted by the LERF and ETF without jeopardizing compliance with discharge requirements for radionuclides (i.e., 0.04 times the derived concentration guidelines), in accordance with Section 8.4.2.1 of WHC-CM-7-5, *Environmental Compliance*.

The dispositioned aqueous waste must meet the acceptance criteria and associated administrative procedures of the 200 Area's Treated Effluent Disposal Facility (TEDF).

3.2.3.6 Liquid Waste. Liquid waste, if generated, shall be transferred to an appropriate processing and storage facility. Radioactive liquids shall not be released to the environment (i.e., soil columns shall not be used for disposal). Piping for radioactive liquid waste shall be double-lined in nonradioactive, clean, or external areas.

If a sanitary effluent sewer is required to support facility operations, the sewer shall be designed for a 7-day, 24-hour, 3 work-shift basis, and shall be sized for the maximum number of people on a single shift. Sewage services provided shall be in accordance with WAC 246-272, "Onsite Sewage System."

3.2.3.7 Solid Waste. The onsite shipment of radioactive solid waste shall be in accordance with DOE-95-SWT-186, *Hazardous Material Packaging and Shipping* (DOE 1995c), and WHC-CM-2-14, *Hazardous Material Packaging and Shipping*, based up DOE Order 460.1, *Packaging and Transportation Safety* (DOE 1995a). Transfer of solid radioactive waste to the Hanford Site Solid Waste Program for dispositioning shall be in accordance with criteria specified in WHC-EP-0063-4, *Hanford Site Solid Waste Acceptance Criteria* (Willis 1993). Threshold doses and/or concentrations below which soil and included rubble do not require controls because site radioactive materials are established in WHC-CM-7-5.

3.2.3.8 SNF Storage. During construction of new installations and retrofit modifications associated with the Phase I solidified HLW interim storage mission, CSB vault #1 will contain SNF in passive storage. The SNF storage mission must not be adversely impacted by the solidified HLW storage mission. Therefore, new installations and retrofit modifications to the CSB shall not compromise the safety and confinement integrity of SNF in storage, nor preclude eventual removal of SNF from storage.

3.2.4 Physical Characteristics

This section provides a brief description of the physical systems required to address the Solidified HLW Interim Storage Program. Many of the systems required to support the Solidified HLW Interim Storage System are being furnished by the existing SNF CSB. Requirements of Section 3.2.4 are only applicable to new installations and retrofit modifications to CSB systems, structures, and components that are provided to support the overall Phase I solidified HLW interim storage mission.

3.2.4.1 Location. The Phase I solidified HLW interim storage system shall be located in the 200 East Area of the Hanford Site at the SNF CSB (Building 212H). Vaults #2 and #3 of the SNF CSB are available for storage of Phase I solidified HLW.

3.2.4.2 Facility Description. The SNF CSB structure consists of three below-grade, concrete vaults approximately 50 m wide by 55 m long by 14 m deep. The CSB structure also contains a 41 m wide by 62 m long by 17 m tall steel shelter. The shelter provides an operating area for load-in/load-out. Mechanical, electrical, and support services are housed in a 15 m wide by 37 m long by 9 m tall metal building. Additional design details of the existing structure are available from the as-built drawings listed in Section 2.2.

Although CSB vault #1 will contain SNF in passive storage, Phase I solidified HLW interim storage uses two of the three available concrete vaults (vaults #2 and #3) in the CSB. Each of the vaults is covered by a concrete deck, and each vault has concrete air plenums on opposite sides. Vault #1 is equipped with steel tubes that are installed in the vertical position, and an air intake and exhaust stack are provided for the cooling system. Storage tubes and intake/exhaust stacks are not installed in vaults #2 and #3.

When fully equipped, each vault can accommodate a storage tube matrix of 22 rows by 10 columns, for a total of 220 steel storage tubes. Each vault can also accommodate overpacked canisters via six over-sized storage tubes. Each tube can hold three standard canisters, or up to three separated cesium containers. The steel tubes are closed and sealed by means of a shielded plug that is installed at the deck level.

Decay heat from solidified HLW shall be removed by natural convection, which involves a process where cooling air is drawn through an inlet duct into a plenum which feeds a vault, flows across the tubes, and exits through an elevated exhaust stack that serves the vault. The motive force for drawing cooling air through the vault is natural convection. The natural convection is caused by a density difference between the hot air inside the vault and the exhaust stack relative to the cool intake air.

3.2.4.3 General Configuration. The general structure and layouts of the Phase I solidified HLW interim storage system shall conform to the applicable requirements of DOE Order 6430.1A, *General Design Criteria* (DOE 1989); National Fire Protection Association (NFPA) NFPA 70, *National Electrical Code* (NFPA 1993a); NFPA 101, *Life Safety Code* (NFPA 1994b); *Uniform Building Code* (ICBO 1994); and A/E Standards, GC-LOAD-01, *Standard Architectural - Civil Design Criteria, Design Loads for Facilities* (Kaiser 1996a). The storage area shall provide confinement in accordance with DOE Order 6430.1A (DOE 1989). The load-in/load-out area shall include the flexibility to receive solidified HLW by conventional truck. The right-of-way for future rail access shall be provided from the 200 East Area's rail system.

3.2.4.4 Heating, Ventilation, and Air Conditioning. Any active (mechanically powered) ventilation system provided for contamination confinement and/or to ensure contamination control shall be in accordance with DOE Order 6430.1A (DOE 1989); DOE Order 5400.5, *Radiation Protection of the Public and the Environment* (DOE 1990); American Society of Mechanical Engineers (ASME) N509-1989, *Nuclear Power Plant Air-Cleaning Units and Components* (ASME 1989a); and ASME N510-1989, *Testing of Nuclear Air Treatment Systems* (ASME 1989b).

The total volume of air that is handled shall be that required for work space conditioning and contamination control, and shall include the infiltration air from the outside. The infiltration of outside air shall be limited. Sufficient redundancy and/or spare capacity shall be provided as necessary to ensure adequate ventilation during normal operations and design basis accident (DBA) conditions.

3.2.4.4.1 Ventilation Zones. Where active ventilation systems are provided to maintain confinement, the definition of the ventilation zones shall be as specified in Table 3-12. The differential pressures specified shall be with respect to atmosphere and shall be considered minimum. Air locks and other barriers shall be provided as required to separate zones, to ensure ventilation balance and contamination control, and to maintain pressure differentials. Ventilation zones shall maintain a minimum 3.1×10^{-2} kPa differential pressure between different zones (see Table 3-12).

Electrical embeds providing access to Zone I may exit in Zone III by means of an inner barrier that provides two seals between the zones. The inner barrier shall require testing to qualify the integrity of the seals. Building air flow shall be from nonradioactive zones to zones with low potential for contamination, to zones with greater potential for contamination. Within a

Table 3-12. Ventilation Zones.

Zone	Minimum DP (kPa)	Description of typical area
I	-2.49 E-01	High and potentially high contamination areas.
II	-1.25 E-01	Areas providing access or penetrations to Zone I. Not normally contaminated areas with moderate contamination potential. May be normally or frequently occupied areas.
III	-6.23 E-02	Not normally contaminated areas with low contamination potential. Normally or frequently occupied areas.
IIIA	-2.49 E-02	Less contamination potential than Zone III. Minimum DP may not be maintained with outer doors open.
IV	+3.11 E-02	Clean areas. Areas where contamination is unacceptable.
Neutral	N/A	Areas not requiring confinement ventilation.

Source: Swenson 1996.

DP = Differential pressure with respect to atmospheric pressure zone, air shall flow from less contaminated to more contaminated areas. If air is cascaded from one zone to another zone with a higher potential for contamination, backflow protection between the zones shall be provided. Backflow protection in supply air systems shall be sufficient to prevent airborne releases to the environment.

If dampers are provided to control and balance air flows, the dampers must be accessible for operation and repair.

3.2.4.4.2 Supply Air. Supply air system shall be conditioned in accordance with DOE Order 6430.1A (DOE 1989). Supply air filters shall be rated at a minimum of 85% efficiency (atmospheric dust spot) in accordance with ASHRAE 52.1-1992, *Gravimetric and Dust-Spot Procedures for Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter* (ASHRAE 1992). Supply air inlets shall be located off the ground to minimize dust loading to the filters and the effects of high winds, windblown trash, windblown vegetation, ash, snow, and ice. Supply air inlet locations shall minimize the possibility of recirculating facility exhaust air. Supply air systems shall be protected from birds and hoarfrost.

The air temperature in personnel-accessible work areas shall be maintained for normal operating conditions. Consideration should be given to using sensible heat from the exhaust stream to preheat incoming air in accordance with DOE Order 6430.1A (DOE 1989).

3.2.4.4.3 Exhaust Air. The adequacy of the filtration system (i.e., the type, if any, and number of filtration stages required) provided for facility exhaust air shall be determined by analysis to ensure that the contamination in the effluents is as low as reasonably achievable (ALARA) and does not exceed established emission limits.

Any HEPA filter assemblies shall comply with DOE Order 6430.1A (DOE 1989), and ASME N509-1989 (ASME 1989a). In-place testing design requirements shall meet all the recommendations cited in DOE Order 6430.1A and ASME N510-1989 (ASME 1989b). Design shall preclude excessive personnel exposure and the release of contaminants to the environment during testing. Design shall provide for measuring the supply and exhaust airflows. Final HEPA filter systems shall include the necessary fire protection provisions to comply with DOE Order 5480.7A, *Fire Protection* (DOE 1993a) and DOE Order 6430.1A.

The exhaust system ducts and the fans for confinement control shall be fabricated to facilitate decontamination. To facilitate decontamination, concrete exhaust plenums shall have a protective coating resistant to deterioration by radiation, process chemicals, and moisture. Multiple fans shall be provided downstream of the filters. Standby fans shall be provided and the operation of the fans shall be initiated by abnormal pressure(s) within the ventilation system.

To ensure isolation, there shall be no common walls between the supply and exhaust air tunnels or ducts. The design shall provide appropriate features that allow each section of HEPA filters to be isolated for filter replacement during normal operations.

Stack height shall be sufficient to meet dispersion requirements for normal as well as DBA releases. Stacks mounted on the process building shall discharge air above the building wake, in accordance with recommended practices, to prevent recirculation of exhaust air to supply air intakes.

3.2.4.4.4 Uncontrolled Access Zones. The uncontrolled access zone ventilation system shall filter, condition, and control the zone environment in accordance with DOE Order 6430.1A, (DOE 1989). Design consideration shall be given to using recycle air or economy cycles in accordance with DOE Order 6430.1A. Exhaust air shall not be used to dilute process, control, and operating zone exhaust to meet emission standards.

3.2.4.4.5 Toilet Facilities. Ventilation air requirements for toilet facilities, if required, shall be in accordance with *ASHRAE Handbook--Fundamentals* (ASHRAE 1993).

3.2.4.4.6 Computer Rooms. Computer room ventilation, if required, shall be designed to accommodate the requirements of the specific computer manufacturer's recommendation for temperature, humidity, and filtration.

