

# Cask Storage System (CSS) Functional Design Criteria (Project W-135)

Prepared for the U.S. Department of Energy  
Assistant Secretary for Environmental Management

Contractor for the U.S. Department of Energy  
under Contract DE-AC06-08RL14788



**P.O. Box 1600  
Richland, Washington 99352**

# Cask Storage System (CSS) Functional Design Criteria (Project W-135)

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**K. K. Lucas**  
Lucas Engineering Management Services

**J. L. Pennock**  
CH2M HILL Plateau Remediation Company

**K. D. Auclair**  
Lucas Engineering Management Services

**D. M. Gerboth**  
AEM Consulting, LLC

**D. W. Bland**  
Lucas Engineering Management Services

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**P.O. Box 1600**  
**Richland, Washington 99352**

**APPROVED**  
By Janis D. Aardal at 8:51 am, Mar 02, 2016

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## Terms

ALARA	as low as reasonably achievable
AMU	aqueous makeup unit
ANSI	American National Standards Institute
AVC	automatic voltage control
BUSS	Beneficial Uses Shipping System
CESP	Capsule Extended Storage Project
CHPRC	CH2M HILL Plateau Remediation Company
CMAA	Crane Manufacturers Association of America, Inc.
CoC	Certificate of Compliance
COR	code of record
CRD	contractor requirements document
CSA	Capsule Storage Area
CSB	Canister Storage Building
CsCl	cesium chloride
CSS	Cask Storage System
DOE	U.S. Department of Energy
DOE-RL	DOE-Richland Operations Office
DOT	U.S. Department of Transportation
DSA	documented safety analysis
FDC	functional design criteria
FHA	fire hazards analysis
HEPA	high-efficiency particulate air
HMS	Hanford Meteorological Station
HVAC	heating, ventilation, and air conditioning
IEEE	Institute of Electrical and Electronics Engineers
LS	limit state
MSA	Mission Support Alliance
NDE	nondestructive examination
NFPA	National Fire Protection Association

NRC	U.S. Nuclear Regulatory Commission
OEE	operational equipment effectiveness
PC	performance category
PRC	Plateau Remediation Contract
QA	quality assurance
RCRA	<i>Resource Conservation and Recovery Act of 1976</i>
RTD	resistance thermal detector
SDC	seismic design category
SOW	statement of work
SSC	structures, systems, and component
SrF <sub>2</sub>	strontium fluoride
TSR	technical safety requirements
VDS	vacuum drying system
WAP	waste analysis plan
WESF	Waste Encapsulation and Storage Facility

# 1 Introduction

## 1.1 Purpose

The purpose of this functional design criteria (FDC) document is to establish the functional and technical requirements for the structures, systems, and components (SSCs) for design, fabrication, and supply of the Cask Storage System (CSS) required for the Capsule Extended Storage Project (CESP) (W-135), which is part of the Environmental Management Cleanup Subproject RL-0013, Solid and Liquid Waste Treatment and Disposal. This project is being managed by CH2M HILL Plateau Remediation Company (CHPRC) in compliance with requirements established by the U.S. Department of Energy (DOE)-Richland Operations Office (RL) in DE-AC06-08RL14788, *CH2M HILL Plateau Remediation Company Plateau Remediation Contract*, hereinafter called the Plateau Remediation Contract (PRC).

CESP involves the removal of cesium and strontium capsules from the Waste Encapsulation and Storage Facility (WESF) and placement of the capsules into a compliant extended storage configuration pending final disposition.

Responsibilities for the CESP are divided between CHPRC and various CESP subcontractors as depicted in Figure 1-1. CHPRC has the responsibility for executing the CESP, consistent with the requirements of the PRC contract, (DE-AC06-08RL14788). CHPRC-02252, *Capsule Extended Storage Project (W-135) Functions and Requirements Document*, establishes the upper level technical basis and requirements for the CESP and is the basis for the detailed technical requirements for the design, fabrication, and supply of the CSS design contained in this FDC document. The requirements for the Capsule Storage Area (CSA)/WESF modification design will be contained in a separate FDC document, CHPRC-02623, *Capsule Storage Area (CSA) and Waste Encapsulation and Storage Facility (WESF) Modifications Functional Design Criteria (Project W-135)*.

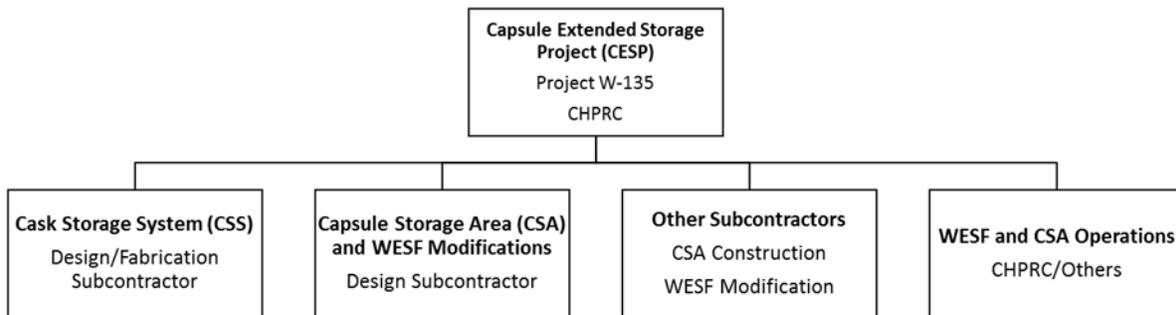


Figure 1-1. CESP Acquisition Structure

Throughout this document, reference is made to CHPRC, the CESP, the CSS contractor (or vendor), and the CSA/WESF Modifications contractor (or vendor). Requirements and criteria that reference the CESP apply to the project as a whole, including CHPRC, the CSS contractor, and the CSA/WESF Modifications contractor. Requirements and criteria that specifically reference CHPRC, the CSS contractor, or the CSA/WESF Modifications contractor apply only to that party.

## 1.2 Applicability

The requirements identified in this FDC apply to the design, fabrication, and construction of the SSCs required for design, fabrication, and supply of the CSS. This FDC is designed to be implemented in conjunction with the CSS statement of work (SOW), which is part of the contract between CHPRC and the CSS contractor for the performance of the design, fabrication, construction, and transfer support operations associated with the execution of the CESP.

The work performed under this FDC includes the following:

- Design, fabricate, and construct a passive extended storage system that will maintain the capsules in a compliant dry configuration.
- Provide technical analyses that will be used by CHPRC in the development of the safety basis and permitting documentation of that system.
- Design and construct a transfer sub-system for moving capsules from WESF to the extended storage system.
- Design and construct any necessary new transfer casks or modify existing casks to facilitate the transfer sub-system.
- Design and construct any necessary new canisters and/or basket assemblies, or modify existing canisters and/or basket assemblies to facilitate the loading and transfer sub-systems.

The contractor will be required to provide engineering support during construction and prepare as-built drawings after project completion.

## 2 Project Overview

### 2.1 Scope Summary

The CESP will acquire necessary capabilities and complete the activities needed to remove the cesium and strontium capsules from WESF and place the capsules into extended storage. The scope covered by this FDC includes the following:

- Design, fabricate, and supply the CSS, inclusive of storage and transfer systems and associated ancillary equipment necessary to support retrieval, packaging, and transfer of the capsules to compliant extended dry storage.

CESP scope not covered by this FDC that will be performed by others includes the following:

- Design and construct the CSA, including storage pad, fencing, lighting, and road access.
- Design and complete WESF modifications needed to support capsule retrieval, packaging, and transfer to the CSA for extended storage.
- Perform capsule transfer operations, including retrieval from existing storage, packaging, and transfer to the CSA and placement into the extended storage configuration.
- Perform regulatory activities and operational preparations necessary for capsule removal from WESF and implementation of extended storage.

The following scope is not included in the CESP:

- WESF base operations, including capsule storage in the WESF pool cells
- WESF upgrades other than those specifically identified as being required to support the CESP
- Decontamination and decommissioning of WESF or the CSA
- CSA base operations
- Final disposition of capsules
- Disposition the capsule transport system

The CESP will be completed when all capsules are placed into the compliant extended storage configuration at the CSA, and project closeout is completed. Although the CESP scope does not include final disposition of the capsules, the storage systems acquired by the project shall not preclude actions that can reasonably be expected to be required for future final disposition.

## 2.2 Key Definitions

The exact equipment that will be used by CESP will be determined by the chosen design solution.

**Canister:** A metal cylinder used to confine the capsules in a storage system using a canister/overpack design. It is protected from normal, off-normal, and accident conditions by the overpack. Canisters shall be designed for both storage and transportation. The internal capsule support structure is referred to as the “basket” or “internals.”

**CSS: The Canister Storage System** is the complete storage system that provides compliant storage of the capsules for the required extended storage period.

**CSA: The Canister Storage Area** includes the storage pad required for compliant storage of the capsules within the CSS, as well as associated fencing, lighting, and road access. The CSA will include a graded, compacted, graveled area around the pad sufficient for capsule receipt operations and surveillance and maintenance. The fencing will be used to limit radiological exposure to nonradiological workers from storage system SSCs and will provide required physical security.

**CSS Transfer System:** Enables transfer of the packaged capsules from WESF to the CSA and placement into extended storage. This equipment can include transport equipment, transfer casks, trailers, crawlers, tow vehicles, and other items necessary for system movement. The configuration of the transfer system will depend on the selected capsule storage system technology.

**Transfer cask:** A component that provides heat removal, shielding, and physical protection during onsite transfer of a loaded canister to a storage overpack or from a storage overpack into the future transportation cask. The transfer cask is typically lifted with lifting trunnions and yoke.

**Storage overpack:** A device into which a canister is placed for storage (typically a concrete and steel cylindrical container or horizontal module) or onsite transfer operations. The storage overpack provides radiological shielding and physical protection for the canister.

**Transfer equipment:** Used to move the transfer cask/storage overpack from WESF; includes equipment such as trailers, dollies, or crawlers, including any restraints or tie-downs required to move the transfer cask/storage overpack; and may include tugs, pushers, or tractors used to move any trailer or dolly. SSCs used to protect the transfer cask/storage overpack from environmental conditions once it leaves WESF

shall be included. Transport equipment does not include temporary lifting yokes, slings, and rigging that are considered ancillary equipment.

**Ancillary equipment:** Includes all associated or related equipment that is required to fully use and handle CSS supplied for its intended purpose at WESF. This includes but is not limited to the following:

- Fixtures for transfer of the empty canister into the storage overpack or transfer cask
- A frame or cradle to support or position an empty canister
- Equipment for remote welding and potential remote weld removal
- Lifting equipment including yokes and slings
- Test equipment for potential pressure testing or helium detection
- Seismic restraints
- Equipment used for component alignment

Ancillary equipment may also include platforms or man-lift equipment necessary to complete transfer cask/storage overpack loading activities, miscellaneous pumps, hand tools, relief valves, hydrogen detectors, or other items as may be uniquely necessary for the proposed solution technology.

**Transportation cask:** A component that provides heat removal, shielding, and physical protection during offsite transfer of nuclear material and/or a loaded canister to an alternate location. The transportation cask is typically licensed in accordance with 10 CFR 71, “Packaging and Transportation of Radioactive Material,” for all U.S. Nuclear Regulatory Commission (NRC)-defined transportation accidents (10 CFR 71 contains a list of approved contents.) A transportation cask is typically lifted with lifting trunnions and yoke.

**Canister / Capsule storage pad:** The concrete foundation and supporting systems such as collection sumps, berms, sump pumps, and other components that the CSS will be placed onto for extended storage of the capsules. The storage pad is a component of the CSA.

**Safety SSCs:** Defined by 10 CFR 830, “Nuclear Safety Management,” to mean both safety class and safety significant SSCs.

**Safety significant SSCs:** Defined by 10 CFR 830 as “the structures, systems, and components which are not designated as safety class structures, systems, and components, but whose preventive or mitigative function is a major contributor to defense in depth and/or worker safety as determined from safety analyses.”

**Safety Class SSCs:** Defined by 10 CFR 830 as “the structures, systems, or components, including portions of process systems, whose preventive or mitigative function is necessary to limit radioactive hazardous material exposure to the public, as determined from safety analyses.”

### 3 Descriptions of WESF and the Capsules

The CESP shall use existing systems at WESF (225-B Building) to the extent that they are cost effective and practical to support capsule retrieval and packaging for onsite transport and extended storage.<sup>1</sup> The WESF layout is depicted in Figure 3-1.

#### 3.1 Capsule Description

Inventory of capsules within the CESP scope is limited to the 1,936 cesium and strontium capsules currently in storage at WESF. The design basis feed characteristics that shall be used for the CESP are identified in this section.

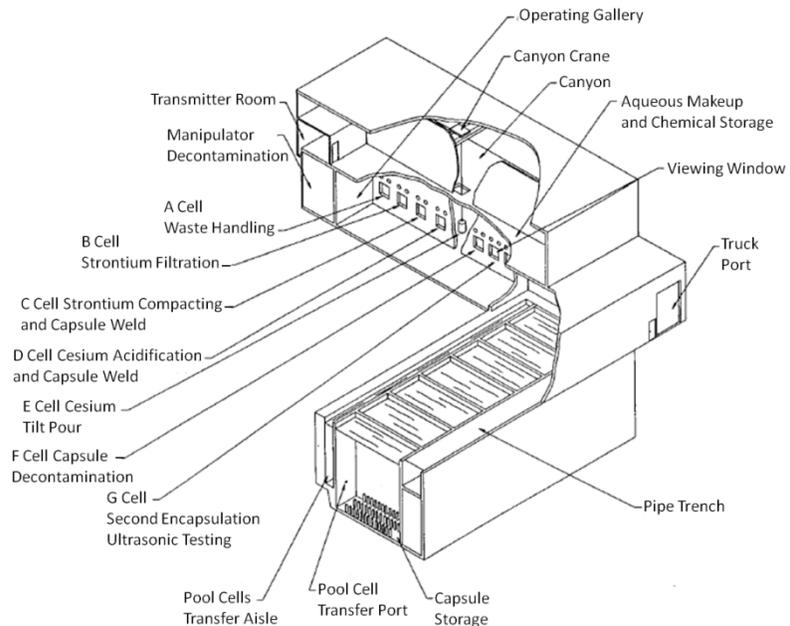


Figure 3-1. WESF Configuration

The capsules consist of a sealed inner capsule filled with either cesium chloride ( $\text{CsCl}$ ) or strontium fluoride ( $\text{SrF}_2$ ) and sealed within an outer capsule. Original functions of the capsules included the following characteristics:

- Containment of the long-lived (approximately 30-year half-life) heat-generating fission products cesium-137 and strontium-90 for 50 years from the time of encapsulation
- Stability when stored and handled in air (to allow for handling in a hot cell)
- Capability of underwater storage and the handling requirements involved
- Retrievability of encapsulated material

Due to integrity concerns (described in further detail as follows), a small number of  $\text{CsCl}$  capsules have been sealed within an additional containment boundary, called a Type W overpack. Capsule materials and dimensions are identified in Table 3-1. A typical capsule is shown in Figure 3-2.

The WESF inventory includes 1,312 standard cesium capsules, 23 cesium capsules in Type W overpacks, 600 strontium capsules, and one zero-power tracer capsule produced with natural strontium.

<sup>1</sup> Throughout the sections that follow, references to “existing systems at WESF” or current conditions at WESF are intended to indicate the conditions that exist after completing the WESF stabilization and ventilation upgrades performed as a part of Project W-130 unless otherwise indicated.

Table 3-1. Capsule Properties

Item	Initial Activity	Containment Boundary	Material	Wall Thickness <sup>a</sup> (cm [in.])	Outside Diameter (cm [in.])	Total Length (cm [in.])	Cap Thickness (cm [in.])
CsCl Capsule	70 kCi Cs-137	Inner	316L	0.241, 0.262, or 0.345 (0.095, 0.103, or 0.136)	5.715 (2.25)	50.165 (19.75)	1.016 (0.4)
		Outer	316L	0.277, 0.302, or 0.345 (0.109, 0.119, or 0.136)	6.668 (2.625)	52.769 (20.775)	1.016 (0.4)
SrF <sub>2</sub> Capsule	90 kCi Sr-90	Inner	Hastelloy <sup>b</sup>	0.305 or 0.345 (0.12 or 0.136)	5.715 (2.25)	48.387 (19.05)	1.016 (0.4)
		Outer	316L <sup>c</sup>	0.277, 0.302, or 0.345 (0.109, 0.119, or 0.136)	6.668 (2.625)	51.054 (20.1)	1.016 (0.4)
Type W Overpack	70 kCi Cs-137	Single	316L	0.318 (0.125)	8.255 (3.25)	55.436 (21.825)	1.016 (0.4)

Note: Capsule data are taken from HNF-22687, *WESF Capsule Data Book*. Critical dimensions should be verified prior to use.

- a. The specified wall thickness of the capsules was changed during production.  
b. Hastelloy is a registered trademark of Haynes International, Inc.  
c. Some of the initial SrF<sub>2</sub> capsules were made with Hastelloy C-276 outer capsules.

