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

ch2m

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

### Change Control Record

<table>
<thead>
<tr>
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<td>0</td>
<td>Initial issuance of document. See ECR-16-000034</td>
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<tr>
<td>1</td>
<td>The change updates the Project W-135 cask storage system functional design criteria document. This revision includes minor changes to clarify responsibilities and ensure consistency with the project functions and requirements document (CHPRC-02252). See ECR-16-000170.</td>
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<td>3</td>
<td>This document is being revised to support issuance of a contract for design of the cask storage system for the WESF capsules. Changes include: update project name to 'Management of the Cesium and Strontium Capsules (MCSC) Project', add requirements for modified coverblocks in case they are needed, add clarifying language in several places based on responses provided to questions from potential bidders on the design contract, revise canister requirements to reflect decision to use smaller canisters compatible with the universal canister, update references and make other minor editorial changes. See ECR-16-001145.</td>
<td>9-21-16</td>
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<tr>
<td>4</td>
<td>The change updates the Project W-135 cask system functional design criteria document. This revision includes changes to reflect the current status of the project and to ensure consistency with the other project functional design criteria documents (CHPRC-02623 and CHPRC-03011) and the functions and requirements document (CHPRC-02252). The primary change is to update terminology based on award of the CSS design contract and selection of a technology for the CSS. See ECR-17-000491.</td>
<td>6-7-17</td>
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<tr>
<td>5</td>
<td>This change updates the Project W-135 cask system functional design criteria document. This revision is issued following completion of the conceptual design review and incorporates comments from the conceptual design review, clarifies functional requirements associated with the canyon and truckport ventilation, and reflects changes in terminology. This revision also changes some design requirements associated with the potential for deep borehole disposal of the capsules. These revised requirements will allow greater flexibility in the design of the cask storage system and will not preclude the choice of deep borehole disposal as an option for the capsules. See ECR-17-001518.</td>
<td>10-5-17</td>
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<tr>
<td>6</td>
<td>This change updates the Project W-135 cask system functional design criteria document in support of the formal preliminary design review. Changes include clarification of capsule dimensions, update of the expected capsule loading date, clarification of responsibilities associated with the temperature monitoring system, clarification of seismic design criteria, update to reflect designation of SSCs as safety significant, update to reflect the safety document approach.</td>
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<td>for transfer of capsules between WESF and the CSA and other minor updates and edits. See ECR-18-000367.</td>
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<td>This change updates the Project W-135 cask system functional design criteria document following the formal preliminary design review. Changes include clarification of the temperature monitoring system safety designation and design criteria and editorial updates in response to design review comments. See ECR-18-000769.</td>
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## Terms

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<th>Description</th>
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<tr>
<td>ALARA</td>
<td>as low as reasonably achievable</td>
</tr>
<tr>
<td>AMU</td>
<td>aqueous makeup unit</td>
</tr>
<tr>
<td>ANSI</td>
<td>American National Standards Institute</td>
</tr>
<tr>
<td>AVC</td>
<td>automatic voltage control</td>
</tr>
<tr>
<td>AWS</td>
<td>Automated welding system</td>
</tr>
<tr>
<td>BUSS</td>
<td>Beneficial Uses Shipping System</td>
</tr>
<tr>
<td>BFE</td>
<td>buyer furnished equipment</td>
</tr>
<tr>
<td>CHPRC</td>
<td>CH2M HILL Plateau Remediation Company</td>
</tr>
<tr>
<td>CFR</td>
<td>code of federal regulations</td>
</tr>
<tr>
<td>CMAA</td>
<td>Crane Manufacturers Association of America, Inc.</td>
</tr>
<tr>
<td>CoC</td>
<td>Certificate of Compliance</td>
</tr>
<tr>
<td>COR</td>
<td>code of record</td>
</tr>
<tr>
<td>CRD</td>
<td>contractor requirements document</td>
</tr>
<tr>
<td>CSA</td>
<td>Capsule Storage Area</td>
</tr>
<tr>
<td>CSB</td>
<td>Canister Storage Building</td>
</tr>
<tr>
<td>CsCl</td>
<td>cesium chloride</td>
</tr>
<tr>
<td>CSP</td>
<td>Capsule Storage Pad</td>
</tr>
<tr>
<td>CSS</td>
<td>Cask Storage System</td>
</tr>
<tr>
<td>DOE</td>
<td>U.S. Department of Energy</td>
</tr>
<tr>
<td>DOE-RL</td>
<td>DOE-Richland Operations Office</td>
</tr>
<tr>
<td>DOT</td>
<td>U.S. Department of Transportation</td>
</tr>
<tr>
<td>DSA</td>
<td>documented safety analysis</td>
</tr>
<tr>
<td>DTS</td>
<td>Dry Transfer System</td>
</tr>
<tr>
<td>FDC</td>
<td>functional design criteria</td>
</tr>
<tr>
<td>FHA</td>
<td>fire hazards analysis</td>
</tr>
<tr>
<td>HEPA</td>
<td>high-efficiency particulate air</td>
</tr>
<tr>
<td>HMS</td>
<td>Hanford Meteorological Station</td>
</tr>
<tr>
<td>HVAC</td>
<td>heating, ventilation, and air conditioning</td>
</tr>
<tr>
<td>IEEE</td>
<td>Institute of Electrical and Electronics Engineers</td>
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LS  limit state
MCSC  Management of the Cesium and Strontium Capsules Project
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  Resource Conservation and Recovery Act of 1976
RTD  resistance thermal detector
SDC  seismic design category
SIP  Shielded Indexer Plate
SOW  statement of work
SSC  structures, systems, and component
SrF₂  strontium fluoride
TSR  technical safety requirements
TSC  Transportable Storage Canister
TSCB  Transportable Storage Canister Basket
UCS  Universal Capsule Sleeve
VCC  Vertical Concrete Cask
VCT  Vertical Cask Transporter
VDS  vacuum drying system
WAC  washington admininistrative code
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 Management of the Cesium and Strontium Capsules (MCSC) Project (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).

The purpose of the MCSC Project is to provide the capability for the removal of cesium and strontium capsules from the Waste Encapsulation and Storage Facility (WESF) and placement of the capsules into an interim storage configuration pending final disposition.

Responsibilities for the MCSC Project are divided between CHPRC and various MCSC Project subcontractors as depicted in Figure 1-1. CHPRC has the responsibility for executing the MCSC Project, consistent with the requirements of the PRC contract, (DE-AC06-08RL14788). CHPRC-02252, Management of the Cesium and Strontium Capsules Project (W-135) Functions and Requirements Document, establishes the upper level technical basis and requirements for the MCSC Project 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 designs will be contained in separate FDC documents, CHPRC-02623, Capsule Storage Area (CSA) Functional Design Criteria (Project W-135) and CHPRC-03011, WESF Modifications Functional Design Criteria (Project W-135).

Figure 1-1. MCSC Project Acquisition Structure

Throughout this document, reference is made to CHPRC, the MCSC Project, the CSS contractor, the WESF Modifications contractor, and the CSA contractor. Requirements and criteria that reference the MCSC Project apply to the project as a whole, including CHPRC, the CSS contractor, the WESF Modifications contractor, and the CSA contractor. Requirements and criteria that specifically reference CHPRC, the CSS contractor, the WESF Modifications contractor or the CSA 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.

The work performed under this FDC includes but is not limited to the following:

• Design, fabricate, and construct a passive CSS that will maintain the capsules in a dry configuration within acceptable temperature limits

• 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/fabricate transfer equipment for moving the CSS from WESF to the CSA

• Design and construct any necessary equipment to perform the CSS loading process.

2 Project Overview

2.1 Scope Summary

The MCSC Project will acquire capabilities needed to remove the cesium and strontium capsules from WESF and place the capsules into interim storage. The scope covered by this FDC includes the following:

• Design, fabricate, and supply the CSS, transfer equipment and associated ancillary equipment necessary to support retrieval, loading, and transfer of the capsules to interim storage.

MCSC Project 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 implement WESF modifications needed to support capsule retrieval, CSS loading, and transfer to the CSA for interim storage

• Perform regulatory activities and operational preparations necessary for capsule removal from WESF and implementation of interim storage.