3.2.4.5 Communications. A communications system shall be provided in accordance with DOE Order 6430.1A (DOE 1989) and DOE Order 5300.1C, *Telecommunications* (DOE 1992a). All normally occupied parts of the facility shall have telephone conduits installed to accommodate communications. Telephones shall be provided for internal and external communications in accordance with DOE Order 6430.1A (DOE 1989). Unit locations shall be chosen to provide operations support, and personnel and equipment safety. Redundant emergency telephone units shall be located in the main operation areas.

Exterior communications and alarm systems (including fire, security, and telephone systems) shall be designed in accordance with DOE Order 6430.1A (DOE 1989).

An intercommunication system shall be included to provide communication between areas within the facility. Unit locations shall be determined to provide communications between areas within the building; call privacy and call annunciator capabilities shall be provided. The intercommunication system shall be an integral part of the telephone system.

A public address system shall be included in the communication system. Speakers shall be installed throughout the building interior and around the building perimeter. The public address system control panel will be located in the communications room, and a microphone for the control of the public address system shall be located in each main operation area.

3.2.4.6 Fire Protection. The fire protection system shall meet the requirements of DOE Order 6430.1A (DOE 1989), DOE Order 5480.7A (DOE 1993a), and NFPA codes and standards.

Depending on a fire hazards analysis, the main water fire protection shall be by a sprinkler system installed in accordance with NFPA 13, *Installation of Sprinkler Systems* (NFPA 1994a), and DOE Order 6430.1A (DOE 1989). Halon shall not be used. Backflow prevention devices shall be installed in accordance with American Water Works Association (AWWA) standards and shall be on the Washington State Department of Health's approved list. Where practical, the need for a fire protection system shall be minimized by eliminating unprotected combustibles. Using water for fire suppression on the storage vault deck is not allowed because of accident consequences related to the SNF in storage.

A fire alarm control panel shall be conveniently located in the building and shall be compatible with the site radio fire alarm report box that interfaces with the 200 Area Fire Department Emergency Dispatch System. The alarm system shall be installed in accordance with NFPA 70 (NFPA 1993a) and NFPA 72, *National Fire Alarm Code* (NFPA 1993b).

3.2.4.7 Drains. Where floor drains are required, all floors shall be drained at the low point. Contaminated and noncontaminated drains shall not be interconnected and backflow prevention shall be provided. Access for cleaning out all drains and lines shall be provided. Curbs or other containment features shall be provided around equipment that is subject to oil leakage to prevent flow of oil into the drain system.

Sanitary drains, where required, shall be sized and installed according to the *Uniform Plumbing Code* (ICBO 1991) and DOE Order 6430.1A (DOE 1989). Storm drains, where required, shall be installed in accordance with DOE Order 6430.1A standard citations.

A chemical collection sump shall be provided if required to serve the area reserved for portable decontamination. The sump material shall be compatible with the chemical waste.

3.2.4.8 Vent. Service vents shall be installed as required and shall not be cross-tied with process vents. Sanitary vents shall be provided in accordance with DOE Order 6430.1A (DOE 1989) and shall be independent of service or process vent systems.

3.2.4.9 Utilities. If the facility requires steam, the facility's steam requirements shall be integrated with the overall steam requirements for the 200 Area. High-pressure air systems, if required, shall have a sufficiently low dew point to prevent condensation from forming in the distribution piping. The air stream shall be free of particulate dirt and oil. Instrument air systems, if required, shall have a dew point of -40 °C and shall be free of moisture, oil (less than 1 ppm), and particulate matter.

Raw and sanitary water, if required, shall be provided in accordance with WAC-246-290, *Public Water Supplies*, and the AWWA and NFPA standards. Sanitary (potable) water shall be separated from raw (nonpotable) water by the design criteria as stated in DOE Order 6430.1A (DOE 1989) and WHC-CM-4-3, *Industrial Safety* (for cross-contamination control). Sanitary water shall be used to meet the water need for the plant facilities (e.g., water for domestic purposes).

Bottled gases shall be supplied as required for facility operation. Recommendations of the Compressed Gas Association (CGA) guidelines CGA P-1-1991, *Safe Handling of Compressed Gas in Containers* (CGA 1991), shall be used as applicable.

3.2.4.10 Electrical. All electrical systems shall conform to NFPA 70 (NFPA 1993a), the Institute of Electrical and Electronic Engineers' (IEEE) C2-1993, *National Electrical Safety Code* (IEEE 1993), and DOE Order 6430.1A (DOE 1989). The use of aluminum conductors requires prior approval. The following provides general guidance for electrical systems.

a. Electrical power shall be supplied to meet all facility and operations requirements.

b. The process and facility power shall be supplied via medium-voltage switchgear, load centers (low-voltage switch gear), motor control centers, and distribution panels.

c. The uninterruptible power supply (UPS) system shall provide uninterruptible power to alarms, critical equipment, instrumentation, and other circuits. The UPS shall provide uninterruptible power to plant functions where continuity of monitoring is essential.

d. Lightning protection/grounding shall be provided for this facility in accordance with requirements in DOE Order 6430.1A (DOE 1989) and NFPA 70 (NFPA 1993a).

e. All electrical equipment and connections (e.g., lighting, conduit, etc.) for the operational areas shall be designed and installed to meet the requirements of NFPA 70 (NFPA 1993a).

f. Sensors and display devices shall be provided for the electrical distribution system. These sensors and devices shall be an integral part of the switch gear, switch panels, and motor control centers, and shall have the capacity to interface with standard programmable controllers and desktop-type personal computers.

g. Emergency power shall be provided if required by safety analysis. Standby power to support design features shall be considered.

3.2.4.11 Maintenance Facilities. Space and environmental quality for equipment maintenance and repair and materials storage shall be provided. The size of area reserved shall be sufficient for decontamination, inspection, and repair needs based on design projections of the quantity and failure-rate of facility equipment. Equipment components shall be designed with the intent that it can be decontaminated, inspected, and/or repaired.

3.2.5 System Quality Factors

The requirements for reliability, maintainability, availability, and other quality factors for the solidified HLW interim storage system are discussed below.

3.2.5.1 Reliability. Facilities associated with the Phase I solidified HLW interim storage system shall use the following reliability concepts.

a. Maximize equipment interchange ability.

b. Locate complex components including electronic devices or those having a high probability of failure in non-radiation areas.

c. Operate power transmission devices below 75% of the manufacturer's rating.

d. Select pumps to operate in the middle of their flow and head range.

e. Provide adequate equipment materials for the operating environment.

f. Use commercially available equipment.

g. Identify equipment repair methods and egress routes.

h. Provide lag storage for process flow interruptions affected by maintenance.

3.2.5.2 Maintainability. Facilities associated with the Phase I solidified HLW interim storage system shall provide for equipment maintenance and repair. To facilitate maintenance and repair, the design shall include the following requirements.

a. Locate higher failure rate assemblies so as to minimize replacement impact on other equipment.

b. Position bulky equipment to be operable and/or serviceable by fixed or mobile crane.

c. Position remotely operated equipment to be visible by remote viewing equipment.

d. Provide portable equipment where feasible.

e. Minimize the number and standardize, to the extent practicable, handling fixtures such as yokes, hooks, grapples, etc.

f. Possess legible identification according to the facility numbering scheme.

For equipment used in radioactive areas that is of high enough value as to warrant decontamination and repair (i.e., cranes), the equipment design shall include the following requirements:

g. Possess protective coatings that are resistant to decontamination solutions.

h. Minimize contamination traps such as ledges and crevices.

I. Maintain portability where feasible.

j. Use standard fastening devices

k. Use fastening devices of dissimilar metal to prevent galling.

l. Be capable of post-repair qualification.

For all equipment used in the facility, the design shall include the following requirements as much as possible.

m. Use standardized equipment and components.

n. Position consumables for ease of access.

o. Provide lay down and work space.

p. Provide for safe isolation by mechanical separation, valving, or electrical disconnection.

3.2.5.3 Availability. The Phase I solidified HLW interim storage system shall support the HLW immobilization facility production schedule. Immobilization of HLW is scheduled to begin in 2002 and be completed in 2007, with a possible extension to 2011. The cumulative total of solidified HLW at production completion corresponds to the peak interim storage capacity requirement. This maximum projected interim storage capacity shall be maintained until the solidified HLW can be transferred to the permanent geologic repository. Additional details of the TWRS Program schedule are shown in Table 3-13.

A national, permanent HLW geologic repository is assumed to start receiving treated Hanford Site HLW no earlier than 2023 with a more likely start date of 2028. Transportation of solidified Hanford Site HLW is expected to take at least 5 years following the receipt of authorization for shipments to the repository. Current projections are that the bulk of solidified HLW can be transported to the repository by 2040. The solidified HLW interim storage facility is planned for closure by 2045.

Table 3-13. Tank Waste Remediation System Program Schedule.

Activity	From	To
+hase I proof-of-concept demonstration		
Minimum order quantity operations	June 1, 2002	June 1, 2007
Extension operations	Completion of minimum order quantity	June 1, 2011
Phase II full-scale production		
Award contract	2005	--
Design, permitting/licensing, construction	2005	2013
Operations	2013	2028
Decontamination and decommissioning	2028	2033

Source: WHC 1996c.

3.2.6 Environmental Conditions

New systems, structures, and components associated with Phase I solidified HLW interim storage shall be designed for the prevailing environmental conditions as specified in Table 3-14. Thermal effects of the soil shall be considered for the buried portions of the system. Additional information on Hanford Site weather conditions can be obtained from the Hanford Site Weather Bureau.

3.2.7 Transportability

Not applicable for this specification.

3.2.8 Flexibility and Expansion

This section provides requirements for flexibility and expansion of the Phase I solidified HLW interim storage system as a contingency for future mission modifications. To achieve this flexibility, the features identified in this section shall be provided.

3.2.8.1 Design Flexibility. The solidified HLW interim storage system shall provide flexibility for storage of 686 large canisters (Hold). The large canister interim storage capability is in lieu of (not in addition to) standard canister interim storage capability. Table 3-15 provides physical attributes of a large immobilized HLW canister. Tables 3-4, 3-5, and 3-6, respectively, provide the estimated radionuclide composition, chemical composition, and physical characteristics of immobilized HLW.

Table 3-14. Hanford Site Environmental Conditions.