Cs-137 = cesium-137

CsCl = cesium chloride

Sr-90 = strontium-90

SrF<sub>2</sub> = strontium fluoride

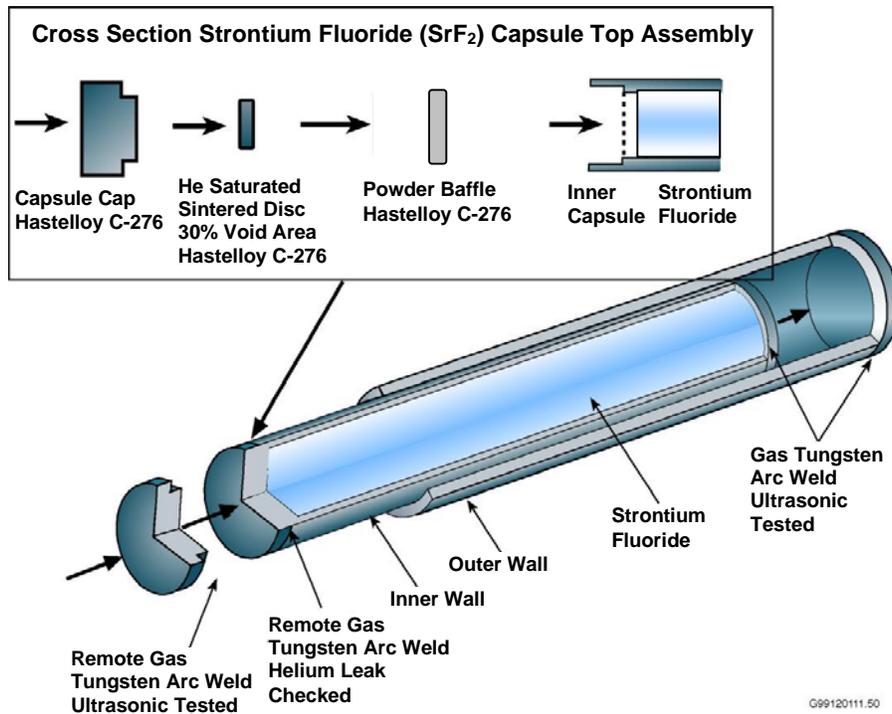
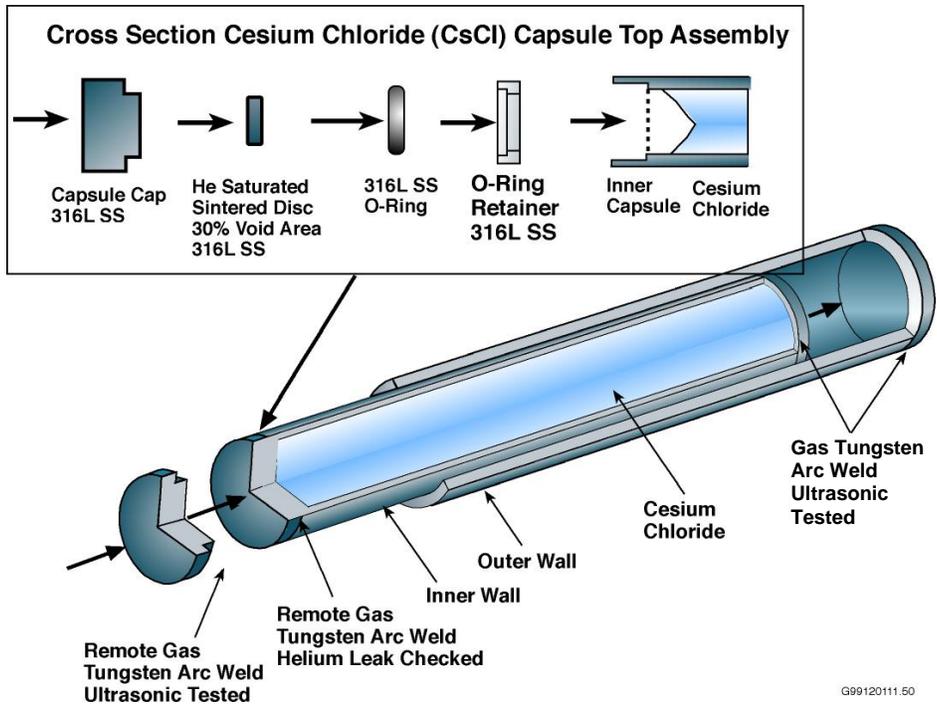


Figure 3-2. Schematic of Cesium and Strontium Capsules

The CsCl in the cesium capsules was produced at WESF by reaction of a cesium carbonate solution with hydrochloric acid. The CsCl aqueous solution was evaporated to form a solid CsCl that was then heated to approximately 740°C to produce a molten material. Each batch of molten CsCl salt filled up seven inner capsules.

The SrF<sub>2</sub> in the strontium capsules was produced by adding solid sodium fluoride to an aqueous feed solution containing strontium that had been neutralized to a pH of 8 to 9 with a sodium hydroxide solution. The resulting slurry was heated, with mixing, for 1 hour and then filtered. The filter cake was washed with water and fired at approximately 800°C in argon for several hours. After cooling, the SrF<sub>2</sub> was pulverized to minus 1.27 cm (0.5 in.) diameter granules and loaded into an inner capsule by impact consolidation, which was essentially a cold-step-pressing operation.

Almost 190 of the strontium capsules contain both SrF<sub>2</sub> and impurities collected from the hot cell floor during operations. The type and quantity of the impurities are not specifically known but can be bounded. Based on comparative power-to-weight ratios with other strontium capsules processed at the same time, some of these capsules contain up to approximately 50 percent impurities.

The cesium capsules contain two radioactive isotopes of cesium (cesium-135 and cesium-137 and their decay daughter products), nonradioactive cesium-133, and small quantities of impurities such as sodium, aluminum, and iron. The strontium capsules contain strontium-90 and its decay daughter products, nonradioactive isotopes strontium-84, strontium-86, strontium-87, strontium-88, and small quantities of impurities such as aluminum and calcium. The primary isotopes of concern are cesium-137 and strontium-90, which have radioactive half-lives of 30 and 29 years, respectively. The isotope cesium-135, which is present in small quantities, has a significantly longer half-life than cesium-137 and is a weak beta emitter with no gamma radiation. Because cesium-135 does not contribute significantly to the activity of a cesium capsule, it is not considered to be an isotope of concern. The total activity within a capsule is approximately double that of the cesium-137 and strontium-90 due to barium-137 and yttrium-90 daughter products from the decay of the cesium-137 and strontium-90, respectively.

Approximately half of the cesium capsules were leased to private irradiators in the 1980s. Many of these capsules experienced significant thermal cycles, and two of them failed. One leaked radioactive material outside of the capsule, and the other experienced a failed outer capsule weld. All of the leased capsules were returned to WESF. Sixteen of these capsules did not pass acceptance criteria for continued storage in the pool cells and were placed inside a third container (Type W overpack). An additional seven Type W overpacks contain repackaged CsCl that was originally contained within WESF capsules.

The capsules are currently stored underwater in a pool cell that provides both cooling and shielding from radiation. Figure 3-3 is a photograph of the storage configuration; the pool cell and storage configuration are described further in Section 3.2. Heat shall be removed from the capsules to control the temperature of the cesium or strontium salt within the capsule, both in the bulk salt and at the interface between the salt and the stainless steel capsule. Elevated temperatures will enhance the corrosion rates of the stainless steel capsules; temperatures that exceed the melting point of the salts within the capsules may cause the contents to expand, potentially breaching the capsule and releasing its radioactive contents. Limitations have also been placed on the total capsule heat load

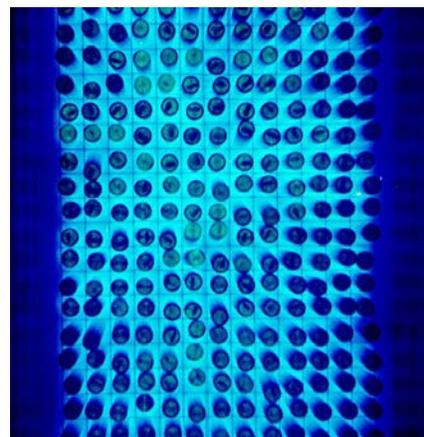


Figure 3-3. Capsules in Wet Storage in WESF Pool Cells

allowed in various areas of the facility to prevent challenges to the facility structure under normal, off-normal, and accident conditions.

In 2014, the total heat generation rate from the capsules was approximately 262 kW. The CESP shall assume capsule removal from WESF starting no earlier than January 1, 2018. The individual capsule decay heats are found in CHPRC-02248, *Estimate of WESF Capsule Decay Heat Values on January 1, 2018*.

Certain capsules contain a residual coating of foreign organic material due to storage at offsite locations (CHPRC-02306, *WESF Capsule Residue Inspection Report*). Depending upon the safety evaluation, this material may require removal to reduce a potential source of hydrogen generation or to enhance thermal transfer properties prior to placing the capsules in their storage configuration.

Detailed information, including descriptions of capsule anomalies that may have an effect on the storage system design such as cesium capsules that were created from multiple pours about the capsules, is located in the following documents:

- HNF-7100, *Capsule System Design Description Document*
- HNF-21462, *WESF Capsule Families*
- HNF-22687, *WESF Capsule Data Book*
- HNF-22693, *WESF Strontium Capsule Weight Data*
- HNF-22694, *WESF Cesium Capsule Weight Data*
- WMP-16937, *Corrosion Report for Capsule Dry Storage Project*
- WMP-16938, *Capsule Characterization Report for Capsule Dry Storage Project*
- WMP-16939, *Capsule Integrity Report for Capsule Dry Storage Project*
- WMP-16940, *Thermal Analysis of a Dry Storage Concept for Capsule Dry Storage Project*
- WMP-17265, *Summary Report for Capsule Dry Storage Project*

## 3.2 WESF Description

The following summary description of WESF is intended to provide an overview of the facility and a description of the key features that relate to removal of capsules. The contractor is responsible for verifying key dimensions and features of WESF. Figures 3-4 through 3-7 provide facility layout information.

### 3.2.1 Introduction

WESF is located in the Hanford Site 200 East Area adjacent to the west end of B Plant (Figure 3-4). The WESF facility consists of the 225-B Building and several support buildings. The 225-B Building is a two-story structure 48 m (157 ft) long by 30 m (97 ft) wide by 12 m (40 ft) high at the outside dimensions. The first floor is 1,301 m<sup>2</sup> (14,000 ft<sup>2</sup>), and the second floor is 557 m<sup>2</sup> (6,000 ft<sup>2</sup>). The ground elevation of the facility is approximately 213 m (700 ft) above sea level and approximately 61 m (200 ft) above the underground water table. The building is divided into Areas 1, 2, and 3. Area 1 is a one-story abovegrade reinforced masonry wall structure with a metal deck diaphragm roof supported on open-web steel joists and steel beams and includes the WESF support area, heating, ventilation, and air conditioning (HVAC) room, pool cell entry airlock, and pool cell monitoring area. Area 2 is a two-story abovegrade structure with reinforced concrete roof and floor slabs supported by reinforced concrete shear walls in the

section of the 225-B Building enclosing the hot cells, canyon, hot and cold manipulator shops, manipulator repair shop, operating gallery, service gallery, and aqueous makeup unit (AMU) area. Area 3 is a one-story structure that contains the truck port and pool cell area. The general layout of WESF is shown in Figure 3-4.

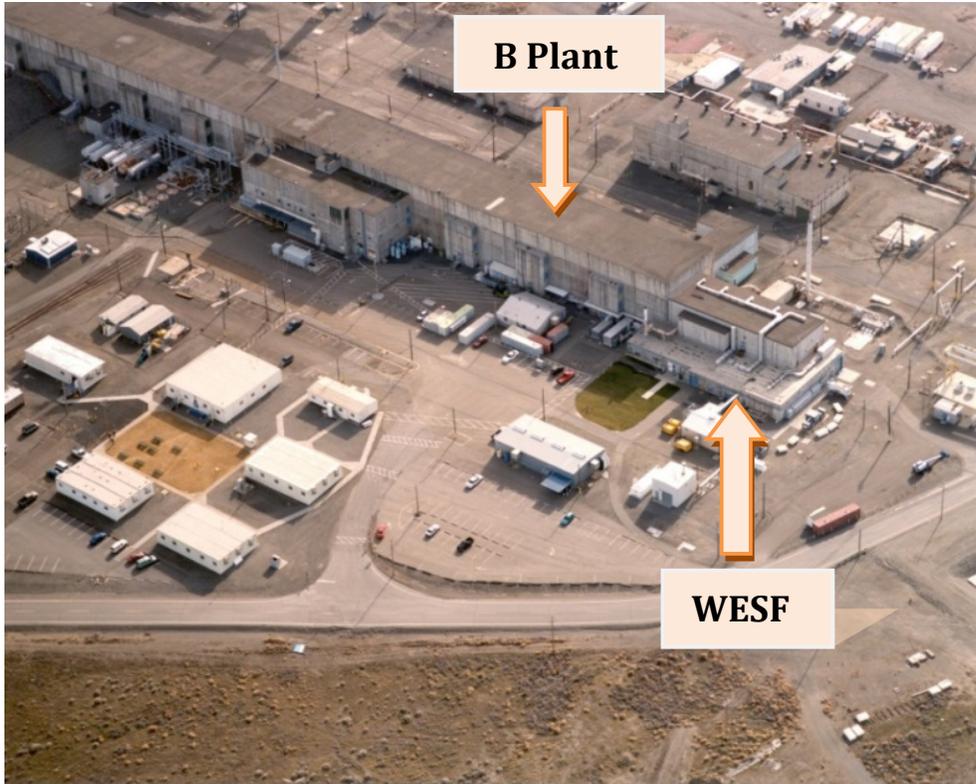


Figure 3-4. WESF Located at the West End of B Plant

The current WESF mission is to store cesium and strontium capsules in a safe manner, in compliance with all applicable rules and regulations. The scope of the WESF mission is currently limited to facility maintenance activities, inspection, decontamination and shipment of capsules, and storage and surveillance of capsules. WESF is a Hazard Category 2 facility based upon the quantity, form, and location of radioactive material.

The CESP shall use existing systems at WESF to the extent that they are cost effective and practical to support capsule retrieval and packaging for onsite transport and extended storage. Various maintenance and upgrade activities are planned in the near future for WESF that will modify the facility configuration. The anticipated facility configuration at the start of the CESP is described in further detail in the following sections. Details associated with key interfaces and other critical aspects of the facility and/or capsules are described in more detail in Chapters 4 through 9 of this FDC.

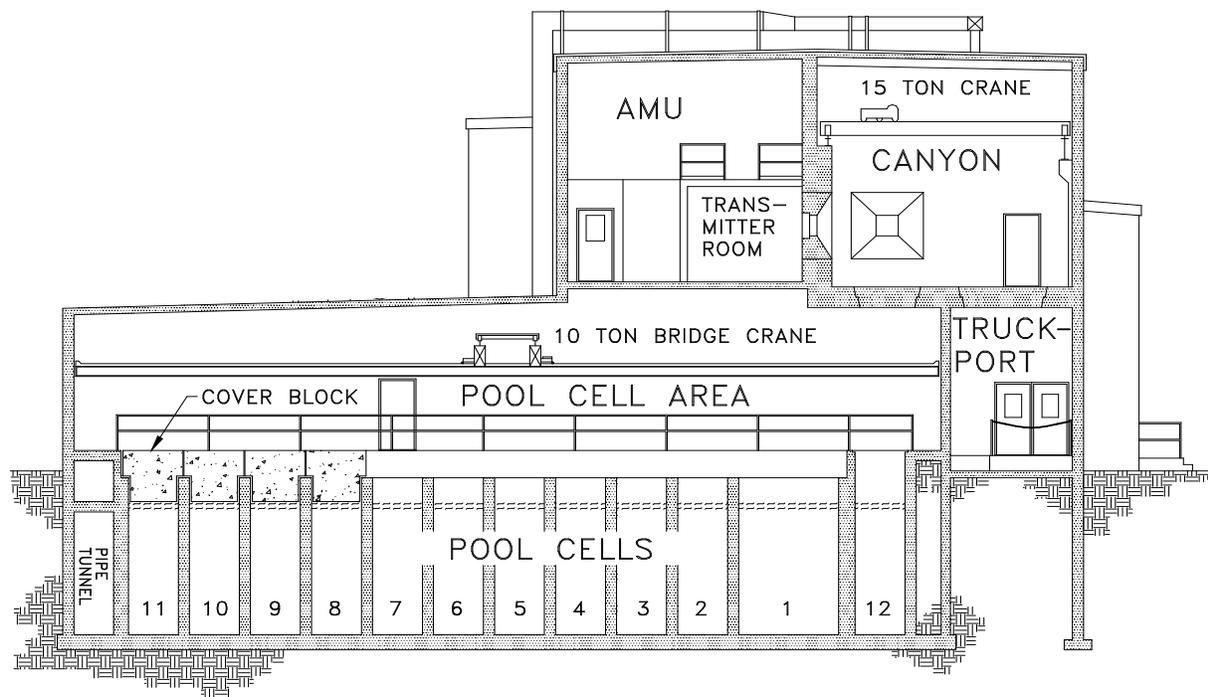


Figure 3-5. WESF Plan View

### 3.2.2 Background

The WESF facility was designed and constructed to process, encapsulate, and store the extracted long-lived radionuclides strontium-90 and cesium-137 from defense wastes. Construction of WESF started in 1971 and was completed in 1973. Encapsulation of CsCl and SrF<sub>2</sub> started in fall 1974. Cesium processing was shut down in October 1983, and strontium processing was shut down in January 1985. Final overall process shutdown was completed in September 1985. Only equipment and instruments that were required for cell maintenance and surveillance remained operational in the hot cells. In 2001, the water sources to A through F Cells were isolated, and the manipulators were removed. Only F and G Cells remained as working hot cells.