The following scope is not included in the MCSC Project:

• Capsule transfer operations, including retrieval from existing storage, CSS loading and transfer to the CSA, and placement into the interim storage configuration

• WESF base operations, including capsule storage in the WESF pool cells

• WESF upgrades other than those specifically identified as being required to support the MCSC Project

• Decommissioning of WESF or the CSA

• CSA base operations

• Final disposition of the capsules

• Disposition of the capsule transfer equipment.
The MCSC Project will be completed when the capability is provided to place all capsules into interim storage at the CSA and project closeout is completed. Although the MCSC Project scope does not include final disposition of the capsules, the CSS 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 following general definitions pertain to the MCSC Project.

**Ancillary equipment:** Includes all associated or related equipment that is required to fully use and handle CSS components supplied for their intended purpose at WESF. This includes, but is not limited to: equipment for transfer of the empty Transportable Storage Canister (TSC) into the Vertical Concrete Cask (VCC); a frame or cradle to upend or position an empty Universal Capsule Sleeve (UCS) for loading and/or remote welding, as well as potential remote weld removal; lifting equipment including yokes (if used) and rigging; test equipment for vacuum testing or helium detection; seismic restraints (if required); and equipment used for component alignment.

Equipment used for component alignment shall also include any solution specific designed, fabricated, and delivered specialty WESF cover blocks, as allowed in the SOW and as may be reviewed and approved by CHPRC. The specialty designed cover block ancillary equipment shall conform and comply with applicable requirements of this FDC. Ancillary equipment may also include platforms or man-lift equipment necessary to complete CSS loading activities, miscellaneous pumps, hand tools, relief valves, hydrogen detectors, or other items as may be uniquely necessary for the proposed solution technology. Certain common items, e.g. cranes, man-lifts, etc., may be supplied as buyer furnished equipment (BFE) by CHPRC as allowed and agreed in the SOW and/or contract.

**Automated welding system:** The automated welding system (AWS) is used to perform field closure activities following loading of cesium and strontium capsules into the CSS.

**Capsule Storage Area:** The CSA includes the capsule storage pad (CSP) required for storage of the capsules within the CSS, as well as associated fencing, lighting, and road access. The CSA will include a prepared area around the pad sufficient for CSS operations, and surveillance and maintenance operations. This area may be graded, compacted gravel, or concrete, dependent upon usage and load requirements. The fencing will be used to limit radiological exposure to non-radiological workers from the CSS and will provide required physical security. The CSA shall include features to address storm water in a manner that does not interfere with the operation of the CSS (e.g. passive cooling).

**Capsule Storage Pad:** The CSP is the concrete foundation upon which the CSS will be placed for interim storage of the capsules. The CSP shall include features to address storm water in a manner that does not interfere with the operation of the CSS (e.g. passive cooling).

**Cask Storage System:** The CSS is the complete system that provides storage of the capsules for the required interim storage period. The CSS includes the TSC, TSC Basket (TSCB), and VCC. A loaded CSS will also include the UCS and capsules.

**Dry Transfer System:** The Dry Transfer System (DTS) is a shielded bell housing that will be used to transfer the UCS from the G Cell into a CSS located in the WESF truck port. The DTS will be moved using the existing canyon crane and is a component of the Ancillary Equipment package.
Safety class structures, systems and components: Safety class SSCs are defined by 10 CFR 830, “Nuclear Safety Management,” 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.”

Safety significant structures, systems and components: Safety significant SSCs are 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 structures, systems and components: Safety SSCs are defined by 10 CFR 830 to mean both safety class and safety significant SSCs.

Shielded Indexer Plate: The Shielded Indexer Plate (SIP) is a device which provides a shielded transfer interface between the DTS and the CSS. The SIP is positioned on top of the CSS and maximizes shielding by providing a pass-through within a shielded housing that is rotated to align with the individual tubes of the TSCB.

Transfer cask: A component that provides heat removal, shielding, and physical protection during transfer of a loaded TSC into a VCC or from a VCC into a transportation cask. The transfer cask is typically lifted via lifting trunnions and yoke. A transfer cask is not expected to be used to support the MCSC Project, but it is a component that could be used to support future transportation of the TSC off-site for final disposal or as a recovery action.

Transfer equipment: Used to move the loaded CSS from WESF to the CSA. It may also be used to move an unloaded CSS or a VCC. It includes equipment such as trailers, crawlers, or tow vehicles, including any restraint or tie-downs required to move the CSS and may include tugs, pushers or tractors used to move any trailer or dolly. SSCs used to protect the CSS from environmental conditions once it leaves WESF shall be included. Transfer equipment does not include temporary lifting yokes or rigging that are considered ancillary equipment (see also vertical cask transporter [VCT]).

Transportable Storage Canister: The TSC is designed to fit inside the VCC for storage and the transportation cask for transportation. The TSC houses the empty or UCS loaded TSCB.

Transportable Storage Canister Basket: The TSCB is commonly referred to as the basket. It is designed to house multiple UCS and is placed inside the TSC.

Transportation cask: A component that provides heat removal, shielding, and physical protection during off-site transfer of a loaded TSC to an alternate off-site location. The transportation cask is typically licensed in accordance with 10 CFR 71, “Packaging and Transportation of Radioactive Material,” for all Nuclear Regulatory Commission (NRC) defined transportation accidents for a list of approved contents. A transportation cask is typically lifted with lifting trunnions and yoke. A transportation cask is not expected to be used for the MCSC Project, but it is a component that could be used for future transportation of the TSC off-site for final disposition or as a recovery action.

Universal Capsule Sleeve: The UCS is designed to hold standard cesium/strontium capsules or Type W capsules. It is 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 TSC and VCC.
**Vertical Concrete Cask:** The VCC is the storage overpack that houses the TSC. The VCC provides radiological shielding, physical protection, and passive cooling for the TSC.

**Vertical Cask Transporter:** The VCT is part of the Transfer Equipment set of SSCs. It is a wheeled, towed hydraulic lift unit that is designed to lift and carry a CSS over the grade and road conditions existing at the site along the designated haul path. An aircraft gate tractor is typically provided as the prime mover of the VCT for all on site cask movements. The VCT interfaces with the CSS via two lifting lug sets bolted to the VCC top plate connected by engagement pins to two lift links on the VCT.

## 3 Descriptions of WESF and the Capsules

The MCSC Project shall use existing systems at WESF (225-B Building) to the extent that they are cost effective and practical to support capsule retrieval and loading for onsite transfer and interim storage. The WESF layout is depicted in Figure 3-1.

### 3.1 Capsule Description

Inventory of capsules within the MCSC Project 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 MCSC Project are identified in this section.

The capsules consist of a sealed inner capsule filled with either cesium chloride (CsCl) or strontium fluoride (SrF₂) 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 CsCl capsules have been sealed within an additional containment boundary, called a Type W overpack. Typical 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.
Table 3-1. Typical Capsule Properties

<table>
<thead>
<tr>
<th>Item</th>
<th>Initial Activity&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Containment Boundary</th>
<th>Material</th>
<th>Wall Thickness&lt;sup&gt;b&lt;/sup&gt; (in.)</th>
<th>Outside Diameter (in.)</th>
<th>Total Length (in.)</th>
<th>Cap Thickness (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CsCl Capsule</td>
<td>70 kCi Cs-137</td>
<td>Inner</td>
<td>316L</td>
<td>0.095, 0.103, or 0.136</td>
<td>2.250 or 2.255</td>
<td>19.725</td>
<td>0.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Outer</td>
<td>316L</td>
<td>0.109, 0.119, or 0.136</td>
<td>2.625, 2.645, or 2.657</td>
<td>20.775</td>
<td>0.4</td>
</tr>
<tr>
<td>SrF&lt;sub&gt;2&lt;/sub&gt; Capsule</td>
<td>90 kCi Sr-90</td>
<td>Inner</td>
<td>Hastelloy&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0.12 or 0.136</td>
<td>2.255</td>
<td>19.05</td>
<td>0.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Outer</td>
<td>316L&lt;sup&gt;d&lt;/sup&gt;</td>
<td>0.109, 0.119, or 0.136</td>
<td>2.625, 2.645, or 2.657</td>
<td>20.1</td>
<td>0.4</td>
</tr>
<tr>
<td>Type W Overpack</td>
<td>70 kCi Cs-137</td>
<td>Single</td>
<td>316L</td>
<td>0.125</td>
<td>3.25</td>
<td>21.825</td>
<td>0.4</td>
</tr>
</tbody>
</table>

Note: Capsule dimensions are nominal. See CHPRC-03594, *WESF Capsule Dimensions*, for exact dimensions and tolerances. Critical dimensions should be verified prior to use.

a. Capsule activity as measured at fabrication
b. The specified wall thickness of the capsules was changed during production.
c. Hastelloy is a registered trademark of Haynes International, Inc.
d. 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 SrF₂ 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 heated at approximately 800°C in argon for several hours. After cooling, the SrF₂ 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 SrF₂ 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.
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 generated by the capsules was approximately 262 kW. The MCSC Project shall assume capsule removal from WESF starting on January 1, 2021. Individual capsule decay heat values can be located in CHPRC-02248, *Estimate of WESF Capsule Decay Heat Values on January 1, 2018*. The capsules are currently managed as mixed high-level waste and are regulated under the *Resource Conservation and Recovery Act of 1976*.¹

Certain capsules may 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*

### 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 CSS 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 m² (14,000 ft²), and the second floor is 557 m² (6,000 ft²). 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.