Environmental condition	Value
Location [a]	N 136 279 (N 42 000) E 572 885 (W 55800)
Elevation [a]	215.8 m
Ambient air temperature [b]	
- Range	-29 to 49°C
- Maximum rate of increase	14°C per 20 min
- Maximum rate of decrease	13°C/h
Barometric pressure [a]	
- Range	9.52 to 10.24 kPa
- Maximum rate of increase	0.5 kPa/h
- Maximum rate of decrease	0.5 kPa/h
Relative humidity [b]	5% to 100% (rate of change is negligible)
Precipitation	
- Mean annual precipitation [b]	160 mm
- Maximum precipitation rate of change [b]	15.2 mm/h
- Rain [a]	152 mm/hr (maximum)
- Snowfall [a]	203 mm per 24 h (maximum) 635 mm (maximum accumulation)
- Sleet and hail [a]	Accounts for less than 1% of all frozen precipitation Hailstone diameter 10 mm (maximum)
Blowing dust and smoke [b]	
- Visibility	10 km or less with sky completely obscured
- Maximum frequency	10 times per year
- Duration	24 hrs per occurrence
Wind speed [b]	
- Maximum gusts	129 km/h
- Average (west-northwest direction)	12.4 km/h
Frost line [b]	91 cm
Solar radiation [b]	Frequent exposure due to minimal cloud cover

[a]Source: Swenson 1996.
[b]Source: WHC 1995a.

Table 3-15. Large Canister Attributes.

Parameter	Unit	Nominal large canister	Maximum large canister
Surface gamma dose rate	Sv/h	--	10^3 [a]
Neutron dose rate	Sv/h	--	0.1 [a]
Removable surface contamination (alpha)	Bq/m^2	--	367 [a]
Removable surface contamination (alpha)	Bq/m^2	--	3670 [a]
Inert cover gas leak rate	atm-cc/sec		10^{-4} [a]
Heat	watts	600 [b]	1,500 [a]
Length	m	4.5 [b]	4.5 [a]
Diameter	cm	61.0 [a]	62.5 [b]
Wall thickness	cm	0.95 [b]	0.95 [b]
Glass volume	m^3	1.04 [b]	1.16 [b]
Glass fraction	%	85 [b]	95 [b]
Glass weight	kg	2,735 [b]	3,060 [b]
Shell weight	kg	667 [b]	667 [b]
Total canister weight	kg	3,402 [b]	3,727 [b]

[a] RL 1996.
[b] Hold.

The design basis thermal load per vault shall be calculated based on 124 large immobilized HLW canisters at 0.4 kW each, 70 large immobilized HLW canisters at 0.6 kW each, 180 large immobilized HLW canisters at 1.5 kW each, and 66 cesium containers at 1.5 kW each (Hold).

3.2.8.2 Design Expansion. The solidified HLW interim storage system shall be designed to allow (to the extent practical) co-location of two vaults adjacent to the CSB at a future date. This capability is driven by the uncertainty associated with the total quantity of solidified HLW that actually requires interim storage.

3.2.9 Portability

Not applicable for this specification.

3.3 DESIGN AND CONSTRUCTION

The design and construction of new and retrofit systems, structures, and components associated with the Phase I solidified HLW interim storage shall be in accordance with the regulations, orders, directives, codes, and standards listed in Section 2.0. New and retrofit solidified HLW interim storage systems, structures, and components shall be designed, constructed, and operated to modern industry standards promulgated for new facilities having equivalent functions within the commercial nuclear industry. Furthermore, requirements of Section 3.3 are only applicable to new installations and retrofit modifications to CSB systems, structures, and components that are required to fully support the overall Phase I solidified HLW interim storage mission.

3.3.1 Materials and Equipment

The requirements for material and equipment furnished for the solidified HLW interim storage facilities are outlined below.

3.3.1.1 Energy Conservation. High-pressure sodium vapor lighting and fluorescent lighting shall be used whenever possible. The interior lighting shall be installed in accordance with the Illumination Engineering Society of America (IES) Standards (IES 1993) and DOE Order 6430.1A (DOE 1989), except in the remote areas where the minimum requirements shall be determined by the light intensity requirements for remote viewing. Emergency lighting shall be in accordance with NFPA 101 (NFPA 1994b).

The exterior walls insulation requirements shall be in accordance with DOE Order 6430.1A (DOE 1989). Identification of outside design temperatures shall be in accordance with DOE 6430.1A and A/E Standards, GH-CLIM-01, *Standard Mechanical Design Criteria for Heating, Ventilation, and Air Conditioning* (Kaiser 1996b). Identification of inside design temperatures shall be in accordance with DOE Order 6430.1A. Performance standards for all facilities shall be in accordance with 10 CFR 435, "Energy Conservation Voluntary Performance Standards for New Buildings; Mandatory for Federal Buildings."

Economics and alternatives shall be considered in accordance with DOE Order 6430.1A, where applicable. Electrical equipment shall conform to DOE Order 6430.1A, National Electrical Manufacturers Association (NEMA) standards, National Electric Code requirements, and ANSI/ASHRAE/IES 90A-1980, *Energy Conservation in New Building Design* (ANSI/ASHRAE/IES 1980). Energy metering shall be provided in accordance with DOE Order 6430.1A.

3.3.1.2 Cranes and Hoists. Cranes and hoists shall conform to applicable sections of DOE/RL-92-36, *Hoisting and Rigging Manual* (RL 1993a); American Society of Mechanical Engineers (ASME) B30 Series, *Miscellaneous Specifications for Cranes, Hoists, and Hooks* (ASME 1994a); and the Crane Maintenance Association of America (CMAA) Specification #70, *Specifications for Top Running Bridge and Gantry Type Multiple Girder Electric Overhead Traveling Cranes* (CMAA 1994). Cranes and hoists required for handling nuclear or radioactive materials shall meet (in addition to the above criteria) the applicable requirements in ASME NOG-1-1989, *Rules for Construction of Overhead and Gantry Cranes (Top Running Bridge, Multiple Girder)* (ASME 1989c), and NUREG-0554, *Single Failure-Proof Cranes for Nuclear Power Plants* (NRC 1979).

Consideration shall be given in design and procurement to disassembly features such as plug-in units for drives and electrical connectors. Maintenance platforms shall be provided where necessary for work on the cranes.

3.3.1.3 Piping and Vessels. The following provides requirements for piping and vessels that are furnished to solidified HLW interim storage facilities.

3.3.1.3.1 Embedded and/or Contaminated Piping. Embedded and/or contaminated lines, racks, and piping shall be designed and installed in accordance with ASME B31.3-1990, *Chemical Plant and Petroleum Refinery Piping* (ASME 1990) (Appendix M of this code shall be followed for proper application of the requirements). Piping shall be designed for removal, or shall permanently be installed and provide a service life equal to the life of the facility. Embedded piping installations shall meet Category 1 seismic requirements and hydraulic shock pressures. Piping and piping components shall be made of materials compatible with the operating conditions (i.e., chemical, abrasives). Embedded lines must have adequate spares or must be replaceable. Safety class piping must meet requirements of *ASME Boiler and Pressure Vessel Code Section III, Rules for Construction of Nuclear Power Plant Components* (ASME 1995a).

3.3.1.3.2 Other Piping. Piping shall be seismically designed in accordance with its safety classification. Sprinkler system piping shall be in accordance with NFPA 13 (NFPA 1994a). Other piping, such as cold chemical or instrument air, shall be designed and installed in accordance with ASME B31.1-1992, *Power Piping* (ASME 1992), ASME B31.3-1990 (ASME 1990), or ASME/ANSI B31.9-1988, *Building Services Piping Code* (ASME/ANSI 1988), as defined in the scope of these codes and DOE Order 6430.1A (DOE 1989). Cylinder gas piping shall be designed and installed in accordance with CGA P-1-1991 (CGA 1991). Piping identification shall meet Occupational Safety and Health Administration standards. The separation of potable water supplies from other water supplies and the use of backflow preventers shall be in accordance with the *Uniform Plumbing Code* (ICBO 1991) and DOE Order 6430.1A. All safety class piping must meet requirements of ASME Section III (ASME 1995a).

3.3.1.3.3 Contaminated Vessels. Contaminated vessels containing fluids at pressures of 103 kPa (gage) and greater shall be designed and constructed in accordance with *ASME Boiler and Pressure Vessel Code Section VIII, Rules for Pressure Vessels* (ASME 1995b), Division 1. This code shall also be used to design and fabricate other tanks that contain fluids at pressures lower than 103 kPa (gage), except seal pots and agitator oil catch tanks. All vessels (designed and fabricated in accordance with ASME Section VIII, Division 1 requirements) shall be designed and fabricated with the intent to be code stamped, which ensures the quality of design and the fabrication of the vessels. Any safety class vessels must meet the requirements of ASME Section III (ASME 1995a).

3.3.1.3.4 Noncontaminated Vessels. Noncontaminated pressure vessels containing fluids at pressures of 103 kPa (gage) and greater shall be designed and constructed in accordance with ASME Section VIII, Division 1 requirements (ASME 1995b) and shall be code stamped. Atmospheric tanks shall be constructed in accordance with ASME Section VIII, Division 1 requirements (ASME 1995b); American Petroleum Institute (API) Standard 650, *Welded Steel Tanks for Oil Storage* (API 1993); or other industry standards appropriate to the intended service. Code stamping of atmospheric vessels is not required. A process shall be provided to remove vessels from service and allow them to be accessed for inspection.

3.3.1.3.5 Piping and Vessel Insulation. Vessels and piping insulation shall meet the requirements of DOE Order 6430.1A (DOE 1989), and ANSI/ASHRAE/IES 90A-1980 (ANSI/ASHRAE/IES 1980), as applicable. Vessels and piping used for contaminated service shall be left uninsulated or they shall use specially designed insulation to ensure that the outer surface can be decontaminated. All surfaces with elevated temperatures that could cause thermal currents and spread contamination must be insulated to 50 °C maximum temperature or cooled to 50 °C.

3.3.1.4 Finishes and Special Coatings. Finishes used for decontamination shall be in accordance with DOE Order 6430.1A (DOE 1989). Special wall coatings that can be easily decontaminated shall be used on the walls, floors, and ceilings in other areas where infrequent decontamination is required. A process to identify chipped paint shall be provided (e.g., a gray undercoat and a white top coat or another two-color equivalent).

3.3.2 Radiation

3.3.2.1 Shielding. The shielding requirements of different areas in a facility shall be in accordance with the dose limits provided in 10 CFR 835, "Occupational Radiation Protection" (Subpart K) and HSRCM-1, *Hanford Site Radiological Control Manual* (RL 1993b). Hourly dose rates assume 2,000 work hours per year. The maximum annual exposure to an individual from all sources must not exceed the cumulative limits set forth in 10 CFR 835, which are summed over all controlled access areas. Where the potential exists for airborne contamination, allowance shall be made for internal deposition of radionuclides in determining the total dose. Allowable airborne contamination levels are provided in HSRCM-1.

The source term used for shielding design should be the maximum expected during normal operation. The shielding source term shall be based on the worst case of immobilized HLW canister or separated cesium container, as appropriate. This source term shall be used to quantify gross facility source terms and for localized effects. Quantities and locations of radioactive material shall be assumed so the largest credible dose is used as the shielding design basis. Source terms that may develop in operating areas over time and requirements for lower background radiation levels shall be considered.

