STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
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October 30, 2019 19-NWP-163

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PO Box 999, MSIN: K1-46
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John R. Eschenberg, President
Washington River Protection Solutions
PO Box 850, MSIN: H3-21
Richland, Washington 99352

Re: Proposed Class 3 Permit Modification 8C.2018.1D to the *Hanford Facility Resource Conservation and Recovery Act Permit, Dangerous Waste Portion, Revision 8C, for the Treatment, Storage, and Disposal of Dangerous Waste* (Site-wide Permit), Part III, Operating Unit Group 19, Capsule Interim Storage, WA7890008967

References: See Page 3

Dear Addressees:

This letter transmits the Department of Ecology's (Ecology) proposed permit modification 8C.2018.1D to Part III, Operating Unit Group 19, Capsule Interim Storage, of the *Hanford Facility Resource Conservation and Recovery Act Permit, Dangerous Waste Portion, Revision 8C, for the Treatment, Storage and Disposal of Dangerous Waste*.

The Permittees are the United States Department of Energy (USDOE) as owner/operator and CH2M HILL Plateau Remediation Company as co-operator.

USDOE held a public comment period regarding the Class 3 Permit Modification request for the Capsule Interim Storage from November 27, 2017 through January 31, 2018 (Reference 1). They held a public meeting on December 13, 2017, at the Richland Public Library at 6:30 pm.

Ecology received 102 public comments from USDOE's comment period. As a result of the public comments received and after performing a completeness review, Ecology requested the following information from the Permittees and made the following modifications to the draft submittal:

- Ecology requested information regarding seismic considerations, an updated training plan, and general design, construction, and operation information for the proposed facility. This is documented in incompleteness determination letter issued February 13, 2018 (Reference 2).

- The Permittees provided the technical information to make the application complete and addressed Ecology's technical deficiencies by updating all associated addenda to better describe Capsule Interim Storage and ensure that the operation of the facility will be protective of human health and the environment for the lifespan of the facility.

Based upon the updated certified application submitted on July 31, 2019 (Reference 3), and an agreed-upon text change to Addendum G, Training, Ecology has determined that the application is complete.

Ecology issued a *Response to Comments* document from the public comment period. Ecology's *Response to Comments* document is on the enclosed DVD (Ecology Publication 19-05-017) and on Ecology's website at http://nw.ecology.commentinput.com/?id=CpErH.

Washington Administrative Code 173-303-840(3)(d) requires at least a 45-day public comment period for the draft permit modification. Ecology will hold this public comment period from November 4, 2019 through December 20, 2019. This comment period initiates the second portion of the Class 3 Permit Modification. A public hearing is not scheduled, but Ecology will consider holding one if there is enough interest.

This proposed Class 3 Permit Modification would add the Capsule Interim Storage Operating Unit Group to the Site-Wide Permit. Capsule Interim Storage will contain a single Dangerous Waste Management Unit, the Capsule Storage Area, which will store 1,936 cesium and strontium capsules currently stored at the Waste Encapsulation and Storage Facility.

The proposed permit modification is on the enclosed DVD and on Ecology's website at http://www.ecy.wa.gov/programs/nwp/commentperiods.htm. A DVD is also at the Hanford Public Information Repositories in Richland, Spokane, and Seattle, Washington, as well as Portland, Oregon. A hard copy is on file at the locations listed below:

Department of Ecology Nuclear Waste Program 3100 Port of Benton Boulevard Richland, Washington 99354	United States Department of Energy Administrative Record 2440 Stevens Center Place Richland, Washington 99354

Individuals can request copies of the DVD by contacting Ecology's Resource Center at (509) 372-7950.

If there are any questions regarding this permit modification, please contact Matt Williams, Environmental Engineer, at matt.williams@ecy.wa.gov or (509) 372-7910 or Mandy Jones, Permit Coordinator, at mandy.jones@ecy.wa.gov or (509) 372-7916.