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 movement 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 MCSC Project shall use existing systems at WESF to the extent that they are cost effective and practical to support capsule retrieval and loading for onsite transfer and interim storage. The anticipated facility configuration at the start of the MCSC Project 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 Sections 4 through 10 of this FDC.
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 SrF₂ 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. In 2017, A through F Cells were filled with grout to stabilize legacy contamination. Only G Cell remains operational.

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 MCSC Project Reference Drawing List

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

The canyon area has loose contamination requiring preventive measures to contain contamination when cover blocks are removed (see Section 3.2.7 for preventive measures regarding ventilation confinement). 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 SrF₂ 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 transfer casks, and conduct waste management activities. The processing cells are sequentially designated A through G. A through F Cells are filled with grout.

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 removable 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 mineral 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 system to move capsules between G Cell and Pool Cell 12 will be available for use by the MCSC Project. 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.

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 MCSC Project. 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 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.
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 by separating the canyon airspace from the outdoor air. A motor-operated 3.7 m (11 ft) wide roll-up door (4.6 m [14 ft] high) provides access to the outside. However, interferences inside the truck bay (HVAC ducting; wall-mounted equipment, electrical wiring, and instrument air lines; and the bulk of the door in the rolled-up position) restrict the usable space within the bay to nominally 10'-6" wide by 12'-0" high. 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 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 MCSC Project, 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 is provided in Figure 3-9.

![Figure 3-8. K1, K2, and K4 Ventilation](image-url)
Figure 3-9. K3 Ventilation

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.

The K3 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 K3 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 exhausts to the K1/K3 combined stack.

The canyon and G Cell operate as a single pressure control. System manipulation will be required to maintain ventilation balance while opening the G Cell man entry door or removing the G Cell cover block.

Canyon temperature during loading may be assumed to be 80° F.

Equipment and materials can be moved in and out of the canyon by removing the truck port coverblock. Residual contamination remains within the WESF canyon so the canyon is normally maintained at a lower pressure than the truck port for contamination control. When the truck port coverblock is removed, a 2.4 by 3.7 m (8 by 12 ft) opening is created between the canyon and the truck port (drawing H-2-66418-1, Structural Second Floor Plan Area 2). As long as the truck port outside doors remain closed, the K3 system can operate in this configuration and there will be some airflow between the truck port and the canyon. This configuration is not a normal condition and should not be maintained for a period greater than one shift. Provision should be made to limit the airflow between the truck port and the canyon if the truck port coverblock will be removed for greater than one shift. The truck port has existing supply dampers that can be adjusted to help obtain an acceptable differential pressure between the truck port and the canyon. The G Cell coverblock and the truck port coverblock shall not be removed at the same time.

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 MCSC Project.

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 K3 exhaust system has been reserved for a potential future additional ventilation skid to support the MCSC 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 MCSC Project major systems.

The MCSC Project 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.

Design of the CSS shall allow for future removal of the capsules for final disposition.

The selected CSS design approach consists of a UCS, TSC with TSCB, and a VCC. The UCS is a metal cylinder used to hold the capsules. The TSC is a canister that houses the TSCB and protects the UCS from normal, off-normal and accident conditions in conjunction with the VCC. The TSCB is the internal basket assembly which houses the UCS and which provides radial and horizontal capsule support and heat transfer functions within the TSC. The VCC is a vertical concrete cask into which a TSC is placed.
for storage. VCCs provide long term radiological shielding and physical protection for the TSCs which contain the UCSs containing the capsules. In addition, the VCC also provides a flow path for the internal circulation of air adjacent to the TSC for passive heat removal.

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

![Figure 4-1. Top-Level Process Functions](image)

The first step in the process entails acquisition/fabrication of the CSS in accordance with the requirements contained within this FDC. This is followed by the construction of the CSA under separate contract in accordance with CHPRC requirements as defined by CHPRC-02623. The CSA activities are inclusive of 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. In addition, in accordance with CHPRC-03011 and also under separate contract, required modifications to WESF shall be identified, designed, fabricated / constructed / installed, tested and documented as necessary, inclusive of the additional inputs based on the selected CSS. The remaining steps in the process entail retrieving and loading capsules into the UCS, transferring the loaded UCS into the TSC/TSCB/VCC, transferring the loaded CSS to the CSA, and placing the loaded CSS into the approved storage configuration at the CSA.

General requirements that apply to all process steps, such as contamination control and shielding, are identified in other sections of this document. Functional and any special requirements for the CSS are described in Sections 4.1 through 4.2. The throughput requirements are identified in Section 4.3.

The MCSC Project process shall ensure that CSS loading 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. If this cannot be achieved, 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 MCSC Project SSCs associated with the CSS shall be performed entirely by the CSS contractor in accordance with the CSS SOW. The parenthetical Section references identify the sections of this document which contain additional detail of the functions and requirements of the cited SSCs:
• MCSC Project CSS loading system, transfer equipment, and storage system (Section 4.1)
  – CSS loading system components, including the UCS
  – transfer equipment components, including the VCT, trailers, dollies, and tugs, pushers, or tractors
    used to move any trailer or dolly, etc.
  – storage system components

• Ancillary and other equipment (Section 4.2)
  – Special lift devices
  – Transfer equipment not otherwise addressed above and / or in Section 4.1
  – Equipment used for component alignment. Also included shall be any solution specific designed,
    fabricated, and delivered specialty WESF cover blocks as allowed in the SOW and as may be
    reviewed and approved by CHPRC. The specialty designed cover block ancillary equipment
    shall conform and comply with applicable requirements of this FDC.
  – Welding equipment
  – Vacuum drying and helium backfill equipment
  – Leak testing equipment
  – Pumps, gauges, relief valves, rigging, and measuring and test equipment
  – Cranes
  – Forklifts
  – Manlifts that may be unique and specific to the CSS contractor design.

The CSS contractor shall provide a complete engineering package as described in this FDC and the SOW
demonstrating that the CSS design is sufficient to meet the requirements and specifications of the project.

The CSS contract 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 CSS Loading System Components, Transfer Equipment, and Storage System

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. All CSS components (as well as transfer and ancillary
equipment) shall be compatible with respect to functions and materials.

Some requirements for the CSS are derived based on assumptions related to potential future deep
borehole disposal of capsules. These assumptions are based on information provided in SAND2015-6009,
Deep Borehole Field Test Requirements and Controlled Assumptions, and SAND2015-8332,
Groundwork for Universal Canister System Development.

4.1.1 CSS Loading System Components

The CSS 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 the CSS components to allow common handling equipment. Internal variations to the UCS/TSCB 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 CSS 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 4-2 have been established to keep the salts within the capsules from melting. The temperature limits also serve to limit the potential for capsule overpressurization resulting from a cesium chloride volume expansion due to a solid phase transformation. Temperature limitations of the capsule stainless steel shall also be considered.

An individual UCS 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 reloading. No more than three capsules can be placed in a single layer.

A proof-of-dryness test demonstrates that each UCS 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 CSS 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. These features include:

- Suitable access to the annular space between the TSC and VCC for insertion of remote inspection, test and repair equipment
- Suitable spacing between the TSC and VCC for performing remote inspection, test and repair activities
- The annular space between the TSC and VCC shall allow access (free of obstruction) to the TSC fabrication welds for remote inspection, test and repair equipment and activities.