Additional guidelines for radiological design are provided in HSRCM-1 (RL 1993b) and WHC-SD-GN-DGS-30011, *Radiological Design Guide* (WHC 1994). The shielding design criteria in WHC-SD-GN-DGS-30011, Section 7.0, shall be used to determine the shielding requirements of different areas in the facility. Shielding shall be designed to limit the total whole body dose to less than 5 mSv per year. Basis: WHC 1995a.

3.3.2.2 ALARA. Facilities associated with the solidified HLW interim storage system shall be designed to provide for ALARA in accordance with 10 CFR 835 and HSRCM-1 (RL 1993b). Guidelines for achieving exposure levels that are ALARA are contained in PNL-6577, *Health Physics Manual of Good Practices for Reducing Exposure to Levels that are as Low as Reasonably Achievable (ALARA)* (PNL 1988). The WHC implementation of the ALARA program is described in WHC-IP-1043, *WHC Occupational ALARA Program* (WHC 1995b). Basis: WHC 1995a.

3.3.2.3 Contamination Control. Where required, an HVAC system shall be provided to ensure safe facility operation. The HVAC system shall be designed to maintain air flow from non-contaminated to progressively contaminated areas. Consideration shall be given to providing separate HVAC supply systems for contaminated and noncontaminated areas. The HVAC system(s) shall meet applicable requirements in DOE Order 6430.1A (DOE 1989), ASME N509-1989 (ASME 1989a), ASME N510-1989 (ASME 1989b), and HSRCM-1 (RL 1993b).

3.3.2.4 Personnel Protection. A health protection system (HPS) shall be used to ensure safe operation of the facilities. The HPS will monitor for and protect personnel and the environment from radioactive and hazardous materials. The HPS shall provide the following features: instrumentation for sampling, monitoring, and alarm of radiation conditions; contamination and hazardous conditions; alarm of environmental releases; trend analysis of potential exposures and releases; acquisition of data for reporting; and maintenance of this data.

3.3.3 Name Plates and Product Markings

Not applicable for this specification.

3.3.4 Workmanship

Not applicable for this specification.

3.3.5 Interchangeability

Where retrofit modification requires installing components that replicate existing SNF CSB component functions, interchangeability shall be considered when designing and procuring high-cost components.

3.3.6 Safety and Regulatory Compliance

The solidified HLW interim storage system shall be designed, constructed, and operated in full compliance with applicable federal, state, and local laws and regulations to protect the public, worker health and safety, and the environment. The solidified HLW interim storage system shall be designed to commercial industry standards for resistance to seismic events, floods, and other natural phenomena. The degree of redundancy, reliability, and availability shall correspond to a systematically determined safety classification for all systems, structures, and components. The safety of the public and the workers and the protection of the environment shall be the primary considerations in the design, construction, startup, and operation of solidified HLW interim storage facilities. Basis: WHC 1995a.

3.3.6.1 Site Boundary. A site boundary, consistent with DOE/EIS-0189, *Final Environmental Impact Statement for Tank Waste Remediation System* (DOE 1996) shall be used for safety and environmental impact assessments. This site boundary encompasses the Hanford Site boundary with the following exceptions: north - Columbia River (the river's near bank), and east - Columbia River (the river's near bank). Basis: WHC 1995a.

3.3.6.2 Classification of Structures, Systems, and Components. The solidified HLW interim storage system design shall comply with the requirements of WHC-CM-4-46, *Safety Analysis Manual*, Chapter 9. This manual uses a graded approach for the safety classification of structures, systems, and components.

3.3.6.3 DBAs. The solidified HLW interim storage system shall be designed to withstand the effects of DBAs, as delineated in DOE Order 6430.1A (DOE 1989), DOE Order 5480.23, *Nuclear Safety Analysis Reports* (DOE 1992b), and DOE-STD-3009-94, *Preparation Guide for U.S. Department of Energy Non-Reactor Nuclear Facilities Safety Analysis Report* (DOE 1994f). Radioactive and toxic materials shall be confined within allowable limits. All safety class items (and safety-significant items required to prevent failure of safety class items) shall withstand the following DBAs in a manner that preserves the safety function. Safety-significant items (other than those required to prevent failure of safety class items) are required to withstand DBAs in accordance with WHC-CM-4-46. Releases postulated to occur as a result of DBAs shall be limited in accordance with WHC-CM-4-46.

3.3.6.4 Design Basis Fire. Solidified HLW interim storage structures, systems, and components shall withstand fire damage and shall maintain containment and confinement barriers. Safety class systems shall safely withstand a design basis fire as determined by a fire hazards analysis. The design basis fire shall be defined as a fire that results from the burning of all combustible materials enclosed within a continuous barrier. The barrier shall be rated at a minimum of 2 hours and 4 hours, where required, according to DOE Order 6430.1A (DOE 1989), Section 0110-99.0.7.

3.3.6.5 Design Basis Power Failure. The adequacy of the final containment and confinement barriers and safety class systems shall be evaluated against the design basis power failure, which is total loss of power from the 200 East Area's power grid. The design basis power failure shall be considered to be a total loss of normal power for a maximum of 48 hours.

3.3.6.6 Design Basis Earthquake. Safety class items (and safety-significant items whose failure could result in failure of the safety function of a safety class item) shall be designed to survive the applicable design basis earthquake as defined in A/E Standards, GC-Load-01 (Kaiser 1996a), with an amplification factor of 1.75 to increase the ground acceleration from 0.2 to 0.35 g for safety class items. In addition, the safety class items shall be designed for the small-magnitude, near-field earthquake. The spectra given in the standard shall be used in designing the facility for a design basis earthquake.

The following requirement and associated standards shall be applied to performance category PC3, which is the highest category for non-reactor facilities: DOE Order 5480.28, *Natural Phenomena Hazards Mitigation* (DOE 1993b); DOE-STD-1020-94, *Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities* (DOE 1994d); DOE-STD-1021-93, *Performance Categorization Criteria for Structures, Systems, and Components at DOE Facilities Subject to Natural Phenomena Hazards* (DOE 1993d); DOE-STD-1022-94, *Natural Phenomena Hazards Site Characterization Criteria* (DOE 1994e), and DOE-STD-1023-95, *Natural Phenomena Hazards Assessment Criteria* (DOE 1995b). Performance category PC3 requirements will be bounded by use of the Newmark-Hall ground-response spectra that are amplified from an anchor of 0.20 to 0.35 g.

Non-safety class items shall be designed in accordance with the *Uniform Building Code* (ICBO 1994).

3.3.6.7 Design Basis Wind. Safety class and safety significant items shall be designed to withstand the wind loading according to A/E Standards, GC-LOAD-01 (Kaiser 1996a). Features necessary to protect offsite and onsite personnel shall be designed to withstand design basis wind and missiles, with the criteria for high-hazard usage applicable to safety class items and moderate hazard usage applicable to safety-significant items.

3.3.6.8 Design Basis Flood. The evaluation of the 200 Area has been determined to be outside the maximum extent of the Hanford Site design basis flood.

3.3.6.9 Volcanic Eruption Considerations. The location of facilities encompassed by the solidified HLW interim storage system suggests that volcanic action may affect operation. Therefore, the design of safety class items shall include protection from ash resulting from volcanic eruption in accordance with A/E Standards, GC-LOAD-01 (Kaiser 1996a).

3.3.6.10 Abnormal Operations Detection. The solidified HLW interim storage system design shall include provisions monitor and sound alarm if abnormal conditions are detected (e.g., radioactive particulate release, regulated liquid and gaseous release, abnormal radiation levels, fires, overheating, or pressurization). Process and facility systems shall be designed for safe channeling of energy and material flows (e.g., rupture discs, fault-to-ground electrical circuitry, siphon breaks, etc.).

3.3.6.11 Accidental Radioactive Releases. The solidified HLW interim storage system shall be designed, constructed, and operated so after a DBA, the potential exposure to radiation shall be within regulatory requirements, as specified in applicable sections of 10 CFR 72.106, "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste" (Subparts E, F, G, and H).

3.3.6.12 Occupational Radiological Exposures. The solidified HLW interim storage system shall be designed, constructed, and operated such that worker radiation exposures during normal operation and anticipated operational occurrences are within regulatory requirements, as specified in applicable sections of 10 CFR 20, "Standards for Protection Against Radiation," and 10 CFR 835, "Occupational Radiation Protection." Action shall be taken to achieve the fundamental goal of reducing worker exposures to levels ALARA.

3.3.6.13 Worker Safety and Industrial Hygiene. The solidified HLW interim storage system shall be designed, constructed, and operated so worker exposures to occupational safety hazards are within the requirements of 10 CFR 835; 29 CFR 1910, "Occupational Safety and Health Standards;" DOE Order 5480.10, *Contractor Industrial Hygiene Program* (DOE 1985); and DOE Order 5483.1A, *Occupational Safety and Health Program for DOE Contractor Employees at Government-Owned, Contractor-Operated Facilities* (DOE 1983).

3.3.6.14 Inherent and Passive Features. To the degree practical, the solidified HLW interim storage system shall incorporate inherent and passive features to preclude the need for staff-intensive operations.

3.3.6.15 Defense-in-Depth Design Approach. The solidified HLW interim storage system design shall use the fundamental principles of defense-in-depth (i.e., redundancy and diversity) to ensure that critical safety functions are achieved and that multiple barriers are provided for the release of radioactivity.

3.3.6.16 National Environmental Policy Act. The solidified HLW interim storage system shall be designed, constructed, and operated in full compliance with the *National Environmental Policy Act of 1969* (NEPA), as specified by implementing regulations 40 CFR 1500-1508, "Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act," and 10 CFR 1021, "National Environmental Policy Act Implementation Procedures."

3.3.6.17 RCRA. The solidified HLW interim storage system shall be designed, constructed, and operated in full compliance with RCRA, as specified by implementing regulations 40 CFR 264, "Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," and WAC 173-303, "Dangerous Waste Regulations."

3.3.6.18 Pollution Prevention and Waste Minimization. The solidified HLW interim storage system shall be designed, constructed, and operated to integrate the following fundamental goals: (1) reduce the total release of hazardous materials to the environment through source reduction and recycling, (2) support site-specific goals for the reducing the generation of all types of wastes and pollutants from site operations, and (3) establish operational restrictions to meet as ALARA objectives for radioactive materials in effluents.

3.3.6.19 Recyclable Materials. Recyclable materials (i.e., depleted uranium and contaminated/irradiated metals) shall be incorporated into the design of facilities within the solidified HLW interim storage system to the extent practical.

3.3.6.20 Emergency Planning. The solidified HLW interim storage system shall be designed with the goal to eliminate the need for offsite evacuation and sheltering.