The waste analysis plan (WAP) developed for WESF (HNF-7342, *Waste Encapsulation and Storage Facility Waste Analysis Plan*) defines the process impurities (barium, cadmium, chromium, lead, and silver) that are contained in the encapsulated salts, as the “dangerous” wastes that are stored at WESF, per WAC 173-303, “Dangerous Waste Regulation.” The WAP (HNF-7342) identifies the process knowledge and analytical basis for this dangerous waste designation.

### 3.2.3 Key WESF Features Related to Capsule Removal

Facility features and dimensions that may pertain to the removal of the capsules from WESF are summarized in this section. Additional information on these features is provided in Sections 3.2.4 through 3.2.7.

WESF facility drawings and dimensions have not been verified by field walkdowns. Facility dimensions, therefore, should be considered approximate. Verification of any facility dimensions that are critical to the contractor’s design is the responsibility of the contractor. Table 3-2 provides a list of the drawings to be used for dimension references of WESF.

Table 3-2. WESF CESP Reference Drawing List

<b>Drawing</b>	<b>Title</b>
H-2-66401 sheet 1	<i>Architectural First Floor Plan Area 1</i>
H-2-66402 sheet 1	<i>Architectural First Floor Plan Area 2</i>
H-2-66403 sheet 1	<i>Architectural First Floor Plan Area 3</i>
H-2-66404 sheet 1	<i>Architectural Second Floor Plan</i>
H-2-66405 sheet 1	<i>Architectural Sections</i>
H-2-66416 sheet 1	<i>Structural Floor Plan &amp; Details Area 1</i>
H-2-66417 sheet 1	<i>Structural First Floor Plan Area 2</i>
H-2-66418 sheet 1	<i>Structural Second Floor Plan Area 2</i>
H-2-66420 sheet 1	<i>Structural Sections Area 2</i>
H-2-66421 sheet 1	<i>Structural Foundation &amp; Floor Plan Area 3</i>
H-2-66422 sheet 1	<i>Structural Sections Area 3</i>
H-2-66423 sheet 1	<i>Structural Process Cells Plans</i>
H-2-66424 sheet 1	<i>Structural Process Cells Sections</i>
H-2-66425 sheet 1	<i>Structural Cover Blocks</i>
H-2-66428 sheet 1	<i>Structural Sections Areas 2 + 3</i>
H-2-66536 sheet 1	<i>HVAC Plan First Floor Sheet # 2</i>
H-2-66537 sheet 1	<i>HVAC Plan First Floor Sheet # 3</i>
H-2-66538 sheet 1	<i>HVAC Plan Second Floor</i>

The canyon area has loose contamination requiring preventive measures to contain contamination when cover blocks are removed. Operations involving the canyon can be facilitated with a combination of selective containment and decontamination.

G Cell is generally free of contamination but may require respiratory protection for entry if the cover blocks have been removed.

The pool cells are very clean, with pool cell water samples near or below detection limits for contamination.

### 3.2.4 WESF Processing Cells

WESF incorporates seven processing cells (hot cells) that were used to encapsulate CsCl chloride and SrF<sub>2</sub> salts, perform quality assurance (QA) and inventory control checks on the capsules, transfer the capsules to and from storage in the pool cell area, load capsules into transport casks, and conduct waste management activities. The processing cells are sequentially designated A through G.

Project W-130, the WESF Stabilization and Ventilation Project, will be completed prior to execution of the CESP. As a part of Project W-130, six of the processing cells (“A” through “F”) will be filled with grout to stabilize residual contamination. Only G Cell will remain operational.



Figure 3-6. WESF G Cell Window and Manipulators

G Cell was originally the final encapsulation cell. Cover blocks in the cell ceiling provide access to the canyon. This cell is equipped with a concrete-shielded, hydraulic-operated personnel entry door (approximately 0.9 m [3 ft] wide) and a pass-through drawer, both of which are accessible from the service gallery through the G Cell airlock. Normally, G Cell has very little contamination, and a significant radiation source exists only when capsules are present. The floor is capable of supporting the existing 11,340 kg (25,000 lb) Beneficial Uses Shipping System (BUSS) cask. During past operations, G Cell has also accommodated the GE 700 and GE 1500 casks. The GE 700 cask was taller (165 versus 124 cm [65 versus 49 in.]) and heavier (16,103 kg [35,500 lb]) than the BUSS cask. A penetration through the G Cell floor into Pool Cell 12 is provided for transferring the capsules between G Cell and the pool cells. A manually operated transfer cart is used to move capsules into or out of Pool Cell 12. G Cell is still an active hot cell with installed manipulators and active water sources. G Cell contains a 2-ton capacity hoist that is controlled from the operating gallery. G Cell also contains a removeable shielded storage container (G-7 tank) which would be used to store failed capsules if necessary.

Two 5,443 kg (12,000 lb) lead-glass windows provide shielding and a direct view into G Cell from the operating gallery (Figure 3-6). Windows contain a small quantity of white oil to enhance visibility through the several panes of shielding glass.

The mechanical Central Research Laboratories Model F master-slave manipulators are used in the hot cells. A manipulator boot or flexible sleeve protects the slave end from contamination and provides an air barrier between the hot cell and the operating gallery.

The capsule transfer system to move capsules between G Cell and Pool Cell 12 will be available for use by the CESP. The 2-ton hoist inside G Cell is also available but may require upgrade or replacement prior to use. CHPRC will perform required periodic maintenance activities on the 2-ton hoist. Manipulators are installed in the G Cell manipulator ports and are available for use. There are some spare Central Research Laboratory Model F manipulators available, as well as some replacement parts for the manipulators; however, capability for manipulator repair and refurbishment is limited.

### 3.2.5 WESF Canyon, Service Gallery, Operating Gallery, and Truck Port Areas

The 225-B Building canyon is approximately 6.7 m (22 ft) wide by 31 m (101 ft) long by 6.1 m (20 ft) tall (Figure 3-7) and is located on the second floor. The canyon is accessible from the second floor AMU area through a shielded personnel entry door and via a stairwell from the first floor access hallway. Each access door is part of an airlock. An outside access door is also provided at the west end of the canyon as an emergency exit. Canyon operations can be viewed from the AMU area and manipulator repair shop through four windows in the interior walls of the canyon. The windows are dry-type (no oil) lead-glass.



Figure 3-7. 225-B Building/WESF Canyon

The canyon provides access to the hot cells, truck port, and pool cell area by means of removable high-density, stepped cover blocks. A 15-ton design capacity remotely operated crane, capable of traveling the full length of the canyon, removes the cover blocks and handles equipment. A decontamination and maintenance area for the crane is located at the east end of the canyon. Canyon crane operations can be observed through the four lead-glass viewing windows in the canyon wall at the AMU level. A remote-control television system mounted to the crane allows the crane operator to observe the movement of the crane hooks and the load using a television monitor located in the AMU area.

The canyon crane has a design capacity of 15 tons. It is functional but not in frequent use. It is available for use by the CSS contractor, and all required periodic maintenance will be performed by CHPRC. Acceptability of the crane to lift desired loads should be verified early in the project. The current control system for the crane is aged and may require replacement to ensure reliable operations. This upgrade is not planned prior to the CESP. Any necessary upgrades to meet requirements for safety significant and/or safety class cranes under DOE O 420.1C, *Facility Safety*, Attachment 3, Table 4, will be the responsibility of the CSA/WESF Modifications contractor, with input from the CSS contractor. The service gallery, located on the first floor, is used to service the hot cells from the south side and contains some of the auxiliary cold (nonradioactive) process piping. Access to G Cell from the service gallery is provided by a pass-through drawer and by a personnel entry door located in an airlock. The service gallery may be accessed from the truck port and access hallway.

The operating gallery is located on the north side of the hot cells on the first floor. The operating gallery is accessible from the support area, elevator, cold manipulator shop, pool cell area, and HVAC room. Remote work in the hot cells is accomplished with master-slave manipulators operated from the operating gallery. The hot cell instrumentation control panels are located adjacent to the manipulator operating areas. In the event of manipulator failure, the manipulator is removed from the hot cell by an overhead trolley and moved to the hot manipulator shop, which is located adjacent to and east of the operating gallery. Replacement manipulators are inserted into the hot cell using the overhead trolley. Lead-glass windows are provided for direct viewing of the interior of each hot cell at the operating gallery level (not

all windows are usable). A nonshielding window for viewing the pool cell area is located on the west wall.

The truck port is an enclosed area, located at the west end of WESF, which provides confinement for cask and low-level solid waste loading and unloading. A motor-operated 3.7 m (12 ft) wide roll-up door (4.6 m [15 ft] high) provides access to the outside. Other interior access doors are located in the service gallery and pool cell area. A diesel-powered forklift is used to load and unload casks and solid waste burial boxes in the truck port.

Exterior to the WESF facility and to the west of the truck port, there is a 25-ton overhead crane and pad that were originally used to support shipping cask operations. This crane is no longer operational and could be removed by the CSA/WESF Modifications contractor, with input from the CSS contractor, if required for space considerations.

### 3.2.6 Pool Cell System

The pool cell area has 12 pool cells that provide underwater storage and transfer capability for the cesium and strontium capsules. This area is located on the west side of the first floor of the 225-B Building. Pool Cells 1 through 11 are positioned south to north adjacent to each other and have a water depth of about 4 m (13 ft). Pool Cell 12 runs along the east side and partially along the south side of these storage pools and contains about 3 m (10.5 ft) of water. A general orientation of the pool cells is shown in Figure 3-5.

All pool cells have liners constructed of 16-gauge, type 304 stainless steel on the sides and 14-gauge, type 304 stainless steel flooring. Transfer ports consisting of a pipe and 10 cm (4 in.) ball valve connect Pool Cells 1 through 11 to Pool Cell 12. The transfer port can be opened and closed to transfer capsules or water between each of the pool cells and Pool Cell 12. A cask pit for wet loading of capsules is located in Pool Cell 12, to the south of Pool Cell 1. Wet loading operations were not performed during the facility's operating life. Each pool cell can be further shielded and protected by covering it with a series of stepped concrete cover blocks. Currently, the cover blocks are not in place to facilitate the dispersion of radiolytic hydrogen generated by the interaction between radiation from the capsules and the water in the pool cells. Deionized water is added to the pool cells as required to make up volumes lost through radiolysis and evaporation. The pool cell water is not contaminated with radionuclides.

A motorized catwalk is located over the pool cells and can travel the full length of the pool cell area. This catwalk provides access to each of the pool cells for capsule inspection, movement, and maintenance activities. A bridge crane with a 10-ton design capacity is used in the pool cell area to move equipment as necessary. It is available for use by the CESP, and all required periodic maintenance will be performed by CHPRC. Acceptability of the crane to lift desired loads should be verified early in the project.

Capsules are transferred individually between the hot cells and the pool cell area through a capsule transfer chute between G Cell and Pool Cell 12. The capsule transfer chute is equipped with a trolley device for lowering the capsules into Pool Cell 12 or bringing the capsules into G Cell. Once in the pool cells, the capsule is moved down Pool Cell 12 with tongs, through the transfer port, to the assigned pool cell.

Capsules may be stored in Pool Cells 1, 3 through 7, and 12. A documented safety analysis (DSA) (HNF-8758, *Waste Encapsulation and Storage Facility Documented Safety Analysis*) and technical safety requirements (TSR) (HNF-8759, *Waste Encapsulation and Storage Facility Technical Safety Requirements*) currently prohibit movement of cover blocks and other heavy loads that have the potential to damage the capsules or pool structure over pool cells containing capsules unless for emergency response. Lifting of heavy objects over the pool cells containing capsules will require a DOE-RL-approved change to the DSA (HNF-8758).

Cover blocks may not be placed on pool cells containing capsules unless measures are implemented to address the potential accumulation of hydrogen in the vapor space beneath the cover blocks. These measures will also require a DOE-RL-approved change to the DSA (HNF-8758).

### 3.2.7 HVAC System

The WESF ventilation system is designed to produce airflow patterns that move air throughout the building from areas of lesser potential contamination to areas of greater potential for contamination. Contaminated areas are maintained at a negative pressure with respect to the atmosphere. The HVAC system has four separate supply systems and three separate exhaust systems that service the major confinement areas in the 225-B Building. A simplified schematic flow diagram for K1, K2, and K4 is provided in Figure 3-8. The K3 ventilation schematic flow diagram after completion of Project W-130 is provided in Figure 3-9.