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 exit air temperatures of CSSs. This shall include temperature monitoring devices at outlet air vents of all CSSs.

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. The definition of “accident conditions” is situational specific and a critical element of the safety basis, authorization basis, and design basis of all designated safety SSCs. Examples include, but are not limited to ‘accident conditions’ associated with the transportation of radioactive materials on the Hanford site (e.g. a load tipping over during travel); during the loading of a UCS/TSC (e.g. ‘hung’ load or dropped load), etc.
Specific accident conditions have been identified and analyzed in accordance with DOE-STD-1189-2008, *Integration of Safety Into the Design Process*; DOE-STD-1195, *Design of Safety Significant Safety Instrumented Systems Used at DOE Non-Reactor Nuclear Facilities*; and other requirements documents as noted in Sections 6 (in particular 6.6.5 and 6.7), 7 and 8 of this document. The MCSC-specific strategy is described in CHPRC-02236, *Waste Encapsulation and Storage Facility Management of Cesium and Strontium Capsules (Project W-135) Safety Design Strategy*.

Based on the capsule data provided in CHPRC-02248, and in consideration of the expected January 1, 2021 loading date, the CSS contractor is responsible for selecting the capsules to be stored in each UCS/TSC and for providing heat load and structural calculations for each UCS/TSC. Therefore, it is the CSS contractor’s responsibility to determine the total quantity of UCS/TSCs required for the project.

The CSS contractor is responsible for designing a CSS for the WESF capsule payload meeting the structural and thermal limitations of the codes and standards applicable to their existing CoC for storage, and the requirements of this FDC. Wherever CoC is used and cited in the balance of this FDC, the preceding requirement and basis shall be implied. Appropriate structural and thermal calculations must be performed to demonstrate that these requirements have been met. The CSS contractor may choose specific combinations of capsules from the WESF inventory to place in individual UCS/TSCs (e.g., combinations of “hot” and “cold” capsules) to achieve these requirements, within the limitations established in this FDC. A single structural analysis using bounding conditions, or a set of structural calculations, each of which bounds a family of capsule/UCS/TSC combinations with common conditions, is acceptable, provided that the CSS contractor can demonstrate that the calculation bounds all pertinent capsule characteristics.

### 4.1.1.1 UCS/TSC

UCS/TSCs 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 UCS/TSCs shall be designed for storage and transfer of the WESF capsules described in this FDC document and shall meet the conditions of service and environmental loads of the Hanford Site.

The UCS shall be designed to hold no more than three capsules per layer. It shall be a right circular cylinder with a maximum outside diameter of 21.21 cm (8.35 inches), a nominal height/length of 56.388 cm (22.2 inches), and a maximum height/length of 497.84 cm (196 inches), including any lifting features; less any dimensional tolerances required to allow close tolerance emplacement into a waste package / disposal overpack. This requirement is based on assumptions related to potential future deep borehole disposal of capsules.

The maximum weight of a filled UCS shall be less than 861.83kg (1,900 lb). This requirement is based on assumptions related to potential future deep borehole disposal of capsules.

The external edges of the UCS shall have a radius of curvature sufficient to protect against gouging of the internal surfaces of any container into which it is placed, and the external surface finish shall be prepared so as to minimize contamination trapping and facilitate decontamination should it be necessary (e.g. RMS 50 / less than an N value of 7, or better). This requirement is based on assumptions related to potential future deep borehole disposal of capsules.

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

The UCS/TSC shall be designed to store the capsules safely for the established design life.
The UCS and/or the TSC shall be designed for welded closure. External welds on the UCS/TSC except the closure welds shall be treated to remove residual stresses prior to loading to mitigate the potential for stress corrosion cracking as required by ASME code for material fabrication and examination.

The UCS loading process shall establish a drying condition of a maximum of 10 torr held for 10 minutes (when the UCS is isolated from the vacuum system and the vacuum pump is turned off). Following the successful dryness test, the UCS shall be evacuated to < 3 torr prior to inert gas backfill. The basis of this requirement is a standard established and approved by the NRC and the commercial nuclear industry to define an internal dryness adequate to prevent corrosion of zirconium cladding. This dryness standard is assumed valid for stainless steel.

The UCS and TSC, if required, shall each use a sufficient quantity of inert gas (typically helium) to provide adequate cooling and of a quality sufficient to support the heat transfer process. If inert gas is required, then the UCS and/or TSC sealing method shall ensure that the inert gas will be retained until calculations show that it is no longer needed to maintain required temperatures.

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

The UCS and TSC shall each be conspicuously marked with the following information:

- Model number
- Unique identification number
- Empty weight.

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

The UCS/TSC shall be designed with means for attaching lifting devices to facilitate UCS/TSC transfer operations. The lifting features shall be designed in accordance with DOE-STD-1090-2011, *Hoisting and Rigging*, ANSI N14.6, *Radioactive Materials – Special Lifting Devices for Shipping Containers Weighing 10,000 Pounds or More*, and DOE/RL-92-36, *Hanford Site Hoisting and Rigging Manual*, for lifts both empty and loaded. The UCS/TSC lifting features shall not protrude beyond the UCS/TSC side walls and shall be incorporated into the TSC top lid for a loaded TSC. This requirement is based on assumptions related to potential future deep borehole disposal of capsules.

UCSs shall be designed to minimize the time required for vacuum drying.

The UCS shall be designed, made of materials, constructed and fabricated from 316L stainless steels compatible with the materials used for the outer cesium and strontium capsules to prevent significant chemical, galvanic, or other reactions between or among the storage system components or the capsules including possible reaction with water during the storage period.

Organic, hydrocarbon-based material shall not be used or placed in the UCS/TSC. This requirement is based on assumptions related to potential future deep borehole disposal of capsules.

The TSC shell (316L stainless steel) shall be fabricated using welding processes and schedules that avoid excessive heat input in order to preclude significant material sensitization. Efforts shall be taken to limit the number of weld repairs during shell fabrication. Weld repairs, when made, shall be documented, to include the following information:
• Description of the repair to include size – length, width and depth

• Location of the repair (weld map or other means) such that the repaired area can be identified and located during in-service inspection after the CSS is placed into service

• TSC shell fabrication shall consider use of Surface Stress Improvement (SSI) or other techniques to improve TSC shell weldment corrosion performance.

The UCS (including the UCS lifting feature) shall be able to bear the weight of the number of UCSs that could be stacked on top of it in a disposal configuration, as shown in Table 4-1, below. This requirement is based on assumptions related to potential future deep borehole disposal of capsules.

<table>
<thead>
<tr>
<th>Height of UCS, in Terms of Capsule Lengths</th>
<th>Number of UCSs That Could Be Stacked on Top of Bottom UCS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 capsule length</td>
<td>7 UCSs</td>
</tr>
<tr>
<td>2 capsule lengths</td>
<td>3 UCSs</td>
</tr>
<tr>
<td>3 capsule lengths</td>
<td>2 UCSs</td>
</tr>
<tr>
<td>4 capsule lengths</td>
<td>1 UCS</td>
</tr>
<tr>
<td>5 – 9 capsule lengths</td>
<td>0 UCSs</td>
</tr>
</tbody>
</table>

Safety class and safety significant UCS/TSC SSCs 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 UCS and TSCB/TSCs

• Fixtures for transfer of the empty or loaded UCS/TSC into the VCC

• A frame or cradle to upend or position an empty or loaded UCS

• Equipment for remote welding and potential remote weld removal

• Lifting equipment including yokes (if used) and rigging

• Test equipment for vacuum testing or helium detection

• Seismic restraints (if required)

• Equipment used for component alignment inclusive of but not limited to any solution specific designed, fabricated, and delivered specialty WESF cover blocks as allowed in the SOW and as may be reviewed and approved by CHPRC. The specialty designed cover block ancillary equipment shall conform and comply with applicable requirements of this FDC.
Ancillary equipment may also include platforms or man-lift equipment necessary to complete CSS loading activities, miscellaneous pumps, hand tools, relief valves, hydrogen detectors, or other items as may be uniquely necessary for the proposed solution technology. Additional requirements regarding Ancillary Equipment is found in Section 4.2 of this FDC.

4.1.2 Transfer Equipment

The CSS contractor shall provide the design and fabrication for equipment which enables transfer of the loaded CSS from WESF to the CSA and placement into the interim storage configuration. This equipment shall include all necessary transfer equipment, ancillary equipment, and other items necessary for system SSC movement.