3.3.7 Human Engineering

Human factors criteria shall be applied to the design of facilities associated with the solidified HLW interim storage system. These criteria shall be considered for upgrading existing facilities where cost-benefit or risk-tradeoff analysis indicate justification for such expenditures. Equipment (e.g., control panels, work tables and counters, enclosures, seating, storage, special clothing, and any other equipment designed for an operator) to be used by personnel shall be designed or selected to accommodate a wide array of personnel body dimensions. Generally, it is recommended that equipment dimensions accommodate the fifth to ninety-fifth percentile of the user population. For recommended data representing these percentiles, see NUREG-0700, *Guidelines for Control Room Design Reviews* (NRC 1981), Section 6.1; and MIL-STD-1472D, *Human Engineering Design Criteria for Military System Equipment and Facilities* (DOD 1993), Section 5.6. Basis: WHC 1995a.

3.3.8 Nuclear Control

The solidified HLW interim storage system design shall comply with DOE Order 5480.24, *Nuclear Criticality Safety* (DOE 1992c), as implemented by WHC-CM-4-29, Nuclear Criticality Safety.

3.3.9 System Security

The solidified HLW interim storage system design shall incorporate measures necessary to prevent unauthorized access to nuclear materials, theft, diversions, hoaxes, and other malevolent acts intended to release radioactivity or disrupt operations based on a specified threat, in accordance with DOE Order 5632.1C, *Protection and Control of Safegaurds and Security Interests* (DOE 1994b) and DOE-M 5632.1C-1, Manual for Protection and Control of Security Interests (DOE 1994c). Physical features shall be incorporated that provide a credible adversary delay, which is time-based on a worst-case adversary consideration contained in *Design Basis Threat Policy for Department of Energy Programs and Facilities* (DOE 1993e).

3.3.10 Government-Furnished Property Usage

Not applicable for this specification.

3.3.11 Computer Resource Reserve Capacity

Not applicable for this specification.

3.4 DOCUMENTATION

The documentation requirements are outlined below, including waste form qualification plans, test plans, quality assurance documentation, records management, specifications, drawings, technical manuals, and procedures. Formal documentation controls shall be used to ensure that requirements are clearly defined and controlled and that facilities within the solidified HLW interim storage complex satisfy technical, safety, and operational requirements.

3.4.1 Quality Assurance

The solidified HLW interim storage system shall adhere to the applicable requirements of 10 CFR 830.120, "Quality Assurance Requirements." In accordance with these requirements, each project developed under the Solidified HLW Interim Storage Program shall develop a project-specific Quality Assurance Program Plan (QAPP) encompassing the following program elements as applicable to the project: program, personnel training and qualifications, quality improvement, documents and records, work processes, design, procurement inspection and acceptance testing, management assessment, and independent assessment. The QAPP shall be submitted to the DOE for approval. Basis: WHC 1995a.

All subcontractors providing services for a project (e.g., A-E services, construction management services, and testing services in support of technology development) shall be required to have (or to develop) a QAPP that is compatible with the requirements of 10 CFR 830.120, as specific to the subcontractors area of responsibility. As long as the program is compatible with the above referenced requirements, the program's basis can be founded in existing consensus standards, such as ASME NQA-1-1-1994-IA, *Quality Assurance Program Requirements for Nuclear Facility Applications* (ASME 1994b); 10 CFR 50, "Domestic Licensing of Production and Utilization Facilities," Appendix B; and the International Organization for Standardization ISO 9000 Series, *Quality Management and Quality Assurance Standards* (ISO 1994). All subcontractor QAPPs shall be submitted to the Project Hanford Management Contractor for review and concurrence.

3.4.2 Safety Documentation

Safety analysis reports and technical safety requirements, or technical specifications (in accordance with Nuclear Regulatory Commission regulations), as appropriate, shall be developed to establish a basis for the facility and to control solidified HLW interim storage system operations.

3.4.3 Waste Form Qualification

A waste form qualification plan and a waste form qualification report shall be prepared in accordance with DOE/RW-0351P (DOE/RW 1996) and DOE/EM-0093 (DOE/EM 1995). The plan and report only shall address the immobilized HLW canister attributes that could credibly be affected by interim storage activities.

3.4.4 Environmental Permits

Environmental permits and documentation shall be prepared in accordance with 40 CFR 264, WAC 173-303, 40 CFR 1500-1508, 10 CFR 1021, WAC 246-247, WAC 173-400, WAC 246-272, and any other applicable regulation.

3.5 LOGISTICS

Not applicable for this specification.

3.6 PERSONNEL AND TRAINING

Requirements for personnel and training are identified in this section. The solidified HLW interim storage system shall be designed for operation by personnel possessing qualifications and trained in accordance with DOE 5480.20A, *Personnel Selection, Qualification, Training, and Staffing Requirements at DOE Reactor and Non-Reactor Facilities* (DOE 1994a). Basis: WHC 1995a.

3.6.1 Personnel

Operational work spaces shall be designed for the projected number of personnel that are required to meet the process operational flow of materials and related support requirements.

3.6.2 Training

An operational training program shall be established in accordance with DOE Order 5480.20A (DOE 1994a). Retraining and recertification shall be another part of the operator training plan. Basis: WHC 1995a.

3.7 CHARACTERISTICS OF SUB-SYSTEM ELEMENTS

This section identifies each major segment of the Phase I solidified HLW interim storage system and describes the requirements for each segment.

3.7.1 Phase I Solidified HLW Acceptance

The following requirements are allocated specifically to acceptance of Phase I solidified HLW.

a. Casks provided to the privatized production facilities shall exhibit smearable surface contamination (internal and external) of less than 367 Bq/m^2 alpha and less than 3670 Bq/m^2 gamma/beta. Basis: RL 1996.

b. Solidified HLW will be accepted at the rate of approximately three shipments every week. Each shipment consists of a single cask loaded with either one immobilized HLW canister or one separated cesium container.

3.7.2 Phase I Solidified HLW Transport

The following requirements are allocated specifically to transport of Phase I solidified HLW.

a. At a minimum, onsite transportation casks shall be designed to limit radiation levels (when loaded) to a maximum of 2 mSv/h at the outer surface and 0.1 mSv/h at a distance of 2 m from the vertical surface. Further reduction in surface dose rates shall be provided if dictated by ALARA considerations. Basis: RL 1996.

b. The solidified HLW shall be transported to the SNF CSB via the Hanford Site roadway system. The transport mechanism shall be a truck-based transporter.

c. Support for on-demand delivery of a transporter/cask to all solidified HLW production facilities shall be provided. One transporter/cask should remain in standby at all times.

d. Radiological surveys of the transporter and cask shall be performed to assess the contamination levels before release for use. Visual inspections of the transporter and cask shall be performed to assess the condition and determine maintenance needs.

3.7.3 Phase I Solidified HLW Interim Storage

The following requirements are allocated specifically to storage of Phase I solidified HLW.

a. The solidified HLW shipment is received at the SNF CSB and is placed in storage within 12 hours. The canisters/containers are placed in interim storage for up to 40 years. The solidified HLW centerline temperatures should never exceed the specified limits (see Section 3.2.1.3). Storage locations shall be monitored and maintain containment integrity.

b. If primary containment is compromised, the solidified HLW and storage location should be decontaminated. The failed solidified HLW shall be repackaged (i.e., place the canister or container inside an appropriately sized overpack).

3.7.4 Phase I Solidified HLW Retrieval

The solidified HLW for final disposition shall be retrieved in 12 hours and transported to the appropriate facility for offsite shipment or further processing. This requirement is allocated specifically to retrieval of Phase I solidified HLW.

3.7.5 Phase I Solidified HLW Delivery for Staging and Load-Out

A description of this system segment and its allocated requirements are (TBD).

3.7.6 Phase I Solidified HLW Support

The following requirements are allocated specifically to support services of Phase I solidified HLW:

a. Provide all the necessary accommodations to facilitate SNF CSB operations and maintenance activities during the load-in/load-out and interim storage modes of operation.

b. Receive and store chemicals, materials, and supplies necessary for operation and maintenance.

c. Provide facilities for the maintenance of radioactive and nonradioactive equipment to support operations and to minimize downtime. The radioactive equipment maintenance area shall include appropriate minimal portable decontamination capability of small items with portable equipment.

d. Provide operational support facilities and equipment (e.g., truck loading and unloading areas, cranes, and cask handling equipment) as required.

e. Provide operational support services to the degree required for facility operation (e.g., electrical power, site-generated power, uninterruptible power, communications, compressed gases, sanitary water, raw water, and sewers).

f. Provide changing rooms for contamination control, including lockers, showers, and health physics areas.

g. Provide offices and work space in temporary facilities in noncontaminated areas.

h. Provide an HPS to monitor and protect personnel and the environment from radioactive and hazardous materials. The HPS shall include instrumentation for sampling, monitoring, and alarm of radiation, contamination, and hazardous conditions; alarm for environmental releases and trends for potential exposures and releases; acquisition and reporting of data; and maintenance of data.

3.8 PRECEDENCE

The hierarchical relationship among requirements specified in Section 3.0 is as follows, except where Washington State has been granted regulatory authority by the U.S. Government:

a. Federal laws (e.g., Code of Federal Regulations)

b. Revised Code of Washington, as specified in Washington Administrative Code)

c. Local ordinances

d. DOE Orders and U.S. Secretary of Energy directives

e. National and international consensus codes and standards

f. Hanford Site-specific codes and standards.

3.9 QUALIFICATIONS

Records, documents, and document control pertinent to design functions shall be in accordance with 10 CFR 830.120, ASME-NQA-1-1994-IA (ASME 1994b) (partial guidance to comply with 10 CFR 830.120), DOE 5500.7B, *Emergency Operations Record Protection Program* (DOE 1991), and ANSI/ANS-3.2-88, *Administrative Controls and Quality Assurance for the Operational Phase of Nuclear Power Plants* (ANSI/ANS 1988). Upgraded quality assurance requirements of DOE/RW-0333P, *Quality Assurance Requirements and Description for the Civilian Radioactive Waste Management Program* (DOE/RW 1995) shall be applied to items identified as being a waste acceptance process activity.

A waste acceptance process activity produces information that will be used to certify that immobilized HLW canisters comply with repository acceptance criteria as specified in DOE/RW-0351P (DOE/RW 1996), and DOE/EM-0093 (DOE/EM 1995). Waste acceptance process activity items and the actions to prevent or mitigate their failure shall be identified by a comprehensive, systematic, documented design evaluation. Basis: WHC 1995a.

3.10 STANDARD SAMPLE

Not applicable for this specification.

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4.0 QUALITY ASSURANCE PROVISIONS

This section describes the means by which requirements of Sections 3.0, 4.0, and 5.0 shall be verified and/or validated. Upgraded quality assurance requirements shall be applied to items identified as having high technical risk and being critical items. Critical items and the actions to prevent or mitigate their failure shall be identified by a comprehensive, systematic, documented evaluation of the design. Critical items include safety class items; items whose failure could cause failure of a safety class item; items related to demonstrating compliance with repository waste acceptance criteria; items whose failure could result in extended downtime, significant program delay, or high recovery cost; and high development, high risk equipment.