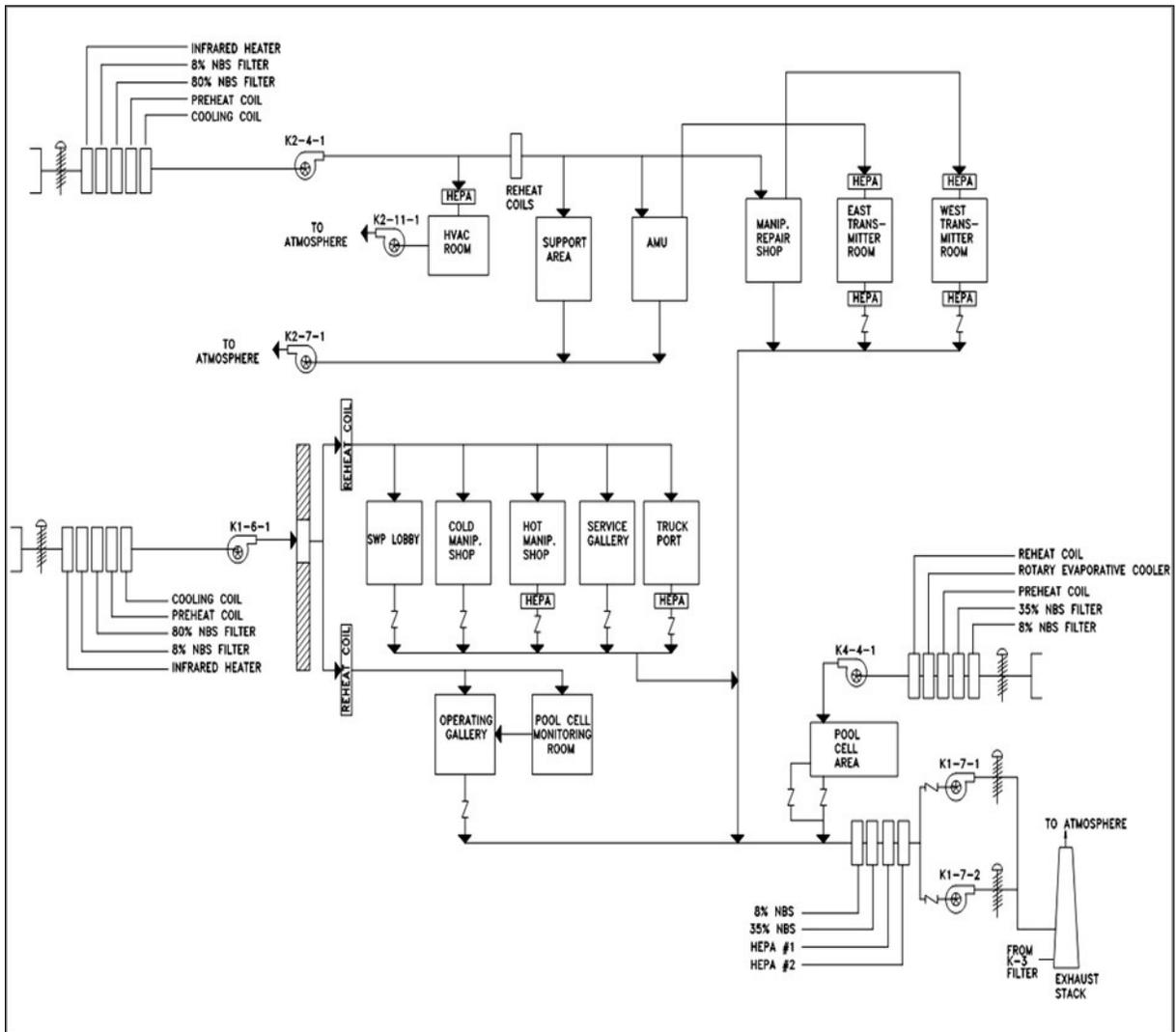


Figure 3-8. K1, K2, and K4 Ventilation

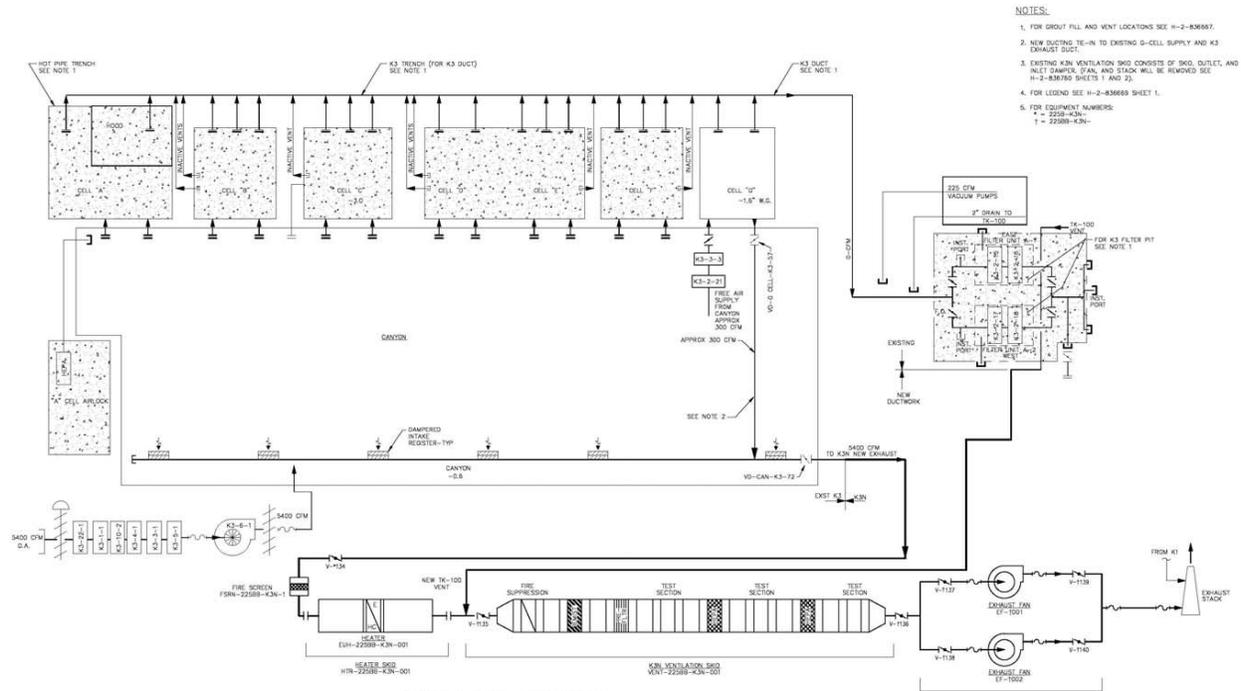


Figure 3-9. K3 Ventilation after Project W-130

The K1 HVAC system provides ventilation for potentially contaminated areas such as the operating and services galleries and the truck port. The system supplies 100 percent outside air. The supply air is filtered, heated, or cooled appropriately and distributed through a duct network to the areas shown on the airflow diagram. The K1 exhaust system provides ventilation exhaust for the pool cell area, transmitter rooms, and manipulator repair shops as well as for the areas supplied by the K1 supply system. The ventilation flow to the exhaust system removes hydrogen (produced by hydrolysis of the pool cell water) from the pool cell area. This flow-through of fresh air prevents the accumulation of hydrogen gas. Air balance control and isolation of the rooms is accomplished by dampers in all supply and exhaust ducts. The exhaust from the K1 system sequentially passes through one stage of prefilters, one stage of bag filters, and two stages of high-efficiency particulate air (HEPA) filters. One of the two redundant fans exhausts the air from the filter banks through the monitored 296-B-10 stack. Standby power is available to the K1 exhaust system as well as to the K1 supply fan units. Failure of the online K1 exhaust fan (or an overload in the system) automatically initiates action of the standby fan.

The K2 HVAC system provides ventilation for uncontaminated areas such as the offices, HVAC room, and AMU. The system supplies 100 percent outside air. The supply air is filtered, heated, and cooled appropriately and distributed through a duct network. The K2 system also provides supply air to the two transmitter rooms. Because the transmitter rooms are potentially contaminated, the K1 system provides exhaust from these two areas. The remainder of the K2 system exhausts air from the change rooms, AMU, and assorted office spaces in the atmosphere.

The K4 HVAC system supplies 100 percent outside air to the pool cell area. The K4 incoming air is filtered and heated or cooled appropriately before entering the centrifugal fan for dispersion to the pool cell area. The pool cell area is exhausted through the K1 exhaust system.

Project W-130, the WESF Stabilization and Ventilation Project, is scheduled to be completed in 2016, prior to execution of the CESP. Project W-130 will incorporate the following significant modifications to the WESF K3 ventilation system:

- Fill six hot cells (“A” through “F”) with grout.
- Fill two tunnels beneath the hot cell floors with grout (these tunnels are a hot pipe trench that contains process piping to and from the hot cells and the existing K3 ventilation system exhaust duct from the hot cells).
- Replace the existing K3 exhaust system with a new system (K3N) having modified requirements based on reduced hazards in the areas ventilated by the existing K3 system (e.g., the hot cells).

The K3/K3N HVAC system provides ventilation for the canyon and G Cell. The system supplies 100 percent outside air. The supply air is filtered, heated, and cooled appropriately and distributed through a duct network to the canyon. Air from the canyon is drawn into G Cell by the exhaust system. The K3N exhaust system consists of a filter housing with two-stage HEPA filtration and two exhaust fans. It draws air through an exhaust duct in the canyon and will exhaust to the existing K1/K3 combined stack.

The canyon and G Cell will be operated as a single pressure control zone following installation of the K3N ventilation system. System manipulation will be required to maintain ventilation balance while opening the G Cell man entry door or removing the G Cell cover block.

Residual contamination remains within the WESF canyon; therefore, the canyon will continue to be required to be at a negative pressure with respect to the Truck Port. There will be a differential pressure between the Truck Port and the canyon when the Truck Port cover block is removed (2.4 by 3.7 m [8 by 12 ft]; drawing H-2-66418-1, *Structural Second Floor Plan Area 2*) based on the potential flow through the Truck Port. However, there is no current empirically based flow rate or pressure differential data to quantify this. The Truck Port has existing supply dampers that can be adjusted to obtain an acceptable differential pressure between the Truck Port and the canyon.

The canyon is also maintained at a negative pressure with respect to the pool cell area. The ventilation system may have difficulty maintaining this differential pressure if the cover block separating the pool cell area from the canyon is removed. Removing the cover block between the pool cell area and the canyon will likely require either additional ventilation upgrades or further decontamination of the canyon to allow the facility pressure zones to be “collapsed.” Canyon decontamination is not currently planned prior to the CESP. Use of a pass-through for transfer of loaded canisters between the pool cell area and the canyon might be feasible if this option maintains differential pressures between the pressure zones.

Ventilation upgrades may also be required if the hazard analysis identifies a new safety function that will require a change in safety classification. All ventilation upgrades will be reviewed to determine if changes will be required to environmental documentation. Space directly west of the new K3N exhaust system has been reserved for a potential future additional ventilation skid to support the Capsule Removal Project, if required (drawing H-2-836673, *WESF K3N Ventilation Mechanical General Arrangement*).

## 4 Major Systems, Functions, and Requirements

The following discussion is an overview of the functions and requirements for all of the CESP major systems.

CESP will load the capsules into a modified/adapted commercially available Dry Cask Storage System. The selected Dry Cask Storage System will be modified/adapted to accommodate the unique needs of the capsules stored at WESF. The CSS shall passively store the capsules, inside a cask and canister system, in a dry configuration.

Typically, a Dry Cask Storage System consists of a canister, a transfer cask, a storage overpack, and all necessary ancillary equipment to support and enable loading and dry storage of a specific payload. The canister is typically a metal cylinder with an internal support structure – referred to as a basket - used to confine the capsules. In the storage configuration, the canister is protected from normal, off-normal, and accident conditions by the storage overpack. The transfer cask is a metal and/or concrete cylinder that provides physical protection, shielding, and heat removal during onsite movement of a loaded canister and during transfer of the canister to the storage overpack. The storage overpack is a device into which a canister is placed for storage. It is typically a concrete, steel, or combination of concrete and steel vertical/upright cask or horizontal concrete module. Storage overpacks provide long-term radiological shielding and physical protection for the canister containing the capsules. The storage overpack also provides a flow path for the internal circulation of air adjacent to the canister for heat removal.

The CESP shall provide the capability to perform the top-level process functions identified in Figure 4-1.

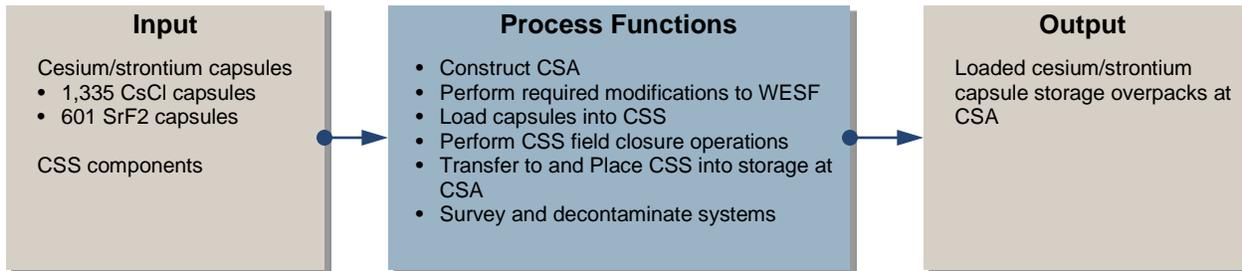


Figure 4-1. Top-Level Process Functions

The first step in the process entails the construction of the CSA and modification of WESF in accordance with CHPRC requirements as defined by CHPRC-02623 and the additional inputs based on the selected CSS, as well as evaluation of, and any subsequent required modifications to, the existing roadway from WESF to the proposed CSA site. The remaining steps in the process entail retrieving and loading capsules into canisters, performing field closure operations, transferring canisters to the CSA, and placing the canisters into storage at the CSA. Functional and any special requirements are described in Sections 4.1 through 4.2. The throughput requirements are identified in Section 4.3.

General requirements that apply to all process steps, such as contamination control and shielding, are identified in other sections of this document. Additionally, the CESP process shall ensure that capsule packaging operations can be conducted such that the total G Cell capsule inventory does not exceed a maximum capsule inventory of 150 kCi cesium-137 and 150 kCi strontium-90. Any increase above this safety basis inventory limit will require a DOE-RL-approved change to the DSA (HNF-8758).

The design shall preclude drops of CSS components that would result in loss of confinement or containment at any time during the process.

CSS field closure operations may be performed in G Cell or in another location in WESF. The location of the field closure operation in WESF needs to be chosen considering personnel dose rates, additional required modifications to WESF, contact versus remote maintenance, and the ability to recover from off-normal events.

Design, fabrication, and delivery of CESP SSCs associated with the CSS shall be performed entirely by the CSS contractor in accordance with the CSS SOW, including all materials, fabrication, special tools, testing, inspection, delivery (free on board Hanford Site), on-site assembly, testing, and acceptance support, and all required documentation for all SSCs required for the project including, but not limited to, the following items. The parenthetical Section references identify the sections of this Chapter which contain additional detail of the functions and requirements of the cited SSCs:

- CESP Cask/Canister storage system, transfer system, and capsule loading system (Section 4.1)
  - capsule loading system components, including the canister
  - Cask/Canister transfer system components, including the transfer cask, trailers, dollies, and tugs, pushers, or tractors used to move any trailer or dolly, etc.
  - Storage overpack
- Ancillary and other equipment (Section 4.2)
  - Special lift devices
  - Transfer equipment
  - Welding equipment
  - Vacuum drying equipment
  - Helium backfill and leak testing equipment
  - Pumps, gauges, relief valves, rigging, and measuring and test equipment
  - Cranes
  - Forklifts
  - Manlifts

The CSS contractor shall provide a complete engineering package demonstrating that the CSS design is sufficient to meet the requirements and specifications of the project. This engineering package shall include, but is not limited to, the following documentation:

- Design criteria
- Drawings
- Calculations
- Equipment data sheets
- Specifications
- System descriptions
- Acceptance testing requirements

The CSS SOW provides detailed requirements for all engineering package content.

The CSS contractor is responsible to support CHPRC in the development of an equipment disposition plan, as described in the SOW.

## 4.1 Cask/Canister Storage System, Transfer System, and Capsule Loading System Components

The CSS contractor's NRC Certificate of Compliance (CoC) equipment will be used as the initial design and analysis basis for the CSS components. These components will be adapted as necessary to accommodate the differences between spent nuclear fuel and WESF capsules and to address facility-specific requirements. The analytical methods used for the design and adaptation of the equipment for use at WESF will follow the DOE and CHPRC requirements contained within this FDC with the exception of those associated with structural analysis codes and methods. (Structural analysis and materials will be completed as defined in Section 4.1.4.4.)

### 4.1.1 Capsule Loading System Components

The metal dry storage canisters provided by the contractor shall be furnished with all internals and hardware required to load and store the capsules in accordance with all final design and operational considerations.

A uniform design shall be used for canisters and storage system components to allow common handling equipment. Internal variations to the canister basket system to accommodate dimensional differences in the capsules or to provide loading geometries specific to strontium and cesium are acceptable. Where "matched sets" are a design feature, all matched sets shall be interchangeable with all other matched sets to minimize the complexity of inventory control, operations, verification activities, and other relevant processes.

The storage system shall be designed to protect capsule integrity to the extent possible. Elevated temperatures will enhance the corrosion rates of the stainless steel capsules; temperatures that exceed the melting point of the salts within the capsules may cause the contents to expand, potentially breaching the capsule and releasing its radioactive contents. The temperature limits provided in Table 5-1 have been established to keep the salts within the capsules from melting. Temperature limitations of the capsule stainless steel shall also be considered.

An individual canister shall not be loaded with a mix of strontium and cesium capsules or Type W and standard capsules. This separation of capsule types is intended to reduce any design complexity that may result from the differing capsule dimensions and materials and will allow for a different long-term disposition path for cesium and strontium capsules without repackaging.

A proof-of-dryness test demonstrates that each canister loaded with capsules is dry to the point that unacceptable pressure or buildup of a flammable gas mixture, at any point in the movement or storage of capsules, is not credible.

To ensure continued performance of the storage system over the design life, features that provide containment shall have the capability to be monitored to determine when corrective action needs to be taken to maintain safe storage conditions. Periodic monitoring is sufficient, provided such monitoring is consistent with the system design requirements.

To confirm the validity of the heat transfer analysis and associated modeling, the CSS design shall include the ability to monitor canister temperatures inside specific high heat storage overpacks. This is expected to include temperature monitoring devices inside cesium and strontium storage overpacks representing the worst case loading configurations as close to the canister as possible.

The CSS design shall enable future removal of capsules from the CSS and the shipment of capsules to another facility for final disposition or as a recovery action.

Safety SSCs shall remain operational over the anticipated ranges for normal, off-normal, and accident conditions.

Based on the capsule data provided in CHPRC-02248, the CSS contractor is responsible for selecting the capsules to be stored in each canister and for providing heat load and structural calculations for each canister. Therefore, it is the CSS contractor's responsibility to determine the total quantity of canisters required for the project.

#### 4.1.1.1 Canister

Metal dry storage canisters shall be furnished with all internals and required hardware based on previous NRC-certified designs adapted for use at WESF and consistent with the final approved design basis. The canisters shall be designed for storage and transportation of the WESF capsules described in this FDC document and shall meet the conditions of service and environmental loads of the Hanford Site.

The canister shall be designed to provide adequate heat removal capacity without active cooling systems.

The canister shall be designed to store the capsules safely for the established design life.

The canister loading process shall establish a drying condition of a maximum of 3 torr held for 30 minutes (when the canister is isolated from the vacuum system) prior to inert gas backfill. The basis of this requirement is a standard established by the NRC and the commercial nuclear industry to define an internal dryness adequate to prevent corrosion of zirconium cladding.

The canister shall use a sufficient quantity of inert gas (typically helium) to provide cooling for the life of the system and of a quality adequate to support the heat transfer process and assumptions.

External surfaces of the canister shall be designed to facilitate decontamination to the extent practical.

The canister shall be conspicuously marked with the following information:

- Model number
- Unique identification number
- Empty weight

The canister markings shall be designed with consideration of the need to clearly identify the component during (potential) future repackaging or offloading activities. The markings shall remain readable through the expected design life.

The canister shall be designed with lifting trunnions or other means for attaching lifting devices to facilitate canister transfer operations. The lifting features shall be designed in accordance with DOE-STD-1090-2011, *Hoisting and Rigging*, and ANSI N14.6, *Radioactive Materials – Special Lifting Devices for Shipping Containers Weighing 10,000 Pounds or More*, for lifts both empty and loaded.

The canister shall be designed to minimize radiation streaming at any location it is anticipated workers will access to complete loading, sealing, welding, or inspection activities.

Canisters shall be designed to facilitate draining operations through design features that minimize the time required for vacuum drying.

The canister shall be designed, made of materials, and constructed to prevent significant chemical, galvanic, or other reactions between or among the storage system components or the capsules including possible reaction with water during wet loading, unloading operations, and the storage period.

Safety class and safety significant canister structures, subsystems, and components important to safety shall be designed to continue to perform their safety function effectively under credible environmental threat and design basis accident conditions.