Transfer equipment is all equipment used to move the CSS from WESF to the CSA. The transfer equipment may also be used to move an unloaded CSS or VCC. 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 CSS; SSCs used to protect the CSS from environmental conditions once it leaves WESF shall be included.

Transfer equipment does not include temporary lifting yokes or rigging that are considered ancillary equipment. Section 4.2 provides additional requirements associated with 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 transfer 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 providing bounding ground loads for the VCT as design input to CHPRC so that CHPRC can ensure that they 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 equipment and activities shall comply with DOE/RL-2001-36, Hanford Sitewide Transportation Safety Document.

4.1.3 Storage System Components

4.1.3.1 VCC

The VCC may be oriented only in a vertical storage configuration.

The VCC 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 VCC 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, ANSI N14.6, and DOE/RL-92-36 for lifts when loaded.

The VCC shall be designed to meet the conditions of service and provide the environmental protection necessary for the UCS/TSC.
The VCC shall be designed to provide adequate passive heat removal capacity without active cooling systems during storage conditions.

The VCC shall be designed to contain and protect the UCS/TSC and stored capsules for the term required per this specification.

The VCC shall be conspicuously marked with the following information:

- Model number
- Unique identification number
- Empty weight.

The VCC shall be labeled to comply with marking requirements from the Resource Conservation and Recovery Act of 1976 (RCRA) permit.

The VCC shall be designed to minimize radiation streaming.

The VCC 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.

VCC SSCs 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 UCS 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. It is not intended that a visual inspection internal to each UCS after loading be conducted. The CSS contractor is expected to provide the systems and capability to visually record the required ID information at the time of loading and that a verification or validation process and capability be provided to assure that the location of a specific capsule is tied to a specific UCS/TSC into which it has been loaded. For example (but not to be considered the only solution), a video record of the capsule ID at the time of loading into a UCS, along with a continuous video record of the UCS up to and including its loading into a TSC, coupled with an audio record of the specific capsule ID, basket ID (if applicable) and UCS ID with time stamps of movement, etc. The CSS contractor shall provide a solution that meets the requirement.

Equipment to ensure that capsules will fit into the required storage configuration will be required (e.g., roundness and straightness gauging), therefore the CSS contractor must identify any external capsule dimensional verifications required to support their concept. The CSS contractor shall ensure that the provided solution has the means to check in-field each capsule to assure that it would fit into their basket assemblies as designed thereby not adversely affecting system solution performance.
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 4-2, are not exceeded during movement and storage of the capsules (WMP-16939).

<table>
<thead>
<tr>
<th>Activity</th>
<th>Strontium Capsules</th>
<th>Cesium Capsules</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accident conditions</td>
<td>800°C</td>
<td>600°C</td>
</tr>
<tr>
<td>Processing, including process upset</td>
<td>540°C</td>
<td>450°C</td>
</tr>
<tr>
<td>Interim storage configuration, summer storage conditions as described in the current and archival data housed within the HMS web-accessed database.</td>
<td>540°C</td>
<td>317°C</td>
</tr>
</tbody>
</table>

Source: HMS, 2011, “Hanford Meteorological Station” website.

HMS = Hanford Meteorological Station

A UCS/TSC design may be developed that will accept a bounding array of capsules within a UCS/TSC. Alternately, blending of high- and low-heat capsules within a UCS/TSC (i.e. purposeful selection and loading of specific capsules) to meet temperature requirements is acceptable. If blending is used, a 10 percent margin shall be added to the estimated decay heat to ensure temperature limits are not exceeded, and a complete loading sequence of all capsules shall be addressed within the thermal analysis. A smaller margin may be used with CHPRC approval.

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 interim storage conditions while not exceeding the thermal limits indicated in Table 4-2.

Additional cooling systems or subsystems may be needed for the capsule heat load rejection, particularly in the G-Cell during UCS loading or staging of the UCS after loading.

The CSS 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 4-2 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 interim storage configuration temperature limits shown in Table 4-2, followed by a temperature decrease below the temperature limit. It is important to note that thermal cycling is not an event where the processing (including process upset conditions) thermal limits are exceeded, nor an event wherein the accident condition thermal limits are exceeded. The design solution offered shall meet the requirements stated in Table 4-2 while using only passive systems as stated.

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.

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 determine if vent blockage has occurred. As a result, design efforts shall provide the features necessary for implementation of this method. Requirements for the temperature monitoring system are provided in Section 4.1.4.3.

### 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 resistance thermal detectors [RTD]), and the centralized monitoring/recording system for receiving temperature signals at the CSA from the CSS and from ambient air temperature monitors. 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.

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 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.

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

The temperature monitoring system has been designated Safety Significant and shall be designed to the appropriate standards as specified in Section 6.1.3.

The CSP is being designed to accommodate up to 25 CSSs. The TMS shall also be designed with the capacity to monitor up to 25 CSSs.

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 ambient and outlet temperature difference over time
• Historical record keeping of system temperatures and alarms for a minimum of a 6-month period (assuming a sample rate of once per hour for each temperature monitored), with a means to generate data meeting permanent data archival requirements
• Local annunciation of any storage system alarm condition
• Capability to provide signals for remote annunciation of an off-normal condition or failed instrument signal at a remote 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 4-2 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
• Design and selection of temperature monitoring system components shall consider the maximum radiation dose that the components are expected to receive
• Equipment shall be rated for outdoor service with an ambient temperature range of 115°F to -25°F.
• 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 nuclear safety documentation
• Temperature-indicating displays shall be daylight readable if they are located outdoors.

There is a critical interface between the CSS contractor and the CSA 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 temperature monitoring system design.

Relative to the above mentioned critical interface, and for the benefit of the CSS contractor, the temperature monitoring system shall be installed by CHPRC. Therefore, the CSS contractor shall provide the following information to CHPRC:
• Any specific design and/or operational requirements necessary to house the CSS vendor monitoring/recording system and provide accessibility as required to allow evaluation of CSS temperature conditions
• Any specific design and/or operational requirements necessary to allow CHPRC to design and install all conduit/cabling required to provide power to the CSS temperature monitoring/recording system
Any specific design and/or operational requirements necessary to connect the temperature monitoring/recording system from the CSS and the ambient air temperature monitors to the local annunciation, monitoring and recording at the CSA

Any specific design and/or operational requirements necessary to design and install a remote annunciation system.

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 UCS/TSC shall be designed to maintain its containment when subject to worst case design loads for the UCS/TSC, without taking credit for the corrosion allowance.

Applicable codes, standards, margins, methods, and materials consistent with the CoC for storage as noted in Section 4.1.1 above 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 CSS 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 UCS/TSCs). Where the surface is not stainless steel, coatings shall be used as appropriate 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 CSS shall be those identified in the NRC-issued CoC for storage 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 design shall minimize fluence-enhanced degradation of structural and weld materials.

The UCS 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 UCS 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 CSS shall provide containment appropriate to ensure retention of the CsCl and SrF₂ under all design basis conditions. The capsules shall be assumed to maintain the gross configuration of the salts, but the design should address the possibility of some leakage of radioactive material outside the capsule during storage. The UCS 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 cesium or strontium salts with the UCS 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 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 inner closure weld shall be helium leak checked and the outer closure weld shall be subject to ultrasound inspection. If deviation or exception to inspection requirements is required, a justification for the deviation/exception shall be documented and provided to CHPRC for review and approval as a part of the design review process.

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 CoCs 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. Therefore the CSS contractor must be able to demonstrate that there are no credible leakage scenarios under on-site movement and storage evolutions and conditions. It is intended that the CSS contractor make best use of their current design basis and CoC approved systems to the maximum extent possible, inclusive of alternative codes and standards that have been NRC approved as a part of their approved design and CoCs. The CSS contractor must demonstrate that their current design basis and CoC based systems, as modified to meet the requirements for use at Hanford with the payload represented by the WESF capsules, meet the contract and FDC stipulated requirements, or their engineered equivalent, as reviewed and approved by CHPRC.

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 UCS/TSCs within required temperatures (see Table 4-2) during the UCS/TSC’s respective closure and inspection period shall be provided to maintain capsules within temperature limits.

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.