4.1 INSPECTION RESPONSIBILITY

The projects developed under the solidified HLW interim storage program shall establish a test and evaluation program to demonstrate design requirements conformance as required in the verification matrix table provided in Section 4.3 (see Table 4-1). The test and evaluation program and the conformance verification activities are not intended to replace activities associated with the environmental regulatory permit application process or to otherwise be construed as demonstrating compliance with such regulations.

4.2 SPECIAL TESTS AND EXAMINATIONS

Not applicable for this specification.

4.3 REQUIREMENTS CROSS-REFERENCE

The following requirements define methods to be used for conformance verification:

a. **Analysis**. Analysis is the process used to verify a requirement by rational thinking, studies, modeling, and/or examination of test data to reach a conclusion. Analysis involves the processing of accumulated results and conclusions, intended to provide proof that a requirement has been verified. The analytical results may consist of a compilation or interpretation of existing information or derived from lower-level examination, tests, demonstrations, or analyses.

b. **Examination**. Examination is the process of investigating a product to verify that required features are incorporated. Examination consists of investigation without the use of special laboratory appliances, procedures, supplies, or services to determine conformance. Examination is nondestructive and includes, but is not limited to, visual, auditory, olfactory, tactile, and other investigations (e.g., simple physical manipulation, gauging, and measurement).

c. **Test**. A test is conducted by a quantitative process resulting from the collection of data over a specified time period, under controlled conditions, to verify the as-built item satisfies the requirement. A test denotes the determination of the properties or elements of items (or components thereof) by technical means, including functional operation, the application of established principles and procedures, and the collection of quantitative data. The data analysis derived from testing is an integral part of this method.

d. **Demonstration**. Demonstration is the qualitative process of exercising an as-built or prototypic item to verify that it satisfies the requirement. Data may or may not be collected. Demonstration differs from test by the directness of approach in the verification of a requirement. Demonstration is accomplished without using special instrumentation or equipment; thus, operating a representative item in or near its use environment would be defined as a demonstration rather than a test. Demonstration attempts to verify (qualitatively) the performance of a function, whereas testing involves verifying performance within a specific range of measurement.

Table 4-1 correlates the requirements of Sections 3.0, 4.0, and 5.0 with the methods to be used to demonstrate conformance to the requirements. Conformance documentation will be accomplished using detailed procedures to be developed and performed on all procured or constructed equipment, structures, and software. Table 4-2 provides a cross-reference of requirements contained in Sections 3.0, 4.0, and 5.0.

In Table 4-1, items marked "N/A" (not applicable) do not require verification. These items are titles, explanatory material, or other matter for which verification is not appropriate. When more than one verification method is identified, conformance must be verified by one or more of the indicated methods. Basis: WHC 1995a.

Table 4-1. Verification Matrix. (5 sheets)

Section	Title	N/A	Analysis	Examination	Testing	Demonstration
3.2.1	Performance Characteristics	X	--	--	--	--
3.2.1.1	Design Life	--	X	--	--	--
3.2.1.2	Storage Capacity	--	X	--	--	--
3.2.1.3	Storage Temperature Control	--	X	--	--	--
3.2.1.4	Preservation of Producer-Generated Certification Data	X	--	--	--	--
3.2.1.5	Solidified high-level waste (HLW) Rework	--	X	--	--	X
3.2.1.6	Solidified HLW Interim Storage Design Philosophy	--	X	--	--	--

Table 4-1. Verification Matrix. (5 sheets)

Section	Title	N/A	Analysis	Examination	Testing	Demonstration
3.2.2	System Capability Relationships	X	--	--	--	--
3.2.2.1	Definition of Operating Modes	X	--	--	--	--
3.2.2.2	Operating Modes Schedule	X	--	--	--	--
3.2.3	External Interface Requirements	X	--	--	--	--
3.2.3.1	Immobilized HLW Canisters	--	X	--	--	--
3.2.3.2	Separated Cesium Containers	--	X	--	--	--
3.2.3.3	Repository Acceptance	--	X	--	--	--
3.2.3.4	Gaseous Effluents	--	X	--	--	--
3.2.3.5	Liquid Effluents	--	X	--	--	--
3.2.3.6	Liquid Waste	--	--	X	--	--
3.2.3.7	Solid Waste	--	X	--	--	--
3.2.3.8	Spent Nuclear Fuel	--	X	--	--	--
3.2.4	Physical Characteristics	X	--	--	--	--
3.2.4.1	Location	--	--	X	--	--
3.2.4.2	Facility Description	--	X	X	--	--
3.2.4.3	General Configuration	--	X	--	--	--
3.2.4.4	Heating, Ventilation, and Air Conditioning	--	X	--	X	--
3.2.4.4.1	Ventilation Zones	--	X	--	X	--
3.2.4.4.2	Supply Air	--	X	--	--	--
3.2.4.4.3	Exhaust Air	--	X	--	--	--
3.2.4.4.4	Uncontrolled Access Zones	--	X	--	--	--
3.2.4.4.5	Toilet Facilities	--	X	--	--	--
3.2.4.4.6	Computer Rooms	--	X	--	X	--
3.2.4.5	Communications	--	--	X	--	X
3.2.4.6	Fire Protection	--	X	--	--	--
3.2.4.7	Drains	--	--	X	--	--
3.2.4.8	Vents	--	--	X	--	--
3.2.4.9	Utilities	--	X	X	--	--
3.2.4.10	Electrical	--	--	X	X	--
3.2.4.11	Maintenance Facilities	--	--	X	--	--
3.2.5	System Quality Factors	X	--	--	--	--
3.2.5.1	Reliability	--	X	--	--	--
3.2.5.2	Maintainability	--	X	--	--	--
3.2.5.3	Availability	--	X	--	--	--
3.2.6	Environmental Conditions	--	X	--	--	--
3.2.7	Transportability	X	--	--	--	--

Table 4-1. Verification Matrix. (5 sheets)

Section	Title	N/A	Analysis	Examination	Testing	Demonstration
3.2.8	Flexibility and Expansion	X		--	--	--
3.2.8.1	Design Flexibility	--	X	--	--	--
3.2.8.2	Design Expansion	--	X	--	--	--
3.2.9	Portability	X	--	--	--	--
3.3	Design and Construction	X	--	--	--	--
3.3.1	Materials and Equipment	X	--	---	--	---
3.3.1.1	Energy Conservation	--	X	X	--	--
3.3.1.2	Cranes and Hoists	--	X	--	X	X
3.3.1.3	Piping and Vessels	X	--	--	--	--
3.3.1.3.1	Embedded and Contaminated Piping	--	X	--	--	--
3.3.1.3.2	Other Piping	--	X	X	--	--
3.3.1.3.3	Contaminated Vessels	--	X	--	--	--
3.3.1.3.4	Noncontaminated Vessels	--	--	X	-	--
3.3.1.3.5	Piping and Vessel Insulation	--	--	X	--	--
3.3.1.4	Finishes and Special Coatings	--	--	X	--	--
3.3.2	Radiation	X	--	--	--	--
3.3.2.1	Shielding	--	X	--	--	--
3.3.2.2	ALARA	--	X	--	--	--
3.3.2.3	Contamination Control	--	X	--	--	--
3.3.2.4	Personnel Protection	--	X	X	--	--
3.3.3	Name Plates and Product Markings	X	--	--	--	--
3.3.4	Workmanship	X	--	--	--	--
3.3.5	Interchangeability	--	X	--	--	--
3.3.6	Safety and Regulatory Compliance	--	X	--	--	--
3.3.6.1	Site Boundary	--	X	--	--	--
3.3.6.2	Classification of Structures, Systems, and Components	--	X	--	--	--
3.3.6.3	Design Basis Accidents	--	X	--	--	--
3.3.6.4	Design Basis Fire	--	X	--	--	--
3.3.6.5	Design Basis Power Failure	--	X	--	--	--
3.3.6.6	Design Basis Earthquake	--	X	--	--	--
3.3.6.7	Design Basis Wind	--	X	--	--	--
3.3.6.8	Design Basis Flood	X	--	--	--	--
3.3.6.9	Volcanic Eruption Considerations	--	X	--	--	--
3.3.6.10	Abnormal Operations Detection	--	X	--	--	--

Table 4-1. Verification Matrix. (5 sheets)

Section	Title	N/A	Analysis	Examination	Testing	Demonstration
3.3.6.11	Accidental Radioactive Releases	--	X	--	--	--
3.3.6.12	Occupational Radiological Exposures	--	X	--	--	--
3.3.6.13	Worker Safety and Industrial Hygiene	--	X	--	--	--
3.3.6.14	Inherent and Passive Features	--	X	--	--	--
3.3.6.15	Defense-in-Depth Design Approach	--	X	--	--	--
3.3.6.16	National Environmental Policy Act	--	X	--	--	--
3.3.6.17	Resource Conservation and Recovery Act	--	X	--	--	--
3.3.6.18	Pollution Prevention and Waste Minimization	--	X	--	--	--
3.3.6.19	Recyclable Materials	--	X	--	--	--
3.3.6.20	Emergency Planning	--	X	--	--	--
3.3.7	Human Engineering	--	X	X	--	--
3.3.8	Nuclear Control	--	X	--	--	--
3.3.9	System Security	--	X	X	--	X
3.3.10	Government -Furnished Property Usage	X	--	--	--	--
3.3.11	Computer Resource Reserve Capacity	X	--	--	--	--
3.4	Documentation	X	--	--	--	--
3.4.1	Quality Assurance	--	X	--	--	--
3.4.2	Safety Documentation	--	X	X	--	--
3.4.3	Waste Form Qualification	--	X	X	--	--
3.4.4	Environmental Permits	--	X	X	--	--
3.5	Logistics	X	--	--	--	--
3.6	Personnel and Training	--	--	X	--	--
3.6.1	Personnel	--	--	X	--	--
3.6.2	Training	--	--	X	--	--
3.7	Characteristics of Sub-system Elements	X	--	--	--	--
3.7.1	Phase I Solidified HLW Acceptance	--	--	X	--	--
3.7.2	Phase I Solidified HLW Transport	--	X	X	--	--
3.7.3	Phase I Solidified HLW Interim Storage	--	--	X	--	--
3.7.4	Phase I Solidified HLW Retrieval	--	--	X	--	--

Table 4-1. Verification Matrix. (5 sheets)

Section	Title	N/A	Analysis	Examination	Testing	Demonstration
3.7.5	Phase I Solidified HLW Delivery for Staging and Load-Out	TBD	--	--	--	--
3.7.6	Phase I Solidified HLW Support	--	X	X	--	--
3.8	Precedence	X	--	--	--	--
3.9	Qualifications	--	X	X	--	--
3.10	Standard Sample	X	--	--	--	--
4.0	Quality Assurance Provisions	X	--	--	--	--
4.1	Inspection Responsibility	X	--	--	--	--
4.2	Special Tests and Examinations	X	--	--	--	
4.3	Requirements Cross-Reference	X	--	--	--	--
5.0	Preparation for Operation or Decommissioning	X	--	--	--	--
5.1	Operational Philosophy	--	X	X	--	--
5.2	Pre-Operational and Startup Testing	--	--	--	X	X
5.3	Operations	X	--	--	--	--
5.3	Decommissioning	--	X	--	--	--