#### **4.1.1.2 Ancillary Equipment**

Ancillary equipment includes all associated or related equipment that is required to fully use and handle CSS supplied SSCs for its intended purpose at WESF. This includes but is not limited to the following:

- Fixtures for transfer of the capsules from their current storage positions into CSS contractor provided basket assemblies and canisters
- Fixtures for transfer of the empty or loaded canister into the storage overpack or transfer cask
- A frame or cradle to upend or position an empty canister
- Equipment for remote welding and potential remote weld removal
- Lifting equipment including yokes and slings
- Test equipment for potential pressure testing or helium detection
- Seismic restraints
- Equipment used for component alignment

Ancillary equipment may also include platforms or man-lift equipment necessary to complete transfer cask/storage overpack loading activities, miscellaneous pumps, hand tools, relief valves, hydrogen detectors, or other items as may be uniquely necessary for the proposed solution technology.

### **4.1.2 Cask/Canister Transfer System Components**

The CSS contractor shall provide the design and fabrication for a CSS Transfer System which enables transfer of the packaged capsules from WESF to the CSA and placement into extended storage. This equipment shall include all necessary transfer equipment, ancillary equipment, transfer cask(s), storage casks, and other items necessary for system SSC movement(s). The configuration of the transfer system will depend on the selected capsule storage system technology.

#### **4.1.2.1 Transfer Equipment**

Transfer equipment is all equipment used to move the transfer cask/storage overpack from WESF to the CSA. Transfer equipment typically includes, but is not limited to, equipment such as trailers, dollies, and tugs, pushers, or tractors used to move any trailer or dolly, etc., including any restraints or tie-downs required to move the transfer cask/storage overpack; SSCs used to protect the transfer cask/storage overpack from environmental conditions once it leaves WESF shall be included. Transfer equipment shall also include all necessary equipment and ancillary equipment necessary to transfer the capsules from their current storage locations into CSS contractor provided basket assemblies and canisters, where that equipment is not otherwise provided as Government Furnished Equipment.

Transfer equipment does not include temporary lifting yokes, slings, and rigging that are considered ancillary equipment. Section 4.2 provides additional requirements associated with Transfer Equipment and Ancillary Equipment SSCs.

The CSS contractor shall also provide design input to CHPRC as may be required in support of its design and construction efforts in conjunction with any necessary road modifications in support of the CSS contractor-provided transport system and its operations. Consideration shall be given for risk of damage to roadways in the travel path. Such consideration shall include means to minimize or eliminate roadway damage as the result of turns and changes in direction of the vehicle. The CSS contractor shall be responsible for ensuring that ground loads for the transporter do not exceed limits necessary for protection of underground pipes and utilities present in the travel path

The CSS contractor design shall enable compliance with Hanford Site transport requirements, including applicable speed limitations.

Transfer systems and activities shall comply with DOE/RL-2001-36, *Hanford Sitewide Transportation Safety Document*, and applicable sections of 10 CFR 71 unless approval is obtained from DOE-RL allowing transfers under an approved DSA (HNF-8758) (see Chapter 8).

#### 4.1.2.2 *Transfer Casks*

Transfer casks shall be furnished with all internals and required hardware based on previous NRC-certified designs adapted for use at WESF and consistent with the final approved design basis for use.

Transfer casks shall meet the conditions of service and environmental loads of the site to which they will be exposed.

The transfer casks shall be designed to provide adequate heat removal capacity without active cooling systems.

External and internal surfaces of the transfer casks shall be designed to facilitate decontamination to the extent practical.

The transfer casks shall be conspicuously marked with the following information:

- Model number
- Unique identification number
- Empty weight

The transfer casks shall be designed with lifting trunnions or other means for attaching lifting devices to facilitate capsule and/or canister transfer operations. The lifting features shall be designed in accordance with DOE-STD-1090-2011 and ANSI N14.6 for lifts both empty and loaded.

The transfer casks shall be designed to minimize radiation streaming at any location it is anticipated workers will access to complete loading, transfer, or inspection activities.

The transfer casks shall be designed, made of materials, and constructed to prevent significant chemical, galvanic, or other reactions between or among the storage system components or the capsules, including possible reactions with water during wet loading and unloading operations.

Safety class and safety significant transfer casks structures, subsystems, and components shall be designed to continue to perform their safety function effectively under credible environmental threat and design basis accident conditions.

### 4.1.3 Cask/Canister Storage System Components

#### 4.1.3.1 Storage Overpack

The storage overpack may be oriented in either a vertical or horizontal storage configuration.

The storage overpack shall be furnished with all internals and required hardware based on previous NRC-certified designs adapted for use at WESF and consistent with the final approved design basis for use.

The storage overpack shall be designed with lifting trunnions or other means for attaching lifting devices to facilitate movement and/or assembly. The lifting features shall be designed in accordance with DOE-STD-1090-2011 and ANSI N14.6 for lifts when loaded.

The storage overpack shall be designed to meet the conditions of service and provide the environmental protection necessary for the canister.

The storage overpack shall be designed to provide adequate heat removal capacity without active cooling systems.

The storage overpack shall be designed to contain and protect the canister and stored capsules for the term required per this specification.

The storage overpack shall be conspicuously marked with the following information:

- Model number
- Unique identification number
- Empty weight

The storage overpack may also need to be labeled to comply with marking requirements from the *Resource Conservation and Recovery Act of 1976 (RCRA)* permit.

The storage overpack shall be designed to minimize radiation streaming.

The storage overpack shall be designed, made of materials, and constructed to prevent significant chemical, galvanic, or other reactions between or among the storage system components during loading, unloading, and the storage period.

Storage overpack structures and components important to safety shall be designed to continue to perform their safety function effectively under credible environmental threat and design basis accident conditions.

### 4.1.4 Special Requirements

The following additional Special Requirements shall be addressed in the CSS contractor provided design and SSCs:

#### 4.1.4.1 Capsule Identification

Capsule identification numbers shall be recorded as capsules are loaded into the canister and shall be verified before closure operations begin. Mechanisms that will positively identify the capsules and compare them to the existing inventory, including identifying and recording the capsule identification

number, will be required. Equipment to ensure that capsules will fit into the required storage configuration will be required (e.g., roundness and straightness gauging).

#### 4.1.4.2 Heat Rejection

The systems shall be designed to ensure that the following maximum temperatures at the salt/capsule interface, in Table 4-1, are not exceeded during movement and storage of the capsules (WMP-16939).

Table 4-1. Maximum Temperature at the Salt/Capsule Interface

Activity	Strontium Capsules	Cesium Capsules
Accident conditions	800°C	600°C
Processing, including process upset	540°C	450°C
Extended storage configuration, summer storage conditions as described in the current and archival data housed within the HMS web-accessed database ( <a href="http://www.hanford.gov/page.cfm/hms">http://www.hanford.gov/page.cfm/hms</a> )	540°C	317°C

Source: HMS, 2011, "Hanford Meteorological Station" website.

HMS = Hanford Meteorological Station

Blending of high- and low-heat capsules within a canister to meet temperature requirements is acceptable. However, if blending is required, a 10 percent margin shall be added to the estimated decay heat, and a complete loading sequence of all capsules shall be addressed within the thermal analysis. Alternately, a design may be developed that will accept a bounding array of capsule within a canister.

A thermal analysis shall be performed and documented to demonstrate that the design has adequate capacity to reject the capsule heat load without the use of active cooling systems or subsystems under the most restrictive operating and extended storage conditions while not exceeding the thermal limits indicated in Table 4-1. An additional analysis shall be performed to show that temperature limits can be maintained assuming worst case failure of the capsules.

The systems shall be designed to minimize the occurrence of thermal cycling to the maximum extent practical. In the event a thermal cycling event is unavoidable, the systems and their operation shall be designed to minimize the duration and range of the cycling event and, in no case, shall the maximum limits in Table 4-1 be exceeded. Thermal analysis shall be performed to demonstrate that thermal cycling events will not exceed the stated limits during the most restrictive thermal cycling events. A thermal cycle is defined as an increase in temperature above the extended storage configuration temperature limits shown in Table 4-1, followed by a temperature decrease below the temperature limit.

For obtaining the relevant site meteorological data associated with the environmental weather conditions for system heat rejection analysis, the CSS contractor may use data available from the Hanford Meteorological Station (HMS). The HMS is operated by Mission Support Alliance (MSA) for DOE. The HMS provides a website presents real-time meteorological data from the project's monitoring stations; daily, monthly, and annual weather summaries (including charts and tables); links to Hanford Site climatology reports, a range of Hanford Site weather forecast products, wealth of other data., inclusive of an extensive historical database of meteorological and climatological data. Meteorological measurements have been made at the HMS since late 1944. The basis for the environmental temperature range chosen shall be documented.

The HMS is located near the center of the Hanford Site, just outside the northeast corner of the 200 West Area. The Hanford Site is located north of Richland, Washington (see map and data at the website: <http://www.hanford.gov/page.cfm/hms>).

The Hanford Meteorological Monitoring Network operates to measure, process, analyze, and archive a wide range of meteorological parameters from a variety of monitoring stations, including over 30 instrumented towers strategically placed around the Hanford Site and the surrounding region. Data collected at each monitoring site are transmitted to the HMS every 15 minutes. Among the parameters measured at each monitoring station are air wind direction, wind speed, and temperature. A number of the stations also monitor precipitation, atmospheric pressure, and humidity. Measurements are made at multiple levels on the 122 m (400 ft) towers and three 61 m (200 ft) tower sites in the monitoring network.

Temperature monitoring is the preferred method to ensure vent blockage does not occur. As a result, design efforts shall provide the features necessary for implementation of this method.

The CSS contractor shall provide a minimum of two locations for determination of the ambient temperature of the CSA to be used in determining the temperature rise for each cask. The instruments can be either thermocouples or resistance thermal detectors (RTDs), as the design requires. These monitors shall be located in an area that is representative of the general ambient temperature of the cask environment but placed in a manner which will limit risk of impact during storage system component movement.

The CSS contractor shall provide a temperature monitoring system for each storage system outlet air vent in accordance with the design requirements associated with monitoring. The instruments can be either thermocouples or RTDs, as the design requires. The system shall include all instruments, mounting hardware, wiring, and conduits to accomplish these requirements.

#### *4.1.4.3 Temperature Monitoring System*

The CSS vendor will provide a temperature monitoring and recording system for the CSS, to include all elements required within the CSS (e.g., thermocouple and/or RTD), and the centralized monitoring/recording system for receiving temperature signals at the CSA from the CSS. The CSS temperature monitoring system shall provide the design feature of annunciation of any system fault that might interfere with proper temperature monitoring (e.g., loss of power), as well as any out of specification temperature condition with both local and remote reporting/annunciation features whether hardwired, fiber optic, Wi-Fi, or other remote telemetry mode of operation.

The temperature monitoring system shall include all temperature recording functions necessary to ensure temperature monitoring activities associated with the capsules can be accomplished and maintained.

The temperature monitoring system shall provide the following features, at a minimum:

- Continuous readout of temperatures by location
- Graphical representation, by storage system, of outlet temperature over time
- Graphical representation, by storage system, of inlet and outlet temperature difference over time
- Historical record keeping of system temperatures and alarms for a minimum of a 6-month period, with a means to generate data meeting permanent data archival requirements
- Local annunciation of any storage system alarm condition

- Remote annunciation of an off-normal condition or failed instrument signal at the Canister Storage Building (CSB) central location

All temperature monitoring equipment shall meet the following criteria:

- Instruments shall be capable of measuring critical temperatures (as determined by the design) within the required range and accuracy to ensure that the temperature limits stated in Table 5-1 can be monitored, and controls can be implemented if necessary to prevent the temperature limits from being exceeded.
- Temperature shall be displayed in degrees Fahrenheit.
- Enclosure environmental ratings shall meet or exceed the NEMA 250, *Enclosures for Electrical Equipment (1000 Volts Maximum)*, rating.
- Maximum expected radiation dose in areas containing temperature monitoring system components shall be considered in the design and component selection.
- Expected temperature sensor type (thermocouple and/or RTD) shall be specified with supporting design data to demonstrate compliance with other requirements.
- Expected service life shall be adequate to meet both short-term operational needs and long-term monitoring needs as applicable.
- Expected signal output and interface requirements for temperature transmitters included in the design.
- Quality level and safety class requirements shall be met as identified in the DSA (HNF-8758).
- Temperature-indicating displays shall be daylight readable if they are located outdoors.

There is a critical interface between the CSS contractor and the CSA/WESF Modifications contractor that shall be coordinated by CHPRC such that each contractor shall have effective communication between the other in accordance with the SOW and as directed to facilitate effective and compliant temperature monitoring system design.

For the benefit of the CSS Contractor, the specific design requirements for the temperature monitoring system that will be imposed by CHPRC on the CSA/WESF Modifications contractor are summarized as follows:

- The CSA/WESF Modifications contractor shall design a protective structure located within the CSA, accessible as required to allow evaluation of CSS temperature conditions, to house the CSS vendor monitoring/recording system.
- The CSA/WESF Modifications contractor shall be responsible for designing all conduit/cabling required to provide power to the CSS vendor monitoring/recording system and to connect the monitoring/recording system from the termination point at the CSS to the centralized monitoring/recording system at the CSA.
- The CSA/WESF Modifications contractor shall be responsible for designing a system to provide remote annunciation to a central location at the CSB of an off-normal condition or failed instrument signal detected at the CSS by the monitoring/recording system.
- The CSA/WESF Modifications contractor's design shall be based on design inputs for the temperature monitoring/recording system provided by the CSS vendor.

#### 4.1.4.4 Structural Requirements

The capsules were previously tested for special form qualification (ARH-CD-440, *Cesium Chloride Capsule Testing for Special Form Qualification*). The entire process, including accident conditions, shall be designed such that loads to the capsules do not exceed these values. The canister providing containment of the capsules shall be designed to maintain its containment when subject to worst case design loads for the canister, without taking credit for the corrosion allowance.

Applicable codes, standards, margins, methods, and materials used for issuance of the CoC by the NRC as amplified within the associated detailed licensing and design bases shall be the basis for all structural analysis associated with the storage system used at WESF. Any deviations shall require prior approval by CHPRC.

#### 4.1.4.5 Corrosion and Contamination

The transfer and storage system shall provide for surfaces that can be readily decontaminated if they are exposed to potential contamination (with the exception of the internal surfaces of the canisters). Where the surface is not stainless steel, appropriate epoxy coatings shall be used to minimize contamination. Uncoated carbon steel shall be avoided in applications where the material will be subject to immersion in potentially contaminated water.

Coatings used shall be easy to decontaminate and readily repaired. Coatings shall be selected based on the required performance criteria, including environmental conditions, temperature and radiation exposure, and exposure to areas requiring welding.

All materials used for the storage system shall be those identified in the NRC-issued CoC for the baseline CSS, as modified during the project design process. Materials shall be selected to minimize degradation over the design life due to gamma exposure and/or cesium salt exposure.

The canister shall be constructed of 316L stainless steel and shall include an allowance of at least 0.318 cm (0.125 in.) for internal corrosion from contact of capsule salts with the canister interior in addition to any corrosion allowance required to achieve the design life specified in Section 6.2 for corrosion from other sources.

#### 4.1.4.6 Containment

The transfer and storage system shall provide containment appropriate to ensure retention of the CsCl and SrF<sub>2</sub> under all design basis conditions. The capsules shall be assumed to maintain the gross configuration of the salts, but there may be some leakage of radioactive material outside the capsule during storage. The canister that provides containment shall be constructed of 316L stainless steel and shall include an allowance of at least 0.3 cm (0.125 in.) for internal corrosion from contact of cesium or strontium salts with the canister interior in addition to any corrosion allowance required to achieve the design life specified in Section 6.2 for corrosion from other sources (WMP-16937).

The proposed system shall provide high assurance that containment of the radionuclides will be maintained. Therefore, all welds within the containment boundary shall be subject to radiography inspection to ensure integrity. When such inspection is not possible, redundant barriers are required. These barriers shall be subject to appropriate nondestructive examination (NDE) techniques, at a frequency that ensures any unidentified weld flaws cannot self-propagate during the storage period. The contractor shall design the CSS to ensure all structural and containment requirements are met. Structural requirements will be compliant with those methods and limits contained within the NRC-issued CoC for the baseline CSS design as adapted for use at WESF. Containment will be "leak tight" as defined within ANSI N14.5, *Radioactive Materials – Leakage Tests on Packages for Shipment*.

The CSS contractor shall specify the types of welds to be performed, minimum and maximum thickness of weld layers, critical flaw size within any field generated weld, as well as NDE and leak-testing requirements.

Both factory and field helium mass spectrometer leak tests will be required to demonstrate the containment barrier is leak tight.

The ability to maintain capsules and canister shells within required temperatures during the closure welding and inspection period shall be provided to maintain capsules within temperature limits.

Upon loss of capsule integrity during loading operations, beta monitors and/or area radiation monitors shall be used that will alarm the off-normal condition.

If a failed capsule is detected during packaging operations, facility response procedures will be followed to place the capsule in a safe and stable condition. Further capsule handling will not occur without direction from CHPRC.

#### **4.1.4.7 Shielding**

The CSS contractor shall prepare site-specific radiation dose versus distance curves for the fully loaded CSA using limiting capsules as the source standard. The CSS contractor shall also identify the dose at CSA boundary (security fence), using Hanford Site established methods, and full storage capacity.

The CSS contractor shall perform specific radiation dose calculations for each storage system with the anticipated actual capsules loaded in each canister. The CSS contractor shall provide all temporary shielding required to ensure that actual dose rates are compatible with the calculated rates.