CHPRC recognizes that the contractor existing storage systems licensed under 10 CFR 72, “Licensing Requirements for the Independent Storage of Spent Nuclear Fuel, High-Level Radioactive Waste, and Reactor-Related Greater than Class C Waste,” meet applicable radiation protection requirements described in 10 CFR 72.24, “Contents of Application: Technical Information,” (and by reference, 10 CFR 20, “Standards for Protection Against Radiation”) for the contents allowed by their existing CoC for storage, including the loading and handling operations associated with these contents. The WESF capsules and their loading and handling operations may differ from the characteristics, loading and handling operations of the existing allowable contents. Also, DOE facilities are subject to 10 CFR 835, “Occupational Radiation Protection,” not 10 CFR 20. Therefore, at a minimum, the CSS contractor will be required to perform an evaluation to demonstrate that the WESF CSS falls within the bounds of an existing as low as reasonably achievable (ALARA) analysis that meets the requirements of 10 CFR 835. If not, an updated analysis will be required. The CSS contractor shall perform specific radiation dose calculations for each storage system with the anticipated actual capsules loaded in each UCS/TSC.

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 transfer and loading shall not exceed 100 mrem/hr on contact and are further subject to an ALARA decision making process.

The CSS contractor shall include physical design features that will limit occupational exposure during the CSS 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.

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

4.2 Ancillary and Other Equipment

4.2.1 Special Lift Devices

The CSS contractor shall design, fabricate, and furnish a lifting yoke (if used) and a yoke adapter (if required) for use between the WESF building crane(s) hook and CSS equipment. The CSS contractor shall design, fabricate, and furnish a lifting yoke for movement of a loaded UCS/TSC and/or CSS integrated package system if required for movement of that item. The CSS contractor shall design, fabricate, and furnish any other lifting yokes and adapters (including but not limited to UCS/TSC 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 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. The number of new safety class, safety significant, or defense-in-depth SSCs should be minimized.

4.2.2 Capsule Handling Equipment and Equipment Used for Component Alignment

4.2.2.1 Capsule Handling Equipment

WESF capsule handling equipment is available for use. The CSS contractor shall provide any additional equipment necessary for transfer of capsules to the UCS/TSC. The CSS contractor will comply with design standards appropriate for the equipment 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. The number of new safety class, safety significant, or defense-in-depth SSCs should be minimized.

4.2.2.2 Equipment Used for Component Alignment

This category of ancillary equipment shall consist of any solution specific designed, fabricated, and delivered specialty equipment that facilitates component alignment in support of capsule transfers. Also
included in this category of ancillary equipment shall be any solution specific WESF cover blocks as allowed in the SOW and as may be reviewed and approved by CHPRC.

In the event that specialty designed cover block ancillary equipment is required, the following functional design criteria and limitations shall be met:

- **Weight.** Modified cover blocks shall generally weigh no more than the original cover blocks unless detailed justification provided and accepted by CHPRC.

- **Size/dimensions.** Modified cover blocks, if shaped/sized differently than the original cover blocks, shall be designed such that there are no dimensional conflicts with regard to movement, placement and storage when removed. Modified cover blocks shall also be designed such that their effect on WESF HVAC system flows, when either removed or installed, does not impact the current HVAC system design. Modified cover blocks shall be sized so that they can be placed inside the WESF canyon through existing openings.

- **Material shielding properties.** The cover block concrete elemental formulation/composition is critical to radiation shielding properties for a given cover block thickness. Modified cover blocks shall thus be evaluated for shielding properties to ensure that they provide the same or greater degree of shielding as original cover blocks. If operational and/or design integration considerations require reduced thickness and/or reduced shielding properties, provision shall be made for temporary shielding as may be required during MCSC Project activities. A detailed ALARA analysis shall be documented and approved prior to proceeding with such a design.

- **Thickness.** As discussed under the topic of size, modified cover blocks shall generally be of the same or lesser thickness as the original cover blocks. If modified cover blocks are to be thinner than the originals for any reason such as to allow greater handling/maneuvering flexibility during removal/replacement operations, their material shielding properties (also discussed above) shall be enhanced from the original cover blocks such that they provide the same or greater degree of shielding. This shall be documented by means of independently peer-reviewed shielding calculations. Shielding calculations may be performed using appropriate and NRC validated radiation transport software.

- **Interlocking features.** Modified cover blocks shall have an interlocking design as do the original cover blocks to minimize radiation shine via cracks/seams between blocks. Dimensional tolerances for modified interlocking cover blocks shall be identical or tighter than the original WESF cover block design, but shall not excessively impede design air flow rates and vectors (see following item).

- **Impact on K-3 ventilation system performance.** Cover block modifications shall maintain the design envelope for air flow and vector with cover blocks both in place and removed, as required, for MCSC Project activities.

- **Interchangability.** Modified cover blocks shall not preclude the re-installation of the original cover block.

### 4.2.3 Welding Equipment

The CSS contractor shall provide remote welding equipment capable of the operations needed for UCS and/or TSC sealing activities. The system shall be capable of producing the required weld quality on a consistent basis, with minimal or no process upset or interruption. The CSS contractor shall select a suitable welding technology to meet this criteria which may include fusion welding (such as gas tungsten...
arc welding) or solid-state welding (such as friction stir welding), or other technologies. Welding may take place in G Cell, the canyon, or in the truckport.

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. The number of new safety class, safety significant, or defense-in-depth SSCs should be minimized.

### 4.2.4 Vacuum Drying and Helium Backfill Equipment

The CSS contractor shall provide a UCS/TSC vacuum drying system (VDS) and helium backfill equipment 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 equipment 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 (if required based on volume to be evacuated)
- Stainless steel fittings
- Vacuum sensors
- Two compound pressure gauges
- Dropout tank with sight glass (if required based on amount of moisture expected)
- 30.5 m (100 ft) of vacuum hose
- 99.995 percent quality helium source.

The VDS shall have an ultimate total pressure less than or equal to 1.15 torr. The VDS and helium backfill equipment shall also include multiple isolation valves to manipulate flow in any direction, if required due to multiple connection points.

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. The number of new safety class, safety significant, or defense-in-depth SSCs should be minimized.

### 4.2.5 Leak-Testing Equipment

The CSS contractor shall 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 UCS and/or TSC as required by the design.

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. The number of new safety class, safety significant, or defense-in-depth SSCs should be minimized.
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-STD-1090-2011 and 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 load test report by the component manufacturer that demonstrates compliance with the requirements of DOE-STD-1090-2011 and DOE/RL-92-36.

4.2.7 UCS/TSC Cool-Down Equipment

The CSS contractor shall provide UCS/TSC cool-down equipment capable of supporting UCS/TSC loading 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 (ensuring that the temperature limits of Table 4-2 are not exceeded). The CSS contractor may propose a cooling gas other than helium as an alternative, provided that all other requirements (e.g. thermal, safety, operational, etc.) are met and that the alternative proposal is consistent with the technical specifications and procedures associated with the CSS contractor’s CoC enveloped systems.

4.2.8 Calibrated Equipment

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

4.2.9 Other Equipment

Table 4-3 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>
<thead>
<tr>
<th>Ancillary Item</th>
<th>Contaminated (Yes/No)</th>
<th>Location Used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annulus Shield</td>
<td>N</td>
<td>Loading Area</td>
</tr>
<tr>
<td>Hydrostatic Test System</td>
<td>N</td>
<td>Loading Area</td>
</tr>
<tr>
<td>Fill Pump System</td>
<td>N</td>
<td>Loading Area</td>
</tr>
<tr>
<td>Pump Down System</td>
<td>Y</td>
<td>Loading Area</td>
</tr>
<tr>
<td>Water Circulation System</td>
<td>Y/N</td>
<td>Loading Area</td>
</tr>
</tbody>
</table>

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. The number of new safety class, safety significant, or defense-in-depth SSCs should be minimized.
All equipment shall be compatible with existing WESF equipment.

Other equipment that may also be required includes mobile cranes, forklifts, and manlifts used for the handling, assembly, and movement of materials and equipment. This type of equipment shall be provided as BFE in most cases. In the event that this type of equipment is unique to the contractor and specialized and specific to the provided solution, then the contractor shall provide such equipment. All such lifting equipment shall comply with the requirements of DOE-STD-1090-2011 and DOE/RL-92-36.