N/A = Not applicable

Table 4-2. Requirements Traceability Matrix. (8 sheets)

Section	Requirement number	Description
3.2.1	N/A	Performance characteristics
3.2.1.1	N/A	Minimum design life
3.2.1.2	N/A	Storage capacity
3.2.1.3	N/A	Storage temperature control
3.2.1.4	DOE/RW-0351P	Preservation of producer-generated certification data
3.2.1.4	DOE/EM-0093	Preservation of producer-generated certification data
3.2.1.4	DE-RP06-96RL13308	Preservation of producer-generated certification data
3.2.1.5	DOE/RW-0351P	Over-pack of solidified HLW
3.2.1.6	N/A	Monitoring and maintenance expectations
3.2.2	N/A	System capability relationships
3.2.2.1	N/A	Operating modes for solidified HLW interim storage system
3.2.2.2	N/A	Operating modes schedule
3.2.3	N/A	External interface requirements
3.2.3.1	DOE/RW-0351P	Immobilized HLW canister characteristics
3.2.3.1	DOE/EM-0093	Immobilized HLW canister characteristics

Table 4-2. Requirements Traceability Matrix. (8 sheets)

Section	Requirement number	Description
3.2.3.2	N/A	Separated cesium container characteristics
3.2.3.3	DOE/RW-0351P	Repository storage criteria
3.2.3.3	DOE/EM-0093	Repository storage criteria
3.2.3.4	40 CFR 61	Air emission limits
3.2.3.4	WAC 173-400	Air emission limits
3.2.3.4	WAC 173-460	Air emission limits
3.2.3.4	WAC 173-480	Radiological air emission limits
3.2.3.4	WHC-CM-7-5	Final facility filtration
3.2.3.4	DOE Order 5480.4	Sampling and continuous monitoring of particulate gaseous effluents
3.2.3.4	DOE Order 5484.1	Sampling and continuous monitoring of particulate gaseous effluents
3.2.3.4	WAC-246-247	Best available control technology
3.2.3.5	N/A	Effluent treatment facility acceptance criteria
3.2.3.5	N/A	Liquid effluent retention facility acceptance criteria
3.2.3.5	WHC-CM-7-5	Liquid effluent discharge requirements for radionuclides
3.2.3.7	DOE-95-SWT-186	Onsite shipment of radioactive solid waste
3.2.3.7	WHC-CM-2-14	Onsite shipment of radioactive solid waste
3.2.3.7	DOE Order 460.1	Onsite shipment of radioactive solid waste
3.2.3.7	WHC-EP-0063	Transfer of solid radioactive waste for dispositioning
3.2.3.7	WHC-CM-7-5	Threshold doses and/or concentrations for soil and rubble
3.2.3.8	N/A	Preservation of spent nuclear fuel removal capability and confinement integrity
3.2.4	N/A	Physical characteristics
3.2.4.1	N/A	Location
3.2.4.2	N/A	Facility description
3.2.4.3	DOE Order 6430.1A	General structure and lay-outs
3.2.4.3	NFPA 70	General structure and lay-outs
3.2.4.3	NFPA 101	General structure and lay-outs
3.2.4.3	Uniform Building Code	General structure and lay-outs
3.2.4.3	GC-LOAD-01	General structure and lay-outs
3.2.4.3	DOE Order 6430.1A	Storage area confinement
3.2.4.3	N/A	Solidified HLW receipt via truck and rail access
3.2.4.4	DOE Order 6430.1A	Ventilation systems used for contamination confinement and control
3.2.4.4	DOE Order 5400.5	Ventilation systems used for contamination confinement and control
3.2.4.4	ASME N509-1989	Ventilation systems used for contamination confinement and control

Table 4-2. Requirements Traceability Matrix. (8 sheets)

Section	Requirement number	Description
3.2.4.4	ASME N510-1989	Ventilation systems used for contamination confinement and control
3.2.4.4.1	N/A	Ventilation zones and differential pressures
3.2.4.4.2	DOE Order 6430.1A	Supply air conditioning
3.2.4.4.2	ASHRAE 52.1-1992	Supply air filtration efficiency
3.2.4.4.2	N/A	Supply air inlet locations
3.2.4.4.3	N/A	Number of final facility filtration stages
3.2.4.4.3	DOE Order 6430.1A	Criteria for HEPA filter assemblies
3.2.4.4.3	ASME N509-1989	Criteria for HEPA filter assemblies
3.2.4.4.3	DOE Order 6430.1A	Fire protection provisions for HEPA filter systems
3.2.4.4.3	ASME N510-1989	HEPA filter in place testing design requirements
3.2.4.4.3	DOE Order 5480.7A	Fire protection provisions for HEPA filter systems
3.2.4.4.3	DOE Order 6430.1A	Fire protection provisions for HEPA filter systems
3.2.4.4.3	N/A	Ventilation system decontamination, isolation, and stack height
3.2.4.4.4	DOE Order 6430.1A	Uncontrolled access zone ventilation system
3.2.4.4.5	ASHRAE Handbook--Fundamentals	Toilet facilities ventilation air requirements
3.2.4.4.6	Computer manufacturer's recommendations	Temperature, humidity and filtration requirements for computer rooms
3.2.4.5	DOE Order 6430.1A	Interior and exterior communication systems
3.2.4.5	DOE Order 5300.1C	Interior and exterior communication systems
3.2.4.6	DOE Order 6430.1A	Primary fire protection system installation
3.2.4.6	DOE Order 5480.7A	Primary fire protection system installation
3.2.4.6	NFPA 13	Fire sprinkler system installation
3.2.4.6	AWWA Standards	Backflow prevention
3.2.4.6	NFPA 70	Fire alarm system installation
3.2.4.6	NFPA 72	Fire alarm system installation
3.2.4.7	N/A	Floor drain design requirements
3.2.4.7	Uniform Plumbing Code	Sanitary drain design requirements
3.2.4.7	DOE Order 6430.1A	Sanitary and storm drain design requirements
3.2.4.8	DOE Order 6430.1A	Service and sanitary vents design requirements
3.2.4.9	WAC 246-290	Raw and sanitary water supplies
3.2.4.9	AWWA Standards	Raw and sanitary water supplies
3.2.4.9	NFPA Standards	Raw and sanitary water supplies
3.2.4.9	DOE Order 6430.1A	Isolation of raw and sanitary water
3.2.4.9	WHC-CM-4-3	Isolation of raw and sanitary water
3.2.4.9	CGA P-1-1991	Safe handling of bottled gases
3.2.4.10	NFPA 70	Design and installation guidance for electrical systems

Table 4-2. Requirements Traceability Matrix. (8 sheets)

Section	Requirement number	Description
3.2.4.10	IEEE C2-1993	Design and installation guidance for electrical systems
3.2.4.10	DOE Order 6430.1A	Design and installation guidance for electrical systems
3.2.4.11	N/A	Space provided for equipment maintenance, repair, and decontamination
3.2.5	N/A	System quality factors
3.2.5.1	N/A	Reliability criteria for HLW interim storage structures, systems, and components
3.2.5.2	N/A	Maintainability criteria for HLW interim storage structures, systems, and components
3.2.5.3	N/A	Availability schedule of HLW interim storage facilities
3.2.6	N/A	Hanford site environmental conditions
3.2.7	N/A	Transportability
3.2.8	N/A	Flexibility and expansion of storage program
3.2.8.1	N/A	Design flexibility for large canister storage
3.2.8.2	N/A	Future storage expansion requirement
3.2.9	N/A	Portability
3.3	N/A	Design and construction
3.3.1	N/A	Materials and equipment
3.3.1.1	IES Standards	Interior lighting
3.3.1.1	DOE Order 6430.1A	Energy metering and conservation, insulation, lighting, interior design temperature, and electrical equipment performance
3.3.1.1	NFPA 101	Emergency lighting
3.3.1.1	GH-CLIM-01	Identification of outside design temperatures
3.3.1.1	10 CFR 435	Conservation performance standards
3.3.1.1	NEMA Standards	Electrical equipment selection
3.3.1.1	ANSI/ASHRAE/IES 90A-1980	Electrical equipment performance and selection
3.3.1.2	DOE/RL-92-36	Crane and hoist requirements
3.3.1.2	ASME B30 Series	Crane and hoist requirements
3.3.1.2	CMAA Specification #70	Crane and hoist requirements
3.3.1.2	ASME NOG-1-1989	Crane and hoist requirements (handling nuclear or radioactive materials)
3.3.1.2	NUREG-0554	Crane and hoist requirements (handling nuclear or radioactive materials)
3.3.1.3	N/A	Piping and vessels
3.3.1.3.1	ASME B31.3-1990	Design and installation of embedded and contaminated lines, rack, and piping
3.3.1.3.1	ASME Section III	Safety class and embedded piping requirements
3.3.1.3.2	NFPA 13	Fire sprinkler system piping design and installation
3.3.1.3.2	ASME B31.1-1992	Miscellaneous piping design and installation requirements

Table 4-2. Requirements Traceability Matrix. (8 sheets)

Section	Requirement number	Description
3.3.1.3.2	ASME/ANSI B31.9-1988	Miscellaneous piping design and installation requirements
3.3.1.3.2	DOE Order 6430.1A	Miscellaneous piping design and installation requirements
3.3.1.3.2	CGA P-1-1991	Cylinder gas piping design and installation
3.3.1.3.2	Uniform Plumbing Code	Backflow preventers
3.3.1.3.2	ASME Section III	Miscellaneous safety class piping requirements
3.3.1.3.3	ASME Section VIII	Design and construction requirements for contaminated vessels under pressure
3.3.1.3.3	ASME Section III	Safety class vessel design requirements
3.3.1.3.4	ASME Section VIII	Design and construction requirements for non-contaminated, pressurized and atmospheric vessels
3.3.1.3.4	API Standard 650	Construction requirements for atmospheric tanks
3.3.1.3.5	DOE Order 6430.1A	Vessels and piping insulation
3.3.1.3.5	ANSI/ASHRAE/IES 90A-1980	Vessels and piping insulation
3.3.1.4	DOE Order 6430.1A	Wall coatings for easy decontamination
3.3.2	N/A	Radiation
3.3.2.1	HSRCM-1	Radiological guidelines, dose limits, and airborne contamination levels
3.3.2.1	10 CFR 835	Radiological shielding requirements and dose limits
3.3.2.1	N/A	Shielding source terms
3.3.2.1	WHC-SD-GN-DGS-30011	Radiological shielding requirements for various areas in the facility
3.3.2.2	10 CFR 835	ALARA design of HLW facilities
3.3.2.2	HSRCM-1	ALARA design of HLW facilities
3.3.2.2	PNL-6577	Guidelines for ALARA exposure levels
3.3.2.2	WHC-IP-1043	WHC implementation of ALARA
3.3.2.3	DOE Order 6430.1A	Control contamination via HVAC system
3.3.2.3	ASME N509-1989	Control contamination via HVAC system
3.3.2.3	ASME N510-1989	Control contamination via HVAC system
3.3.2.3	HSRCM-1	Control contamination via HVAC system
3.3.2.4	N/A	Provide health protection system
3.3.3	N/A	Name plates and product markings
3.3.4	N/A	Workmanship
3.3.5	N/A	Interchangeability
3.3.6	N/A	Design and construction in compliance with safety and environmental regulations
3.3.6.1	DOE/EIS-0189	Environmental Impact Statement site boundaries
3.3.6.2	WHC-CM-4-46	Graded approach to safety classification of structures, systems and components