The dose rate from the capsules shall be controlled to less than 0.5 mrem/hr at the fenced perimeter of the CSA when all capsules are in their storage configuration and as far below this value as is reasonably achievable. The dose rate in storage shall not exceed 100 mrem/hr at any accessible point in the storage array. Dose rates during transportation and loading shall not exceed 100 mrem/hr on contact and are further subject to an as low as reasonably achievable (ALARA) decision making process.

The CSS contractor shall include physical design features that will limit occupational exposure during the capsule loading process to ensure overall exposure is less than 20 percent of the standards contained in 10 CFR 835.202, "Occupational Radiation Protection," "Occupational Dose Limits for General Employees," and further amplified in Section 6.5.1.

## **4.2 Ancillary and Other Equipment**

### **4.2.1 Special Lift Devices**

The CSS contractor shall design, fabricate, and furnish a cask lifting yoke and a yoke adapter (if required) for use between the WESF building crane(s) hook and the transfer cask and/or transportation cask. The CSS contractor shall design, fabricate, and furnish a lifting yoke for movement of a loaded overpack/canister system should movement of that item be required. The CSS contractor shall design, fabricate, and furnish any other lifting yokes and adapters (including but not limited to canister yokes) that are required to use the CSS. Cask lifting yokes and yoke adapters shall be designed, fabricated, inspected, and tested in accordance with DOE-STD-1090-2011 and the design/material requirements of ANSI N14.6 for critical lifting devices (single-failure-proof) and shall comply with the requirements of DOE/RL-92-36, *Hanford Site Hoisting and Rigging Manual*, and all other applicable codes and standards associated with the CSS contractor's cask system requirements. Cask lifting yokes and yoke adapters shall be fabricated of structural steel. Where

required for corrosion protection, material shall be stainless steel or carbon steel coated with a high-quality coating to allow for easy decontamination.

The CSS contractor shall recommend appropriate safety classification determinations based on the intended use of the equipment and evaluation of potential accidents and off-normal events. Appropriate QA controls shall be implemented based on the classification of the equipment.

#### 4.2.2 Capsule Handling Equipment

WESF capsule handling equipment is available for use by the CESP. The CSS contractor shall provide any additional equipment necessary for transfer of capsules to the canister. The range of items necessary will depend on the storage system used and the design solution presented. Acceptable proposed solutions may range from an interim shuttle-shipping cask to direct placement in water requiring little to no transfer equipment. The CSS contractor will comply with design standards appropriate for the solutions based on prior approval by CHPRC.

The CSS contractor shall recommend appropriate safety classification determinations to DOE requirements based on the intended use of the equipment and evaluation of potential accidents and off-normal events. Appropriate QA controls shall be applied based on the classification of the equipment.

#### 4.2.3 Welding Equipment

The CSS contractor shall provide remote, semiautomatic, canister welding equipment capable of the operations needed for canister sealing activities. The system shall be capable of gas tungsten arc welding and shall include the following features at a minimum (changes to this list required CHPRC approval):

- 1.0 to 500 A inverter-based power supply, 100 percent duty cycle at 500 A, 30 V, microprocessor controlled providing four servos (travel, wirefeed, oscillation, and automatic voltage control [AVC])
- 460 V three-phase, 50/60 Hz operation
- Remote pendant for operator
- Water circulator for cooling – integrated with the power supply
- Full-function, track-mounted weld head
- Travel, wirefeed, AVC, and oscillation functions
- Capable of one 13.6 kg (30 lb) wire spool for wirefeeder
- Motorized torch tilt
- Dual video frontend hardware to view puddle from front and back
- Dual light source mounted on the weld head
- Video monitors to observe all camera images
- Digital recording capabilities of screen images
- Flat track designed to support up to two weld heads
- Torch and wire manipulation controls at the panel
- All weld head functions located at the operator's pendant

The CSS contractor shall recommend appropriate safety classification determinations based on the intended use of the equipment and evaluation of potential accidents and off-normal events. Appropriate QA controls shall be implemented based on the classification of the equipment. These controls shall include the requirements of ASME NQA-1-2008, *Quality Assurance Requirements for Nuclear Facility Applications*, with ASME NQA-1a-2009, addenda Part I, Requirement 9, “Control of Special Processes,” as applicable.

#### 4.2.4 Vacuum Drying Equipment

The CSS contractor shall provide a canister vacuum drying system (VDS) consistent with the proposed storage system solution. Alternate equipment will be considered should the CSS contractor wish to provide other means of establishing moisture removal. Prior approval of alternate methods will be required. The VDS will be mobile for ease of movement with the following items included at a minimum (changes to this list require CHPRC approval):

- Vacuum pump
- Roots blower
- Stainless steel fittings
- Vacuum sensors
- Two compound pressure gauges
- Dropout tank with sight glass
- 30.5 m (100 ft) of vacuum hose

The VDS shall have an ultimate total pressure less than or equal to 1.15 torr. The VDS shall also include multiple isolation valves to manipulate flow in any direction.

The CSS contractor shall recommend appropriate safety classification determinations based on the intended use of the equipment and evaluation of potential accidents and off-normal events. Appropriate QA controls shall be implemented based on the classification of the equipment.

#### 4.2.5 Helium Backfill and Leak-Testing Equipment

The CSS contractor shall provide equipment capable of canister helium inerting activities. The equipment will be mobile for ease of movement with the following items included at a minimum (changes to this list require CHPRC approval):

- 99.995 percent quality helium source
- Stainless steel fittings
- Two compound pressure gauges
- 30.5 m (100 ft) of hose
- Multiple isolation valves to manipulate flow in any direction

The CSS contractor shall also provide helium leak-testing equipment (that meets the testing requirements of ANSI N14.5) capable of establishing testing results for all testable penetrations to the canister.

The CSS contractor shall recommend appropriate safety classification determinations based on the intended use of the equipment and evaluation of potential accidents and off-normal events. Appropriate QA controls shall be implemented based on the classification of the equipment.

#### 4.2.6 Load-Out Equipment

All required rigging and equipment for interface between WESF cranes and CSS contractor-provided equipment shall be included. All hoisting and rigging equipment and activities shall comply with DOE/RL-92-36. The scope shall include all testing and inspection requirements for rigging. This includes critical lifts as well as standard lifts for staging of ancillary equipment. Included are items such as metal/synthetic slings, shackles, hooks, turnbuckles, swivels, links, rings, and lifting eyes. Equipment shall be designed, specified, and furnished with a 200 percent proof load test report by the component manufacturer.

The CSS contractor shall provide canister cool-down equipment capable of supporting canister unloading in accordance with the storage system overall design capabilities. The cool-down equipment shall have features necessary to force helium flow, cooling, and monitoring functions required to establish safe conditions for capsule removal.

The CSS contractor shall provide calibrated items such as relief valves, torque wrenches, pressure gauges, temperature monitors, and hydrogen monitors as necessary for the design of the storage system operational loading requirements.

Table 4-2 represents a preliminary list of generic items associated with required ancillary equipment that may be required during loading activities. The CSS contractor shall provide all such equipment per design requirements. This list is not necessarily all inclusive, and the CSS contractor shall provide a detailed list of all equipment required for loading and unloading activities prior to the start of loading operations.

Table 4-2. Preliminary List of Ancillary Equipment

Ancillary Item	Contaminated (Yes/No)	Location Used
Annulus Overpressure System (if required)	Y/N	Pool Cell Area
Inflatable Annulus Seal (if required)	Y/N	Pool Cell Area
Annulus Shield	N	Loading Area
Transfer Cask Bottom Protective Cover	Y	Pool Cell Area/Hot Cell
Canister Hydrostatic Test System	N	Loading Area
Canister Fill Pump System	N	Loading Area
Canister Pump Down System	Y	Loading Area
Water Circulation System	Y/N	Loading Area

The CSS contractor shall recommend appropriate safety classification determinations based on the intended use of the equipment and evaluation of potential accidents and off-normal events. Appropriate QA controls shall be implemented based on the classification of the equipment.

#### 4.2.7 Other Equipment

Other equipment that may be required includes mobile cranes, forklifts, and manlifts used for the handling, assembly, and movement of materials and equipment. All such lifting equipment shall comply with the requirements of DOE/RL-92-36.

### 4.3 Throughput Requirements

The CESP shall have the capability to transfer all 1,936 capsules from WESF to the CSA within a 52-week period following successful completion of system startup and readiness review. This 52-week operational period includes anticipated system downtime for routine maintenance.

WESF operates on a four 10s schedule. The standard workday consists of 10 hours of work between the core hours of 6:00 a.m. and 4:30 p.m. No work occurs on Fridays or facility closure days. This schedule may be changed if required to meet the throughput requirements.

The CSS contractor shall provide data as needed to support an analysis to demonstrate that production rate requirements can be met. Specific requirements identified in Section 6.4 of this FDC shall be taken into consideration when completing the throughput analysis

## 5 Interfaces

Some CSS-provided systems will require physical tie-ins with existing systems and structures at WESF and with the CSB at the CSA. The CSS contractor-prepared conceptual design report will define facility interfaces, tie-in requirements, and the approach to testing, consistent with the requirements of PRC-PRO-EN-286, *Testing of Equipment and Systems*. The project will also require access to and performance of work within various areas of WESF and at the CSA site. Requirements for the performance of work on the Hanford Site, including interfaces with CHPRC, are described in the SOW.

Interfaces with Hanford Site Utilities, MSA, the CSS design/fabrication contractor, and the CSA and WESF modifications construction contractors shall be coordinated through CHPRC.

### 5.1 Technical Interfaces

The execution of the scope of work may impact and/or require technical interfaces with CHPRC, as well as other Hanford Site organizations such as but not limited to the following:

- Hanford Site Utilities Organization – Any services, such as electricity, air, or water (either temporary or permanent), required by the CSS contractor’s design shall be clearly identified by the CSS contractor.
- CHPRC QA – The CSS contractor shall have procedures for controlling the configuration of the design during the design, fabrication, and construction phases of the project, in accordance with the CSS contractor’s approved QA program.
- Change Control – Procedures shall ensure that changes to the design are reviewed and approved consistent with the requirements for the initial design.
- CHPRC Engineering – The CSS contractor shall provide to CHPRC any analysis used to support the design of the various system components. The CSS contractor is responsible for determining and performing any additional analysis beyond that specifically identified in the SOW and this FDC to ensure compliance with the project requirements.
- WESF Operations – Any planned physical modifications to any of the existing WESF facility and equipment requires coordination and the approval of CHPRC.
- CSB Operations – Any planned design and construction interfaces with the CSB requires coordination and the approval of CHPRC.

- CHPRC Nuclear Safety – Nuclear safety analysis requires CHPRC and DOE-RL approval.
- CHPRC Environmental – The CSS contractor’s design shall support and comply with the CESP environmental permitting requirements.
- MSA – MSA is responsible for Hanford Site transportation safety and approval of transportation permits. Transportation of materials and equipment, including the transfer of the capsules from WESF to the CSA, must comply with DOE/RL-2001-36.
- CSA/WESF Modifications Contractors – The CSS contractor shall provide technical support for design and construction of the CSA and any required WESF modifications. The CSA/WESF Modifications contractors will receive design inputs related to the CSS, capsule loading, and transfer activities from the CSS contractor via CHPRC.

## 5.2 Utility Interfaces

### 5.2.1 Hanford Site Utilities/Infrastructure

The CSS contractor shall identify required interfaces with existing Hanford Site utilities and infrastructure as needed to support delivery and later system use by others, including but not limited to , capsule transfer operations, and long-term storage operations. The CSS contractor shall identify required interfaces with existing systems at WESF to distribute required utilities (e.g., water, electricity, and sanitation) as required to support later CSS use by others. Initial assessment of utilities and infrastructure interfaces shall occur following completion of conceptual design.

### 5.2.2 Service Roads

To the greatest extent possible, the CSS contractor shall take advantage of existing asphalt roads at the selected site. The casks/canisters will arrive at WESF by existing and extended roadways. The CSS contractor shall provide all necessary design information required to support a design analysis of the existing roadways identified for use by the vehicles transporting casks to and from the CSA. The design analysis shall be performed by others.

### 5.2.3 Interface with Existing 13.8 kV Primary Electrical Distribution System

The CESP shall interface with the existing Hanford Site electrical distribution system. Depending on facility location and power requirements, the existing electrical distribution system may require upgrades.

Required electrical interfaces to support installation and/or use of CSS contractor provided system shall be identified to CHPRC.

Electrical power delivered to the system, electrical installation, and any modifications to the site electrical utilities distribution system, including the 13.8 kV to 480 Vac transformers, shall conform to NFPA 70, *National Electrical Code*, and IEEE C2, *National Electrical Safety Code*.

### 5.2.4 Interface with Site Water Distribution

The CSS contractor shall identify any required interfaces with the onsite water distribution system for potable and raw water to support installation and/or use of CSS contractor provided systems.

The CSS fire protection requirements will be addressed in the design.

### 5.3 WESF Interfaces

The CSS design, construction, and capsule transfer operations will require technical, physical, and operational interfaces with WESF. The CSS contractor shall work with CHPRC, as per the CSS SOW, to meet the WESF DSA (HNF-8758)/TSR (HNF-8759) requirements or modify the DSA (HNF-8758)/TSR (HNF-8759) as necessary to perform the work scope.

### 5.4 CSB Interfaces

The CSS design, construction, and capsule transfer operations will require technical, physical, and operational interfaces with the adjoining CSB facility and site. The CSS contractor shall work with CHPRC, as per the CSS SOW, to meet the CSB requirements as necessary to perform the work scope.

## 6 General Requirements

### 6.1 Discipline-Specific Design Requirements

This section of the FDC provides the general requirements for the CSS design organized by design discipline. It includes relevant codes and standards for those SSCs determined by safety analysis to be safety significant or safety class as identified by DOE O 420.1C. It is the responsibility of the CSS contractor to determine the relevancy of the identified codes and standards to the specific CSS design solution. The codes and standards identified in the following sections are not intended to be all inclusive. It is the responsibility of the CSS contractor to evaluate, identify, and apply the applicable industry codes and standards to the specific design features of the CSS. Natural forces criteria are specified in section 6.7.

#### 6.1.1 Mechanical/HVAC

The CSS contractor activities shall not compromise the capability of the existing WESF ventilation systems to comply with the existing air permit. The CSS conceptual and detailed designs shall identify any interface requirements for installation and/or use of CSS contractor provided systems that potentially affect the WESF ventilation system to determine if the ventilation system requires upgrades to support capsule packaging activities.

The CSS shall not require an active HVAC system to provide radioactive material confinement. Heat removal from the capsules during extended storage shall be by passive means.

Per DOE O 420.1C, safety significant and safety class mechanical handling equipment shall meet the requirements of the codes listed in Table 6-1 as applicable to the specific CESP design.

Table 6-1. Codes for Safety Significant and Safety Class Handling Equipment

Handling Equipment	Safety Significant	Safety Class
Cranes	Applicable CMAA standards; ASME NOG-1-2015, ASME NUM-1, ASME B30.2; DOE-STD-1090-2011	Applicable CMAA nuclear standards; ASME NOG-1-2015, ASME NUM-1, ASME B30.2; DOE-STD-1090-2011
Other Equipment	ANSI N14.6; ASME B30 Series; DOE-STD-1090-2011	ANSI N14.6; ASME B30 Series; DOE-STD-1090-2011

Note: Complete reference citations are provided in Chapter 13.

CMMA = Crane Manufacturers Association of America, Inc.

Cranes, hoists, and lifting devices designed to handle casks and storage overpacks and to facilitate movement of the same within CESP shall meet the requirements of DOE-STD-1090-2011 and DOE/RL-92-36.

### 6.1.2 Civil/Structural

Per DOE O 420.1C, safety significant and safety class structures shall meet the requirements of the codes listed in Table 6-2 as applicable to the specific CESP design.

Table 6-2. Codes for Safety Significant and Safety Class Structures

Structures	Safety Significant	Safety Class
Concrete	ACI-318	ACI-349
Steel	ANSI/AISC 360; AISC-325	ANSI/AISC N690-12

Note: Complete reference citations are provided in Chapter 13.

Safety significant SSCs shall meet the requirements of ASCE/SEI 7-10, *Minimum Design Loads For Buildings and Other Structures*, as applicable to the CESP design, and safety class SSCs shall meet the requirements of ASCE/SEI 43-05, *Seismic Design Criteria for Structures, Systems, and Components in Nuclear Facilities*, as applicable to the CESP design.

All activities associated with the installation, inspection, and testing of structural concrete and structural steel shall be performed under the QA requirements outlined in Chapter 10 of this FDC.

### 6.1.3 Instrumentation and Control Systems

The CSS contractor shall include a control system for the operation of the CSS, which may be located locally to the equipment/machines and/or at WESF with control panels, as necessary, for operation and monitoring of CSS systems. The design of control devices shall conform to the requirements of 29 CFR 1910, "Occupational Safety and Health Standards," and DOE-0359, *Hanford Site Electrical Safety Program (HSESP)*.

Control equipment and devices shall comply with NEMA ICS 1, *Industrial Control and Systems: General Requirements*, and UL 508, *Standard for Industrial Control Equipment*. Control devices shall be designed in accordance with NUREG-0700, *Human System Interface Design Review Guidelines*, as appropriate based on a safety evaluation. Control equipment and devices shall comply with 29 CFR 1910. Control equipment and devices shall conform to NFPA 70. Control panels shall comply with UL 508A, *Standard for Industrial Control Panels*.