4.3 Throughput Requirements

The MCSC Project 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. The CSS loading and transfer schedule for this 52-week operational period shall allow for anticipated system downtime for routine maintenance as well as an allowance for unexpected events such as ventilation or electrical outages, upset conditions, unexpected radiological conditions, and stop work events. The loading and transfer schedule may be extended beyond 52 weeks with CHPRC concurrence.

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. The CSS contractor-prepared 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 CSA and WESF Modifications design contractors, 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, including safety basis limits.

• WESF Operations – Any planned physical modifications to any of the existing WESF facility SSCs requires coordination and the approval of CHPRC.

• Canister Storage Building (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 MCSC Project environmental permitting requirements.

• MSA – MSA is responsible for Hanford Site transportation safety and approval of transportation permits. Movement 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 inputs and interface data for the design and construction of the CSA and any required WESF modifications. The CSA/WESF Modifications contractors will receive design inputs related to the CSS, CSS 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 CSS components 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 transferring 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 MCSC Project 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 70-2008, 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. The CSS design shall be within the bounds of the existing safety basis whenever possible.

The CSS contractor shall identify potential impacts to existing WESF SSCs as soon as possible to ensure that appropriate design input can be provided to the WESF Modifications design contractor. Potential impacts can include utility needs, electric power needs, space requirements, ventilation or cooling needs, new heat loads or radiation fields that could negatively affect existing equipment, increased duty cycles or usage, or additional radiation shielding. The CSS contractor shall minimize any impacts to existing SSCs.

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 phenomena 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 CSS loading activities.
The CSS shall not require an active HVAC system to provide radioactive material confinement. Heat removal from the capsules during interim 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 MCSC Project design.

<table>
<thead>
<tr>
<th>Handling Equipment</th>
<th>Safety Significant</th>
<th>Safety Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cranes</td>
<td>Applicable CMAA standards; ASME NOG-1, ASME NUM-1, ASME B30.2; DOE-STD-1090</td>
<td>Applicable CMAA nuclear standards; ASME NOG-1, ASME NUM-1, ASME B30.2; DOE-STD-1090</td>
</tr>
<tr>
<td>Other Equipment</td>
<td>ANSI N14.6; ASME B30 Series; DOE-STD-1090</td>
<td>ANSI N14.6; ASME B30 Series; DOE-STD-1090</td>
</tr>
</tbody>
</table>

Note: Complete reference citations are provided in Section 13.

CMAA = Crane Manufacturers Association of America, Inc.

All cranes, hoists, and lifting devices designed to handle casks and CSS components and to facilitate movement of the same within MCSC Project 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 MCSC Project design.

<table>
<thead>
<tr>
<th>Structures</th>
<th>Safety Significant</th>
<th>Safety Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete</td>
<td>ACI 318</td>
<td>ACI 349</td>
</tr>
<tr>
<td>Steel</td>
<td>ANSI/AISC 360; AISC-325</td>
<td>ANSI/AISC N690</td>
</tr>
</tbody>
</table>

Note: Complete reference citations are provided in Section 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 MCSC Project 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 MCSC Project 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 Section 10 of this FDC.

6.1.3 Instrumentation and Control Systems

The CSS contractor shall include instrumentation and controls required to support capsule loading activities and long-term storage. Instrumentation may be located locally to the equipment it supports and/or at control panels, as determined by the design. The design of control devices shall conform to the General Industry safety requirements as specified in 29 CFR 1910, “Occupational Safety and Health Standards,” and DOE-0359, *Hanford Site Electrical Safety Program (HSESP)*.

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 MCSC Project design.

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

<table>
<thead>
<tr>
<th>Instruments, Controls, and Alarms</th>
<th>Safety Significant</th>
<th>Safety Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardware</td>
<td>Applicable NFPA codes and standards; ANSI/ANSI-58.8, ANSI/ANSI-59.3, ANSI N13.1, ANSI N323D; ANSI/ISA-Series including ANSI/ISA-67.04.01 and ISA TR 84.00.06; IEEE C2; IEEE-N42.18, DOE-STD-1020-12; and DOE-STD-1195 (implements ANSI/ISA-84.00.01)</td>
<td>Applicable NFPA codes and standards; ANSI/ANSI-58.8, ANSI/ANSI-59.3, ANSI N13.1, ANSI N323D; ANSI/ISA-Series including ANSI/ISA-67.04.01 and ISA TR 84.00.06; IEEE C2; IEEE-N42.18, DOE-STD-1020-12; and DOE-STD-1195 (implements ANSI/ISA-84.00.01)</td>
</tr>
</tbody>
</table>

Note: Complete reference citations are provided in Section 13.

NFPA = National Fire Protection Association

### 6.1.4 Electrical

The MCSC Project 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 70-2008 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 NRC review and approval of their systems. It should be noted that during the MCSC Project 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 UCS/TSC and the VCC. The UCS/TSCs 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 VCC shall be capable of storing the UCS/TSC for up to 100 years without the need to reload.

Appropriate analysis, with peer-reviewed referenced scientific studies, publications from DOE national laboratories, or publications from appropriate industry research organizations (e.g., Electric Power Research institute [EPRI]), shall be provided to demonstrate compliance with the required design life. This shall include an analysis of each component and item within the CSS 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 CSS system components that are modified/adapted directly from commercially available Dry Cask Storage Systems, specifically, use the identical design principles, use the same materials, use the same fabrication processes, and use the same quality control standards, the CSS contractor shall be allowed to rely on the NRC’s extensive work in establishing the required design life. The corresponding components in the commercially available Dry Cask Storage Systems are subject to the NRC’s operations-based aging management, so any operational lessons learned, systemic issues, or later-developed testing protocols can be incorporated into the CSS over its design life.

For the UCS/TSC, consideration shall be provided for temperature variations inside and outside, irradiation effects, galvanic corrosion, residual stresses in welds and the heat-effected zones, residual moisture within the UCS following drying, possible loss of helium during the storage period, and chloride deposition causing corrosion.

For the VCC, consideration shall be provided for temperature variations inside and outside, irradiation effects, galvanic corrosion (if applicable), residual stresses in welds and the heat-effected 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 equipment 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.


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 CSS 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 MCSC Project 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.

The CSS shall be designed to be passive. Thermal cooling is provided by natural circulation that allows for heat removal. Maintenance requirements for the CSS 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 loading, UCS transfer to the TSC/VCC, TSC/VCC closure, CSS transfer to the CSA, 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 CSS loading 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 transfer, and at the CSA. Due to the high dose rates associated with the capsules, all capsule handling and loading 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 CSS loading, UCS and/or TSC closure welding, UCS transfer to the TSC using the DTS, TSC/VCC closure, and CSS 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 µSv) 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

CHPRC recognizes that the contractor existing storage systems licensed under 10 CFR 72 meet applicable radiation protection requirements described in 10 CFR 72.24 (and by reference, 10 CFR 20) for the contents allowed by their existing CoC for storage, including the loading and handling operations associated with these contents. The WESF capsules and their loading and handling operations may differ from the characteristics, loading and handling operations of the existing allowable contents. Also, DOE facilities are subject to 10 CFR 835, not 10 CFR 20. Therefore, at a minimum, the CSS contractor will be required to perform an evaluation to demonstrate that the WESF CSS falls within the bounds of an existing ALARA analysis that meets the requirements of 10 CFR 835. If not, an updated analysis will be required.

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 should be performed during the design process to demonstrate that the design is ALARA.

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 CSS 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

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 new safety SSCs at WESF may be necessary based on the results of the hazards analysis. CSA is expected to be passive with no active safety SSCs.

6.6.5 Safety Analysis
MCSC Project 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 MCSC Project will be managed under the requirements of DOE-STD-1189-2008, Integration of Safety Into the Design Process. The MCSC Project-specific strategy is described in CHPRC-02236.

6.7 Natural Phenomena Criteria
The natural phenomena criteria for MCSC Project SSCs shall be established and implemented as specified in PRC-PRO-EN-097, Engineering Design and Evaluation (Natural Phenomena Hazard), using Seismic Design Category (SDC)-2/Limit State (LS) C criteria as described below.

6.7.1 Seismic
DOE-STD-1189-2008 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 CSS and CSA.

DOE-STD-1189-2008, 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 ANS-2.26 be used for selection of the appropriate LS for SSCs performing the safety functions specified. The resulting combination of SDC and LS selection provides the seismic design basis for SSCs to be implemented in design through ASCE/SEI 43-05.
This text has been interpreted to state that the SDC is to be assigned based on DOE-STD-1189-2008, 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-1189-2008, 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 which includes the CSS and CSP.