Table 4-2. Requirements Traceability Matrix. (8 sheets)

Section	Requirement number	Description
3.3.6.3	DOE Order 6430.1A	Confine radioactive and toxic materials from anticipated design basis accidents
3.3.6.3	DOE Order 5480.23	Confine radioactive and toxic materials from anticipated design basis accidents
3.3.6.3	DOE STD-3009-94	Confine radioactive and toxic materials from DBAs
3.3.6.3	WHC-CM-4-46	Identification of DBAs for safety significant items and acceptable releases resulting from DBAs
3.3.6.4	DOE Order 6430.1A	Continuous barrier rating to withstand design basis fire
3.3.6.5	N/A	Design basis power failure definition
3.3.6.6	GC-LOAD-01	Protection from design basis and near-field earthquakes
3.3.6.6	DOE Order 5480.28	Performance category PC3 design basis and near-field earthquake requirements
3.3.6.6	DOE-STD-1020-94	Performance category PC3 design basis and near-field earthquake requirements
3.3.6.6	DOE-STD-1021-93	Performance category PC3 design basis and near-field earthquake requirements
3.3.6.6	DOE-STD-1022-94	Performance category PC3 design basis and near-field earthquake requirements
3.3.6.6	DOE-STD-1023-95	Performance category PC3 design basis and near-field earthquake requirements
3.3.6.6	Uniform Building Code	Non-safety class earthquake requirements
3.3.6.7	GC-LOAD-01	Capabilities to withstand design basis wind loading
3.3.6.8	N/A	200 Area is outside the extent of the Hanford Site design basis flood
3.3.6.9	GC-LOAD-01	Protect facilities from volcanic ash
3.3.6.10	N/A	Abnormal operations detection
3.3.6.11	10 CFR 72	Potential radiological exposure due to design basis accident maintained within regulatory requirements
3.3.6.12	10 CFR 20	Normal operation radiological exposures
3.3.6.12	10 CFR 835	Normal operation radiological exposures
3.3.6.13	10 CFR 835	Capabilities to minimize occupational safety hazards
3.3.6.13	29 CFR 1910	Capabilities to minimize occupational safety hazards
3.3.6.13	DOE Order 5480.10	Capabilities to minimize occupational safety hazards
3.3.6.13	DOE Order 5483.1A	Capabilities to minimize occupational safety hazards
3.3.6.14	N/A	Inherent and passive features
3.3.6.15	N/A	Defense-in-depth design approach
3.3.6.16	40 CFR 1500-1508	Comply with NEPA
3.3.6.16	10 CFR 1021	Comply with NEPA
3.3.6.17	40 CFR 264	Comply with RCRA
3.3.6.17	WAC 173-303	Comply with RCRA

Table 4-2. Requirements Traceability Matrix. (8 sheets)

Section	Requirement number	Description
3.3.6.18	N/A	Pollution prevention and waste minimization
3.3.6.19	N/A	Recyclable materials
3.3.6.20	N/A	Emergency planning
3.3.7	N/A	Human factors criteria
3.3.7	NUREG-0700	User population representative data
3.3.7	MIL-STD-1472D	User population representative data
3.3.8	DOE Order 5480.24	Comply with nuclear controls
3.3.8	WHC-CM-4-29	Comply with nuclear controls
3.3.9	DOE Order 5632.1C	Capabilities to prevent breach of security per specified threats
3.3.9	DOE-M 5632.1C-1	Capabilities to prevent and delay breach of security
3.3.10	N/A	Government furnished property usage
3.3.11	N/A	Computer resource reserve capacity
3.4	N/A	Documentation controls
3.4.1	10 CFR 830.120	Development of Quality Assurance Program Plan (QAPP)
3.4.1	ASME NQA-1-1994-IA	Follow existing consensus standards
3.4.1	10 CFR 50	Follow existing consensus standards
3.4.1	ISO 9000 Series	Follow existing consensus standards
3.4.2	N/A	Safety documentation
3.4.3	DOE/RW-0351P	Waste form qualification documentation
3.4.3	DOE/EM-0093	Waste form qualification documentation
3.4.4	40 CFR 264	Prepare environmental permits and documentation
3.4.4	WAC 173-303	Prepare environmental permits and documentation
3.4.4	40 CFR 1500-1508	Prepare environmental permits and documentation
3.4.4	10 CFR 1021	Prepare environmental permits and documentation
3.4.4	WAC 246-247	Prepare environmental permits and documentation
3.4.4	WAC 173-400	Prepare environmental permits and documentation
3.4.4	WAC 246-272	Prepare environmental permits and documentation
3.5	N/A	Logistics
3.6	DOE Order 5480.20A	Trained and qualified personnel to operate the HLW interim storage system
3.6.1	N/A	Personnel
3.6.2	DOE Order 5480.20A	Establish operational training program
3.7	N/A	Characteristics of sub-system elements
3.7.1	N/A	Acceptable cask contamination and solidified HLW receipt rate
3.7.2	N/A	Cask surface dose rate and transportation mechanism
3.7.3	N/A	Storage turn around time and over-pack requirement
3.7.4	N/A	Solidified HLW retrieval rate

Table 4-2. Requirements Traceability Matrix. (8 sheets)

Section	Requirement number	Description
3.7.5	N/A	TBD
3.7.6	N/A	Miscellaneous support requirements
3.8	N/A	Hierarchy of requirements
3.9	10 CFR 830.120	Maintaining of documents and records
3.9	ASME-NQA-1-1994-IA	Maintaining of documents and records
3.9	DOE Order 5500.7B	Maintaining of documents and records
3.9	ANSI/ANS-3.2-88	Maintaining of documents and records
3.9	DOE/RW-0333P	Quality assurance for waste acceptance process activities
3.9	DOE/RW-0351P	Defines waste acceptance process activity
3.9	DOE/EM-0093	Defines waste acceptance process activity
3.10	N/A	Standard sample
4.0	N/A	Quality assurance provisions
4.1	N/A	Inspection responsibility
4.2	N/A	Special tests and examinations
4.3	N/A	Requirements cross reference
5.0	N/A	Preparation for operation or decommissioning
5.1	N/A	Operational philosophy
5.2	DOE Order 5480.31	Individual and overall facility pre-operation and startup testing
5.3	N/A	Operations
5.3	ANSI N300-1975	Capabilities to decontaminate and decommission
5.3	DOE Order 5820.2A	Capabilities to decontaminate and decommission

ALARA = As low as reasonably achievable
DBA = Design basis accident
HEPA = High-efficiency particulate air
HLW = High-level waste
HVAC = Heating, ventilation, and air conditioning
NEPA = National Environmental Policy Act of 1969
TBD = To be determined
N/A = not applicable

5.0 PREPARATION FOR OPERATION OR DECOMMISSIONING

The requirements for acceptance, operation, and decommissioning of the Phase I solidified HLW interim storage system are outlined in this section.

5.1 OVERALL OPERATIONAL PHILOSOPHY

The safety of the public and the worker, and the protection of the environment shall be the primary considerations in the startup and operation of the Phase I solidified HLW interim storage system. Startup and operations shall maintain the facilities within their safety authorization basis and shall be conducted in full compliance with applicable federal, state, and local laws and regulations. Operations are to be conducted efficiently. No lost-time accidents shall be a primary goal. Exposures to radiation and toxic materials shall be held to ALARA consistent with good industry practice and DOE regulations and orders.

5.2 PRE-OPERATIONAL AND STARTUP TESTING

Pre-operation and startup testing of the Phase I solidified HLW interim storage system shall be planned and conducted to ensure proper performance of components and subsystems individually and as part of overall facility performance according to DOE Order 5480.31, *Startup and Restart of Nuclear Facilites Operational Readiness Review and Readiness Assessments* (DOE 1993c).

A startup team, consisting either of in-house personnel or a qualified subcontractor, shall be assembled to assist the operations staff in preparing solidified HLW interim storage system acceptance test procedures, calibrating equipment, performing pre-operational testing, and resolving system punch list problems. For each individual facility within the solidified HLW interim storage system, the technical safety requirements shall be based on its safety analysis report. An operational readiness review shall be performed in conjunction with a readiness review. All facilities shall be assumed to be operated to the maximum extent for anticipated operations. Operating procedures shall be validated by procedure walk-throughs and simulated operation prior to use.

5.3 OPERATIONS

The operating scenario is similar to the operation envisioned for SNF. The solidified HLW (immobilized HLW canister or separated cesium container) shall be transported to the CSB in an onsite transportation cask. The cask transporter shall be a diesel-powered tractor/trailer. At the CSB unloading station the onsite transportation cask (containing the solidified HLW product) is removed from the truck trailer and lowered into a shielded pit. Once placed into the pit, the cask is opened. A dedicated crane removes the solidified HLW from the cask, transports the solidified HLW to the appropriate storage tube, and places the solidified HLW into storage.

5.4 DECOMMISSIONING

The Phase I solidified HLW interim storage system design shall include provisions to facilitate decontamination of structures and equipment, minimize radioactive wastes and contaminated equipment quantities, and facilitate removal of radioactive wastes and contaminated materials when facilities are decommissioned. Design guidance that facilitates eventual decommissioning shall be obtained from ANSI N300-1975, *Design Criteria for Decommissioning of Nuclear Fuel Reprocessing Plants* (ANSI 1975) and DOE Order 5820.2A, *Radioactive Waste Management* (DOE 1988). The principles listed below shall be employed to the extent practical:

a. Filters shall be placed as near as practical to the source of contamination to minimize contamination of ductwork.

b. Areas subject to contamination shall be designed to facilitate decontamination. Liners and coatings shall be selected to withstand decontaminating agents and radiation degradation throughout the life of the plant.

c. Storage vault penetrations shall be designed to minimize technical and construction problems in the structural closing and sealing of these penetrations during decommissioning.

d. Penetrations shall be waterproofed for protection during decontamination.

e. Fixtures and outlets shall be sealed.

f. Floors shall be monolithic, nonporous, and sloped toward drains.

g. Drains and similar piping shall have physical provisions for cleaning.

h. Piping systems shall be sloped and free of traps except as required for process isolation.

i. Adequate overhead clearance shall be provided for remote transfer of equipment over installed piping.

j. Aisles shall be wide enough to facilitate movement of equipment.

6.0 REFERENCES

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