The instrumentation and control system shall meet the requirements for the following industry standards as applicable to the project:

- Instruments and controls selected for the expected environment
- Enclosure type ratings in accordance with NEMA 250
- Instrumentation and control system equipment certification by an Occupational Safety & Health Administration-registered nationally recognized testing laboratory as required by DOE-0359
- Instrumentation and control design and installation to facilitate operations and maintenance
- Instrument calibration with National Institute of Standards and Technology traceable documentation

The design of safety-related instrumentation and control systems shall provide for the periodic in-place testing and calibration of instrument channels and interlocks. The design shall allow periodic testing of protective functions to determine if failure or loss of redundancy may have occurred.

Per DOE O 420.1C, safety significant and safety class instrumentation, control, and alarm components shall meet the requirements of the codes listed in Table 6-3 as applicable to the specific CESP design.

**Table 6-3. Codes for Safety Significant and Safety Class Instrumentation**

<b>Instruments, Controls, and Alarms</b>	<b>Safety Significant</b>	<b>Safety Class</b>
Hardware	Applicable NFPA codes and standards; ANSI/ANS-8.3-1997, ANSI/ANS-58.8-1994, ANSI/ANS-59.3-1992, ANSI N13.1-2011, ANSI N323D-2002; ANSA/ISA-Series including ANSI/ISA-67.04.01 and ISA TR 84.00.06; IEEE C2; IEEE-N42.18, DOE-STD-1020; and DOE-STD-1195-2011 (implements ANSI/ISA-84.00.01-2004)	Applicable NFPA codes and standards; ANSI/ANS-8.3-1997, ANSI/ANS-58.8-1994, ANSI/ANS-59.3-1992, ANSI N13.1-2011, ANSI N323D-2002; ANSA/ISA-Series including ANSI-ISA-67.04-.01 and ISA TR 84.00.06; IEEE C2; IEEE-N42.18, DOE-STD-1020, and DOE-STD-1195-2011 (implements ANSI/ISA 84.00.01-2004)

Note: Complete reference citations are provided in Chapter 13.

NFPA = National Fire Protection Association

### 6.1.4 Electrical

The CESP shall interface with the existing Hanford Site electrical distribution system. Depending on facility location and power requirements, the existing electrical distribution system may require upgrades.

Required electrical interfaces to support installation and/or use of CSS contractor provided system shall be identified to CHPRC.

Electrical power delivered to the system, electrical installation, and any modifications to the site electrical utilities distribution system, including the 13.8 kV to 480 Vac transformers, shall conform to NFPA 70 and IEEE C2.

The CSS contractor shall identify in their Code of Record (COR) the Codes and Standards utilized in their design in complying with any requirements to meet USNRC review and approval of their systems. It should be noted that during the CESP project design reviews, additional codes and standards may be invoked if there is insufficient justification that the codes and standards used meet the requirements of DOE.

## 6.2 Design Life

### 6.2.1 General Requirements

Components shall be designed such that continued integrity of the component can be verified over the design life to ensure continued functionality of the component within original requirements.

All systems and equipment provided shall be designed, to the maximum extent practical, to provide a minimum 5-year, maintenance-free service life unless stipulated otherwise.

Tools provided shall be designed, to the maximum extent practical, to provide a minimum 1-year, maintenance-free service life.

Consumables shall have a 1-year minimum service life and be located for ease of inspection, maintenance, and replacement.

### 6.2.2 Storage System

The storage system consists of the canister and the storage overpack. The canisters shall be designed with the intent to enable future extension of the storage period, without retrieval of the capsules for transfer, to a total of 300 years without loss of design function. The storage overpack shall be capable of storing the canister for up to 100 years without the need to repackage.

Appropriate analysis, with peer-reviewed referenced scientific studies, shall be provided to demonstrate compliance with the required design life. This shall include an analysis of each component and item within a canister per the final design (to exclude requirement for analysis of the capsules). Each item shall have documented the following:

- Item description per the design drawings
- Intended function of the item
- Safety classification of the item
- Degradation methods considered and analyzed
- Input scientific data for lifetime determination
- Any analysis required due to item degradation period results
- Listing of assumptions and uncertainties in the analysis

EPA 100/B-03/001, *A Summary of General Assessment Factors for Evaluating the Quality of Scientific and Technical Information*, provides guidance on determining the validity of scientific studies.

For the canister, consideration shall be provided for temperature variations inside and outside, irradiation effects, galvanic corrosion, residual stresses in welds and the heat-affected zones, residual moisture within the canister following drying, possible loss of helium during the storage period, and chloride deposition both internal and external to the canister causing corrosion.

For the storage overpack, consideration shall be provided for temperature variations inside and outside, irradiation effects, galvanic corrosion (if applicable), residual stresses in welds and the heat-affected zones, concrete property losses of shielding/strength/elastic stiffness/toughness, reinforcing steel exposure, and chloride deposition on exterior surfaces causing corrosion.

### 6.2.3 Ancillary Equipment

Transfer system components shall have a minimum 20-year design life.

### 6.2.4 Design Life Analysis

The CSS contractor is responsible to document that components meet design life requirements as described in this document.

## 6.3 Human Factors

The design or the selection of equipment to be operated and maintained by personnel shall include the application of human factors engineering criteria together with other appropriate design criteria.

Decisions concerning which system functions to allocate to humans versus machines shall be determined by analyses of system functions required, impact of error or no action on safety, and a comparison of human capabilities and equipment capabilities for the separate system functions.

Systems, subsystems, and equipment shall consider the human engineering guidelines of DOE-HDBK-1140, *Human Factors/Ergonomics Handbook for the Design for Ease of Maintenance*, and IEEE 1023, *IEEE Recommended Practice for the Application of Human Factors Engineering to Systems, Equipment, and Facilities of Nuclear Power Generating Stations and Other Nuclear Facilities*.

A human factors evaluation shall be performed and documented on the completed design.

## 6.4 Reliability, Availability, Maintainability, and Inspectability

The CSS contractor design shall consider requirements associated with reliability, availability, maintainability, and inspectability. The design shall also consider and demonstrate and/or support analysis that key elements of throughput and operational equipment effectiveness (OEE) requirements have been met in order to meet the overall process completion requirements cited in this FDC and the SOW.

### 6.4.1 Reliability, Availability, and Throughput

The fundamental principles of total productive maintenance will be implemented to the extent practical for the project. The four main principles are efficient equipment, effective maintenance, “mistake-proofing” (i.e., shutdown fail-safing), and integrated safety management. The key performance index for this approach is that of OEE.

#### *Operational Effectiveness Requirements:*

- OEE shall be defined as “A” × “P” × “Q,” where “A” is availability, “P” is productivity, and “Q” is quality.
- Availability shall be defined as that percentage of time the equipment or operation was running compared to the scheduled time available.
- Productivity shall be defined as a function of performance (i.e., the amount of material removed/processed versus the scheduled quantity to have been processed).
- Quality shall be defined as that amount of materials processed that meets requirements versus any amount needing further rework.
- The OEE values shall take into consideration the need for the system’s ability to remove the capsules within 52 weeks following installation of the CES removal and transfer systems.

The CSS contractor will provide input to a CHPRC analysis to demonstrate that the throughput and OEE requirements have been met in order to meet the overall process completion requirements cited in this FDC and the SOW.

### 6.4.2 Availability Requirements

High availability is a system design approach and associated service implementation philosophy and practice that ensures a predetermined minimum level of performance that can be met during a contractual period. Key performance indices associated with availability are losses due to unexpected breakdown, lengthy and unplanned-for repeat setup and adjustment, frequent stoppage and quality defect losses, and poor durability and productive lifespan. To this end, the following will be required at a minimum:

- A failure modes and effects analysis shall be performed to identify potential equipment failures and their consequences and create mitigation strategies to limit the likelihood or consequence.
- Spares shall be used to minimize potential operational downtime as identified by a reliability, availability, and maintainability analysis.
- Equipment permanently located in designated high-radiation areas shall be minimized to reduce the need for worker intervention upon failure.

The CSS contractor will provide input to a CHPRC analysis to demonstrate that the throughput and OEE requirements have been met in order to meet the overall process completion requirements cited in this FDC and the SOW.

#### 6.4.3 Maintainability and Inspectability

The CSS contractor design shall consider maintainability factors specific to equipment used in high-radiation areas. The design shall provide for routine preventive maintenance/calibration where required and maintenance, repair, or replacement of equipment subject to failure. Planning and design of the CESP systems and equipment, and evaluation of the mean time to repair systems and equipment, shall take into account all aspects of operation and maintenance, including the following:

- Personnel safety
- Equipment accessibility
- Dismantling
- Replacement
- Repair
- Frequency of preventive maintenance
- Inspection requirements
- Day-to-day operations

Storage overpacks shall be designed to be passive. Thermal cooling is provided by natural circulation that allows for heat removal. Maintenance requirements for the storage overpacks will be determined by the design but typically consist of periodic inspections to ensure vents are not blocked by debris or wildlife and annual inspections to ensure general operability.

Design decisions shall consider lifecycle costs and all other programmatic requirements affecting WESF and the CSS. The initial construction cost shall be balanced against operation and maintenance costs over the design life. Selection of materials and equipment shall include the cost and availability of materials, parts, and labor required for operation, maintenance, repair, and replacement. Safety is the most important design factor and shall not be compromised by cost or schedule considerations.

The design shall consider maintainability factors particular to the specific equipment used. The CSS contractor design shall provide for routine maintenance, repair, or replacement of equipment subject to failure. Remote and remote-on-remote maintenance are not specifically precluded. The use of remote maintenance systems and tooling will be acceptable for consideration but must be included in the human factors analysis in order to be considered.

The design of SSCs shall allow inspection, maintenance, and testing to ensure their continued function, readiness for operation, and accuracy. The CSS contractor design should locate ancillary equipment (e.g., pumps, blowers, motors, compressors, gear trains, and controls) in areas least likely to become contaminated. The design of equipment that shall be located within contamination areas shall allow for in-place maintenance or replacement. Accurate and effective inspections within a hot cell environment are difficult and challenging. Any remote inspection methods used shall have a plan developed to qualify that the inspection method is capable of achieving the resolution and accuracy required by the design. This qualification process shall comply with the requirements of ASME NQA-1-2008 along with ASME NQA-1a-2009, addenda Part I, Requirement 10, "Inspection."

Capability shall be provided for the maintenance of contaminated equipment that cannot be repaired in place. This capability shall include the necessary provisions for confinement, ventilation, and waste control.

The design of all process equipment shall include features to minimize self-contamination of the equipment, piping, and confinement areas. The design of process equipment shall also include features to minimize the spread of contamination out of local areas.

## 6.5 ALARA Requirements

ALARA principals shall be applied for any worker activity with the potential of dose and contamination exposure. In the course of application of these ALARA principles, the project will ensure radiation exposures to workers and the public, and releases of radioactivity to the environment, are maintained below regulatory limits, and deliberate efforts are taken to further reduce exposures and releases ALARA. Design considerations shall include contamination control, shielding, remote activities, failure recovery, and maintenance.

### 6.5.1 Key ALARA Requirements

The CSS shall be designed to limit occupational radiation exposures in accordance with the requirements of 10 CFR 835 and CHPRC-00073, *CH2M HILL Plateau Remediation Company Radiological Control Manual*.

The CSS contractor design shall protect facility workers from excessive radiation exposure during capsule handling and packaging, canister closure and transfer, canister placement into storage overpacks, and storage operations using appropriate methods (e.g., remote handling, shielding, and contamination control ventilation). The CSS contractor design shall not select administrative controls over engineered features to minimize employee exposure to radiation.

The CSS contractor provided systems shall perform capsule loading and packaging in an area serviced by HEPA filters to minimize potential releases from the building during these activities. The existing WESF ventilation system is available for use but may require modification.

Limiting radiation exposure to facility personnel is a key driver for operations at WESF, during transportation, and at the CSA. Due to the high dose rates associated with the capsules, all capsule handling and packaging activities will be conducted with remote-operated equipment or sufficient shielding to protect facility workers.

To ensure that exposure limits are satisfied, dose estimates shall be developed for capsule loading, canister closure welding, cask transfer, overpack placement into storage, and storage configurations. Preliminary estimates shall be provided as a part of the conceptual design. Final dose estimates shall be provided as a part of the final design.

Beginning at the earliest design stage, requirements for radiological design shall be incorporated into the designs for new components and equipment and modifications of existing components and equipment. ALARA requirements are defined in 10 CFR 835, Subpart K, “Design and Control.”

- Optimization methods shall be used to assure that occupational exposure is maintained ALARA in developing and justifying facility design and physical controls.
- The design objective for controlling personnel exposure from external sources of radiation in areas of continuous occupational occupancy (2,000 h/yr) shall be to maintain exposure levels below an average of 0.5 mrem (5  $\mu$ Sv) per hour and as far below this average as is reasonably achievable. The design objectives for exposure rates for a potential exposure to a radiological worker where occupancy differs from the above shall be ALARA and shall not exceed 20 percent of the applicable standards in 10 CFR 835.202.
- The design objective for control of airborne radioactive material shall be to avoid releases to the workplace atmosphere under normal conditions and to control the inhalation of such material by workers to levels that are ALARA in any situation; confinement and ventilation shall normally be used.
- The design or modification of the facility and the selection of materials shall include features that facilitate operation, maintenance, decontamination, and decommissioning.

### 6.5.2 ALARA Analysis

The basic requirements concerning the use of ALARA in design are contained in 10 CFR 835 (in particular Subpart K), CHPRC-00072, *CHPRC Radiation Protection Program*, CHPRC-00073, and DOE-STD-1098-99, *Radiological Control*. The specific requirements for ALARA analysis are captured in PRC-PRO-RP-1622, *Radiological Design Review Process*, which shall be used by the CSS contractor in the performance of the required ALARA analysis and design activities. Particular attention shall be placed upon PRC-PRO-RP-1622, Sections 3.3.4 to 3.3.9, Appendix A, and Appendix C.

The contractor shall perform an ALARA analysis to include a “time-motion” study that addresses lifecycle dose, including loading the capsules into the storage casks, normal operations, maintenance activities, and ultimately loading the capsules into shipping containers.

ALARA analysis including cost-benefit analysis relative to the dose received should be performed during the design process to demonstrate that the design is ALARA.

For cost-benefit analysis, the process and requirements identified in PRC-PRO-RP-1622, Section 3.3.7, shall be used.

All CSS contractor actions and decisions taken to maintain exposures ALARA shall be documented.

The CSS contractor shall perform shielding analysis for the capsule transfer operations to that ensure dose rates are ALARA and that the design of the capsule storage system is within the shielding limits defined in Section 4.1.4.7.

## 6.6 Safety

The CSS contractor shall perform work in a safe, compliant manner that adequately protects employees, the public, and the environment. The CSS contractor, and its lower-tier subcontractors, shall comply with applicable laws and requirements.

The CSS contractor shall perform work in accordance with CHPRC-approved contractor safety and health procedures. For all onsite work, the contractor shall perform work in accordance with the CHPRC safety and health procedures. The CSS contractor can implement the preapproved procedures included in PRC-PRO-SH-40078, *Contractor Safety Processes*, Appendix F, or submit an alternative program for approval. This alternative safety and health program shall comply with federal, state, and local codes and PRC-PRO-SH-40078, Appendix F. Additional health and safety requirements are specified in the SOW.

### 6.6.1 Occupational Safety and Health

The CSS shall be designed for safe installation, operation, and maintenance in accordance with the applicable requirements of 10 CFR 851, “Worker Safety and Health Program,” 29 CFR 1910, and 29 CFR 1926, “Safety and Health Regulations for Construction.”

### 6.6.2 Confinement Strategy

The CSS contractor design will protect facility workers, collocated workers, and the public by providing multiple layers of protection (i.e., defense-in depth) to prevent and mitigate uncontrolled releases of hazardous materials.

### 6.6.3 Fire Mitigation Strategy

The CSS contractor design shall protect personnel from fires in accordance with the DOE O 420.1C contractor requirements document (CRD), NFPA 101, *Life Safety Code*; ICC, 2012; 29 CFR 1910; and 29 CFR 1926. The CESP shall minimize requirements for fire protection by eliminating unprotected combustible materials from the facility design to the extent practical. The design shall consider fire-retardant materials based on ASTM E84, *Standard Test Method for Surface Burning Characteristics of Building Materials*, and NFPA 701, *Standard Methods of Fire Tests for Flame Propagation of Textiles and Films*.

### 6.6.4 Anticipated Safety Functions

Safety SSCs will be selected based on results of facility- and process-specific hazards analyses. This analysis will be performed as the design develops and will be reviewed and revised as necessary during preliminary and final design.

Designation of any new safety SSCs at WESF may be necessary depending on the method chosen to package the capsules. CSA is expected to be passive with no active safety SSCs.

### 6.6.5 Safety Analysis

CESP physical activities will be performed at WESF, an existing Hazard Category 2 nuclear facility, and at the selected site of the CSA, which will also be a Hazard Category 2 nuclear facility. The CESP will be managed under the requirements of DOE-STD-1189, *Integration of Safety Into the Design Process*. CESP-specific strategy is described in CHPRC-02236, *Extended Capsule Storage Project Safety Design Strategy*.