**Limit State Determination:** Section 5 and Appendix B of ANS 2.26 were reviewed to support determination of an LS. LS C for building structural components was chosen for the CSA pad. The Section 5 definition of LS C for buildings and structural components is that the SSC retains nearly full stiffness and retains full strength, and the passive component it is supporting will perform its normal and safety functions during and following an earthquake. LS C for structures or vessels for containing hazardous material was chosen for the CSS. The Section 5 definition of LS C for structures or vessels containing hazardous material is applicable to low-pressure vessels and tanks with hazardous contents where a release may potentially injure workers. Damage will be sufficiently minor and usually will not require repair.

The CSS components (UCS, TSC, TSCB, and VCC), the temperature monitoring system, and the CSP have been identified as safety significant in CHPRC-03293, *Conceptual Safety Design Report for the Capsule Storage Area*.

The interim 2500-year horizontal response spectra provided in PRC-PRO-EN-097 Figure D-1 and the associated Table D-5 should be used as required and identify a peak horizontal ground acceleration of 0.2826g.

The 225-B Building is credited as safety significant to survive a design basis earthquake (0.25 g peak horizontal ground acceleration). Engineering documentation and seismic criteria for the WESF modifications will comply with PRC-PRO-EN-097 and will consider the failure effects of the interfacing CSS components particularly if the seismic criteria is different.

**6.7.2 Natural Phenomena Other Than Seismic**


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.

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


Designs consistent with the program requirements of DOE O 430.1C 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.

The MCSC Project 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
- MCSC Project 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 NRC 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.

7 Nuclear Safety Requirements

7.1 Nuclear Safety

The MCSC Project shall comply with the requirements of 10 CFR 830 and DOE-STD-1189-2008, 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. CHPRC-03293 includes an initial list of safety equipment. The CSS components (UCS, TSC, TSCB, and VCC), the temperature monitoring system, and the CSP have been identified as safety significant.

Required safety documentation that will be developed by CHPRC include a preliminary hazard analysis for the CSA, a conceptual safety design report for the CSA, a preliminary DSA for the CSA, and a final DSA document for the CSA. WESF will have a modified hazards analysis and DSA. The CSS contractor will provide input to the CHPRC analyses 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 loaded CSS 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 the 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.

### 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 and the CSA. The FHAs will be developed according to the requirements of PRC-STD-FP-40404, *Fire Protection Program*, and 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, a requirement that stored transient combustible material in G Cell be maintained 3 ft from the G Cell windows in all directions, 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. Changes to FHA controls require CHPRC approval.

CHPRC-03299, *Preliminary Fire Hazards Analysis for the Management of the Cesium and Strontium Capsules Project (W-135)*, was developed during conceptual design and provides an initial evaluation of fire hazards and fire related concerns associated with the MCSC Project activities.

CHPRC shall perform an analysis of fire and related hazards. The CSS contractor shall 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

Transfer of loaded CSSs 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*.

The transfer of the CSSs to the CSA will not be 10 CFR 71 compliant. Based on potential normal and accident conditions for this transfer, the package shall meet equivalent safety per DOE/RL-2001-36. CHPRC will develop and implement an appropriate transportation safety document according to the requirements of DOE/RL-2001-36, and PRC-PRO-TP-15665, *Transportation Safety Documents*.

The CSS contractor shall sufficiently document their initial determination or enabling assumption(s) as to whether or not their proposed solution is compliant with 10 CFR 71.

### 9 Environmental/Permitting Requirements

The environmental and permitting strategy for the MCSC Project has been agreed upon by DOE and the Washington State Department of Ecology.
9.1 Dangerous Waste Permitting

The capsules are managed at WESF as mixed high-level waste under RCRA and the implementing regulations specified at WAC 173-303. It is anticipated that the CSA will be permitted as a miscellaneous unit under WAC 173-303-680. The MCSC Project shall comply with the applicable requirements of 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 173-303-320, “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 173-303-380, “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 173-303-680, “Miscellaneous Units”
- 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 will be responsible for preparing work-scope specific documentation required for CHPRC 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 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 MCSC Project 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 miscellaneous unit that is fully compliant with WAC 173-303-280 and WAC 173-303-680.

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

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

9.3 Environmental Design

MCSC Project 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 13693, *Planning for Federal Sustainability in the Next Decade*) are not applicable to 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 MCSC Project may generate a minimal amount of waste in several forms during decontamination, normal operations, and maintenance. The MCSC Project 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 MCSC Project shall interface with existing Hanford Site waste treatment and disposal facilities for disposition of hazardous and radioactive solid wastes generated by the MCSC Project as required by PRC-MP-WM-52872, *Waste Management Basis*. CSS contractor provided systems shall be designed with intent to minimize future generation of waste requiring management and disposal by the MCSC Project.

The CSS contractor shall identify expected waste streams as a result of CSS loading operations. CHRPC will use this information to evaluate the ability of existing waste management programs to manage the waste. Key aspects of this evaluation are:
• Determine if all waste streams have been identified and characterized
• Determine if all wastes can be accepted and treated with existing disposal capabilities
• Determine if the quantity of expected waste is manageable with existing program capacity
• Determine if any aspects of waste disposal are critical to the project success.

9.6 Airborne Emissions

The design of the capsules and the CSS has resulted in a determination that the capsules will be exempt from licensing by the Washington State Department of Health in accordance with WAC 246-247-020, “Radiation Protection—Air Emissions” “Exemptions” (the capsules and the CSS meet the definition of a sealed source [WAC 246-247-030, “Definitions”]). No air permit is required for the CSA, and the existing WESF air permit already addresses transfer of the capsules. Required changes to WESF will be evaluated during the design process to determine if they meet the WAC 246-247-030 definition of a ‘modification’ which would require a change to the air permit.

Neither criteria air pollutants nor toxic emissions 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 MCSC Project 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 2.2, 2.7, 2.14, and 2.15. 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.

MCSC Project 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

Two COR documents have been established for the MCSC Project, CHPRC-02288, Cask Storage System Code of Record (Project W-135), and CHPRC-03275, Capsule Storage Area and WESF Modifications Code of Record (Project W-135).

The COR shall serve as a management tool and source for the applicable requirements documents used to design, construct, operate, and decommission MCSC Project equipment 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 MCSC Project contract.

13 References


72.24, “Contents of Application: Technical Information.”


Subpart G, “Civil Penalties.”


Subpart K, “Design and Control.”

835.202, “Occupational Dose Limits for General Employees.”


Subpart Z, “Toxic and Hazardous Substances.”


ACI 318-14, 2014, Building Code Requirements for Structural Concrete, American Concrete Institute, Farmington Hill, Michigan.

ACI 349-13, 2013, Code Requirements for Nuclear Safety-Related Concrete Structures, American Concrete Institute, Farmington Hill, Michigan.


ASCE/SEI 7-10, 2013, Minimum Design Loads For Buildings and Other Structures, American Society of Civil Engineers/Structural Engineering Institute, Reston, Virginia.


ASME NUM-1, 2016, Rules for Construction of Cranes, Monorails, and Hoists (with Bridge or Trolley or Hoist of the Underhung Type), American Society of Mechanical Engineers, New York, New York.


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*National Environmental Policy Act of 1969, 42 USC 4321 et seq.*


    303-280, “General requirements for dangerous waste management facilities.”
    303-281, “Notice of intent.”
    303-282, “Siting criteria.”
    303-283, “Performance standards.”
    303-290, “Required notices.”
    303-300, “General waste analysis.”
    303-310, “Security.”
    303-320, “General inspection.”
    303-330, “Personnel training.”
    303-335, “Construction quality assurance program.”
    303-340, “Preparedness and prevention.”
    303-350, “Contingency plan and emergency procedures.”
    303-360, “Emergencies.”
303-380, “Facility recordkeeping.”
303-390, “Facility reporting.”
303-395, “Other general requirements.”
303-600, “Final facility standards.”
303-610, “Closure and post-closure.”
303-680, “Miscellaneous units.”
303-803, “Permit application requirements.”
303-806, “Final facility permits.”
303-830, “Permit changes.”


247-020, “Exemptions.”

247-030, “Definitions.”