## 6.7 Natural Forces Criteria

The natural forces criteria for CESP SSCs shall be established and implemented as specified in PRC-PRO-EN-097, *Engineering Design and Evaluation (Natural Phenomena Hazard)*, using the Performance Category 2 (PC-2) criteria.

### 6.7.1 Seismic

DOE-STD-1189 and ANSI/ANS 2.26-2004, *Categorization of Nuclear Facility Structures, Systems and Components for Seismic Design*, (ANS 2.26) were used to determine the general seismic criteria for the new extended storage facility.

DOE-STD-1189, Appendix A, states the following:

The seismic design classifications of ANS 2.26 are to be used in association with DOE radiological criteria provided in this appendix. It is intended that the requirements of Section 5 of ANS 2.26 and the guidance in Appendix A of that Standard be used for selection of the appropriate Limit States (LS) for SSCs performing the safety functions specified. The resulting combination of Seismic Design Category (SDC) and LS selection provides the seismic design basis for SSCs to be implemented in design through ASCE/SEI 43-05, *Seismic Design Criteria for Structures, Systems, and Components in Nuclear Facilities*.

This text has been interpreted to state that the SDC is to be assigned based on DOE-STD-1189, Appendix A, specifically Table A-1, radiological criteria. The LS designations will be derived using Section 5 and Appendix A of ANS 2.26.

**SDC Determination:** Using the guidance provided by DOE-STD-1189, Appendix A, for seismic design of SSCs and the unmitigated consequences from a seismic event in the existing WESF DSA (HNF-8758), a Seismic Hazard Category of SDC-2 will be used for the CSA.

**Limit State Determination:** Section 5 and Appendix B of ANS 2.26 were reviewed to support determination of an LS. LS C was chosen for the new dry storage facility. The Section 5 definition of LS C is an SSC that may sustain minor permanent distortion but shall still perform its safety function. An SSC that is expected to undergo minimal damage during and following an earthquake such that no post-earthquake repair is necessary may be assigned this LS. Assignment of this LS is conservative because the structure of the extended storage facility is not expected to be credited as the primary containment for the material contained within the capsules.

CHPRC procedure PRC-PRO-EN-097 provides seismic design criteria based on SDC and LS designation. Seismic design criteria for SDC-2/LS C will be specified in design documentation. This is essentially PC-2 criteria, which corresponds to a safety classification of safety significant. The actual classification for the CSA will be determined in the new safety basis generated for this project.

The 225-B Building is credited as safety significant to survive a design basis earthquake (0.25 g peak horizontal ground acceleration). If modifications are necessary to the WESF facility to support CESP activities, analysis will be performed as necessary to ensure that the safety function of the 225-B Building is not impacted. The natural forces criteria for PC-2 shall be applied to WESF operation components.

### 6.7.2 Natural Forces Other Than Seismic

Natural phenomenon impacts, other than seismic, will be in accordance with DOE-STD-1020, *Natural Phenomenon Hazards Analysis and Design Criteria for Department of Energy Facilities*, and PRC-PRO-EN-097.

Additionally, the environmental data found in the current and archival data housed within the HMS web-accessed database shall be used when performing analysis and design in accordance with PRC-PRO-EN-097. The HMS data set can be accessed at the following URL:

<http://www.hanford.gov/page.cfm/hms>.

This website presents real-time meteorological data from the project's monitoring stations; daily, monthly, and annual weather summaries (including charts and tables); links to Hanford Site climatology reports; and a wealth of other data.

Data from HMS that is different than that specified in PRC-PRO-EN-097 shall not be used in final calculations without supporting justification and review and approval from CHPRC.

## 6.8 Decontamination and Decommissioning

The CESP shall comply with the design criteria in DOE O 430.1B Chg 2, *Real Property Asset Management*, and 10 CFR 835. The design shall enable future closure of the CSA in accordance with 40 CFR 264, "Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," and WAC 173-303-610, "Closure and Post-Closure."

Designs consistent with the program requirements of DOE O 430.1B Chg 2 shall be developed during the planning and design phases based on a proposed decommissioning method or a conversion method leading to other uses. SSCs shall include features that will facilitate decontamination for future decommissioning, increase the potential for other uses, or both.

Design or modification of the facility and selection of materials shall also include features that facilitate decontamination and decommissioning.

CESP should incorporate the following design principles:

- Provide equipment that precludes, to the extent practical, accumulation of radioactive or other hazardous materials in relatively inaccessible areas.
- Use materials that reduce the amount of radioactive and other hazardous materials requiring disposal and materials easily decontaminated.
- Incorporate designs that facilitate cut-up, dismantlement, removal, and packaging of contaminated equipment and components at the end of useful life.
- Use modular radiation shielding in lieu of or in addition to monolithic shielding walls.
- CESP equipment that is likely to become contaminated shall have special coatings that facilitate decontamination. The design should consider use of rounded corners and epoxy-coated walls in areas that handle or store radioactive material. Finishes shall meet industry and USNRC required best practices and requirements for materials exposed to radioactive materials. The CSS contractor shall provide the code, standard, and/or best practice guidance for all surface finishes that will be exposed to radioactive materials for all CSS SSCs. The CESP will not upgrade existing surfaces at WESF.

## 7 Nuclear Safety Requirements

### 7.1 Nuclear Safety

The CESP shall comply with the requirements of 10 CFR 830 and DOE-STD-1189, as implemented by PRC-PRO-NS-700, *Safety Basis Development*. The specific strategy that will be used to ensure compliance is described in CHPRC-02236.

Required safety documentation that will be developed by CHPRC include a preliminary hazard analysis, a conceptual safety design report, a preliminary safety design report, a preliminary DSA, and final DSA documents for the CESP including modifications to WESF, the design and construction of the CSA, and

the CSS and all of its support equipment and operations. The CSS contractor will provide input to a CHPRC analysis as described in the CSS SOW.

## 7.2 Safety Basis

The CSS contractor will provide input to a CHPRC analysis and shall develop nuclear safety documentation as required by the SOW to the standards identified in CHPRC-02236.

CHPRC's hazard analysis shall cover all new activities within WESF that are necessary to implement the CSS contractor's design, activities to transfer the canisters from WESF to the CSA, and all hazards associated with long-term storage of the capsules at the CSA. The CSS contractor will provide input to a CHPRC analysis as described in the CSS SOW.

The impacts of natural phenomena hazards shall be addressed consistent with the requirements of PRC-PRO-EN-097.

CSS design and fabrication shall provide analyses per the requirements of 10 CFR 830.

## 7.3 Fire Hazards Analysis

Required documentation that will be developed by CHPRC with support from the CSS contractor includes a preliminary fire hazards analysis (FHA) and a final FHA for WESF. The FHAs will be developed according to the requirements of PRC-PRO-FP-40420, *Fire Protection Analysis*.

HNF-SD-WM-FHA-019, *Fire Hazards Analysis for Building 225-B Waste Encapsulation and Storage Facility (WESF)*, describes fire protection controls applicable to WESF. Current controls include a requirement that G Cell may not exceed a maximum combustible loading equivalent to 100 kg of polystyrene and a limitation that no flammable gases (e.g., propane and acetylene) and no highly volatile fuels, including gasoline, shall be used or stored in WESF.

CHPRC shall perform an analysis of fire, blast, missile, and overpressure hazards, and the CSS contractor will provide input to a CHPRC analysis to the extent identified in the SOW to demonstrate compliance with DOE requirements.

Introduction of combustible material in the pool cell area, G Cell, and the canyon shall be limited. These areas of the facility lack automatic fire-suppression systems. The type and quantity of material introduced into these areas shall be reviewed and approved by CHPRC Fire Protection Engineering.

## 8 Transportation and Packaging

Transportation of canisters between WESF and the CSA shall be performed according to the requirements of PRC-PRO-TP-156, *Onsite Hazardous Material Shipments*, and PRC-MP-TP-40476, *Transportation Program Management Plan*, which provides the following two options:

1. Shipments can be performed in full compliance with U.S. Department of Transportation (DOT) regulations, which will require strict adherence to use of DOT packaging as well as all marking, labeling, placarding, and shipping paper requirements.
2. Shipments can be performed as a risk-based shipment that demonstrates by DOE-approved analysis a DOT-equivalent level of safety. An appropriate transportation safety document will be developed and implemented according to the requirements of DOE/RL-2001-36, and PRC-PRO-TP-15665, *Transportation Safety Documents*.

Alternatively, an approach to analyze and control the hazards associated with transportation of the canister using WESF and/or the CSA DSA can be made but will require negotiation with and approval by DOE-RL.

## 9 Environmental/Permitting Requirements

Note that the environmental and permitting strategy for CESP is currently under review. The following discussion is subject to revision based on the final strategy.

### 9.1 Dangerous Waste Permitting

The capsules are managed as mixed high-level waste under RCRA. It is anticipated that the CESP will be permitted under RCRA and WAC 173-303. The CESP shall comply with the following sections of WAC 173-303:

- WAC 173-303-280, “General requirements for dangerous waste management facilities”
- WAC 173-303-281, “Notice of intent”
- WAC 173-303-282, “Siting criteria”
- WAC 173-303-283, “Performance standards”
- WAC 173-303-290, “Required notices”
- WAC 173-303-300, “General waste analysis”
- WAC 173-303-310, “Security”
- WAC 173-303-320, “General inspection”
- WAC 173-303-330, “Personnel training”
- WAC 173-303-335, “Construction quality assurance program”
- WAC 173-303-340, “Preparedness and prevention”
- WAC 173-303-350, “Contingency plan and emergency procedures”
- WAC 173-303-360, “Emergencies”
- WAC 173-303-370, “Manifest system”
- WAC 173-303-380, “Facility recordkeeping”
- WAC 173-303-390, “Facility reporting”
- WAC 173-303-395, “Other general requirements”
- WAC 173-303-600, “Final facility standards”
- WAC 173-303-610, “Closure and post-closure”
- WAC 173-303-630, “Use and management of containers”
- WAC 173-303-803, “Permit application requirements”
- WAC 173-303-806, “Final facility permits”

- WAC 173-303-830, “Permit changes”

The CSS contractor shall be responsible for designing, fabricating, and constructing the CSS in accordance with the requirements of the above sections of WAC 173-303. The CSS contractor input to CHPRC whom will be responsible for preparing the documentation specific to the scope of work required to apply for a Washington State Dangerous Waste permit as described in WAC 173-303-803(3) and WAC 173-303-806. This will include, but is not limited to, design documents and documentation required by WAC 173-303-806(4)(a) to (m), as appropriate to the CSS contractor design. This includes certification of design drawings, specifications, and engineering studies by a professional engineer registered by the State of Washington as required by WAC 173-303-806(4)(a).

## 9.2 Environmental Protection and Pollution Control

The CESP shall comply with applicable federal, state, and local laws and regulations to protect the public, worker health and safety, and the environment.

The CSA will be permitted as a RCRA storage facility that is fully compliant with WAC 173-303-280 and WAC 173-303-630.

WESF is currently operating under the RCRA interim status regulations, and facility modifications to support CESP activities will require final permitting status.

*National Environmental Policy Act of 1969* review requirements for CESP activities will be established through an amended record of decision for the tank closure and waste management environmental impact statement.

The environmental permitting strategy for the CESP is currently under consideration by DOE. The CSS contractor will be required to meet the appropriate facility and CSS systems design requirements when finalized.

## 9.3 Environmental Design

CESP design and construction activities shall be performed in compliance with the CRD of DOE O 436.1, *Departmental Sustainability*. Strategies will be aimed at improving performance in energy savings, water efficiency, carbon dioxide emissions reductions, indoor environmental quality, and stewardship of resources. The High Performance Sustainability Building requirements (Executive Order 13423, *Strengthening Federal Environmental, Energy, and Transportation Management*) shall be implemented to the extent practical during the design of the CSS.

## 9.4 Environmental and Safety Management

The environmental and safety management system, which integrates environment, safety, and health requirements into the work planning and execution processes to effectively protect workers, the public, and the environment, is described in PRC-MP-MS-003, *Integrated Safety Management System/ Environmental Management System Description (ISMSD)*. Personnel safety, equipment safety, and environmental safety are all part of the Integrated Safety Management System.

## 9.5 Managing Waste Generated

The CESP may generate a minimal amount of waste in several forms during decontamination, normal operations, and maintenance. The CESP shall provide for disposal of waste, including accumulation and handling areas as applicable, in accordance with DOE O 435.1 Chg 1, *Radioactive Waste Management*; DOE-STD-1098; WAC-173-303; and WA7890008967, *Hanford Facility Resource Conservation and*

*Recovery Act Permit.* The CESP shall interface with existing Hanford Site waste treatment and disposal facilities for disposition of hazardous and radioactive solid wastes generated by the CESP. CSS contractor provided systems shall be designed with intent to minimize future generation of waste requiring management and disposal by the CESP.

## 9.6 Airborne Emissions

The design of the capsules and potentially the storage system will determine if the radioactive sources will be exempt from licensing by the Washington State Department of Health in accordance with WAC 246-247-020, "Radiation Protection—Air Emissions," "Exemptions." If the capsules or the storage system does not meet the definition of a sealed source (WAC 246-247-030, "Definitions"), a Notice of Construction Application will be submitted. The CSS contractor will be responsible for preparing the documentation specific to their scope of work required to confirm compliance with applicable standards.

It is not anticipated that criteria or toxic emissions will require permitting actions based on the characterization of the capsule contents and capsule construction.

To be protective of personnel, toxic and hazardous airborne emissions shall comply with the permissible exposure levels identified in DOE O 458.1, *Radiation Protection of the Public and the Environment*, and 29 CFR 1910, Subpart Z, "Toxic and Hazardous Substances."

To meet ambient air quality standards, toxic and hazardous airborne emissions shall comply with WAC 173-400, "General Regulations for Air Pollution Sources," and WAC 173-460, "Controls for New Sources of Toxic Air Pollutants."

Radionuclide airborne emissions shall comply with the ALARA-based limits for exposure (dose) to the public, as identified in WAC 173-480, "Ambient Air Quality Standards and Emissions Limits for Radionuclides," and WAC 246-247.

## 10 Quality Assurance Requirements

The CESP will be performed under a QA program meeting the requirements of ASME NQA-1-2008, with the ASME NQA-1a-2009 addenda, Part I and applicable portions of Part II. The applicable portions of Part II are Subparts 2.1, 2.2, 2.3, 2.4, 2.5, 2.7, 2.8, 2.14, 2.15, and 2.20. Contractors performing design, construction, or operation activities shall be subject to the enforcement actions under 10 CFR 820, "Procedural Rules for DOE Nuclear Activities," Subpart G, "Civil Penalties," Appendix A, "General Statement of Enforcement Policy."

The CSS contractor's quality program shall be submitted to CHPRC for review prior to the start of work, and work shall not be authorized until the program is specifically approved by CHPRC as meeting the preceding requirements. Such approval may be conditional and limited to certain program elements.

The CSS contractor shall demonstrate compliance with the requirements of this FDC by keeping current a design requirements compliance matrix that tracks each requirement and where and how it has been implemented in the design documentation.

Design verification for safety class SSCs conducted through design review or alternative calculations shall be performed by competent individuals or groups other than those who performed the original design but who may be from the same organization or same project team. The design verification shall include a review to ensure that design characteristics can be controlled, inspected, and tested, and that inspection and test criteria are identified. The CSS contractor shall be responsible for performing and documenting all design verifications for each system developed.

CHPRC reserves the right to witness any design verification conducted through qualification testing.

CESP activities shall comply with applicable portions of IAEA-TECDOC-1169, *Managing suspect and counterfeit items in the nuclear industry*.

Cleaning, cleanliness, and foreign material exclusion requirements shall be implemented during design, procurement, construction, and operations activities according to the requirements of PRC-PRO-QA-33415, *Structures, Systems, Components Cleaning/Cleanliness and Foreign Material Exclusion*.

## 11 Design Document Requirements

The CHPRC design document requirements for preparation of engineering submittals are provided in the CSS SOW.

## 12 Applicable Requirements Documents

A COR has been established for the CESP, CHPRC-02288, *Capsule Extended Storage Project (W-135) Code of Record*.

The COR shall serve as a management tool and source for the applicable requirements documents used to design, construct, operate, and decommission the CESP over its lifecycle. The COR shall include federal and state laws and regulations, DOE requirements, Hanford Site-specific requirements, and design criteria defined by national codes and standards and by state and local building codes that directly affect public, worker, environmental, or nuclear safety.

The COR shall be updated by CHPRC to include more detailed design requirements during preliminary design. The CSS contractor shall be required to provide input and supporting documentation to the COR throughout the duration of the CESP contract.

During the design phase for any proposed modification(s) of the existing WESF facility, the CSS contractor shall evaluate the existing design basis and authorization basis for the facility in comparison to current federal and state laws and regulations, DOE requirements, Hanford Site-specific requirements, and design criteria defined by national codes and standards and by state and local building codes that directly affect public, worker, environmental, or nuclear safety. The CSS contractor shall identify any significant changes that may need to be incorporated into the COR for the proposed modification and shall submit the recommended changes for review and approval.

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## Appendix A

### Functional Design Criteria Compliance Matrix

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This Appendix is reserved for the Functional Design Criteria Compliance Matrix. This matrix will be included in the next revision to this document. The matrix will provide a checklist for compliance with the requirements identified in this document.

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