Sincerely,

Stephanie Schleif

Stephanie Schleif
Deputy Program Manager
Nuclear Waste Program

mw/jlg

Enclosure

cc: See page 4

References:

1. Letter 18-AMRP-0013, dated November 16, 2017, "Hanford Facility Dangerous Waste Permit Part B Application for the Waste Encapsulation and Storage Facility (WESF) Operating Unit Group (OUG), DOE/RL-2017-43, Revision 0 and the Capsule Interim Storage (CIS) OUG, DOE/RL-2017-44, Revision 0"

2. Letter 18-NWP-026, dated February 13, 2018, "Ecology's Completeness Review for the Class 3 Permit Modification to the *Hanford Facility Resource Conservation and Recovery Act Permit, Dangerous Waste Portion, Revision 8C, for the Treatment, and Disposal of Dangerous Waste*, Part III, Operating Unit Group 6, Capsule Interim Storage (CIS), WA 7890008967"

3. Letter 19-AMRP-0068, dated July 31, 2019, "Response to Notice of Deficiency for the Capsule Interim Storage Operating Unit Group Class 3 Permit Modification Request"

cc electronic w/o enc:

Dave Bartus, EPA
David Einan, EPA
Mary Beth Burandt, USDOE-ORP
Lori Huffman, USDOE-ORP
Christopher Kemp, USDOE-ORP
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BNI Correspondence Control
CHPRC Correspondence Control
Environmental Portal
Gonzaga University Foley Center Library
Hanford Facility Operating Record
MSA Correspondence Control
PNNL Correspondence Control
Portland State University Library, Government Information
University of Washington Suzzallo Library, Government Publications
USDOE-ORP Correspondence Control
USDOE Public Reading Room, CIC
USDOE-RL Correspondence Control
USEPA Region 10 Hanford Field Office Correspondence Control
WRPS Correspondence Control

cc w/enc, DVD and hard copy:

Hanford Administrative Record: Hanford Site-wide Permit
NWP Central File

DEPARTMENT OF
ECOLOGY
State of Washington

FACT SHEET

Proposed Permit Modification to Part III of the *Hanford Facility Resource Conservation and Recovery Act Permit, Dangerous Waste Portion, Revision 8C, for the Treatment, Storage, and Disposal of Dangerous Waste,* WA7890008967, to add Operating Unit Group 19, Capsule Interim Storage

October 2019

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FACT SHEET

Proposed Permit Modification to Part III of the *Hanford Facility Resource Conservation and Recovery Act Permit, Dangerous Waste Portion, Revision 8C, for the Treatment, Storage, and Disposal of Dangerous Waste*, WA7890008967, to add Operating Unit Group 19, Capsule Interim Storage

PERMITTEES

United States Department of Energy
Office of River Protection
(Owner/Operator)
P.O. Box 450, MSIN H6-60
Richland, Washington 99352

CH2M HILL Plateau Remediation Company
(Co-Operator)
P.O. Box 1600, MSIN: H7-30
Richland, Washington 99352

The Washington State Department of Ecology (Ecology) developed this Fact Sheet in accordance with the requirements of Washington Administrative Code (WAC) 173-303-840(2)(f). Its purpose is to discuss the proposed draft permit modification to Part III of the *Hanford Facility Resource Conservation and Recovery Act Permit, Dangerous Waste Portion, Revision 8C, for the Treatment, Storage, and Disposal of Dangerous Waste* (hereafter called the Hanford Site-wide Permit).

This proposed draft permit modification will add Operating Unit Group 19, Capsule Interim Storage to Part III of the Hanford Site-wide Permit.

This Fact Sheet is divided into six sections:

1.0 Hanford Site-Wide Permit Background
2.0 Capsule Interim Storage Dangerous Waste Management Unit Description
3.0 Class 3 Permit Modification Process for Capsule Interim Storage
4.0 Proposed Modification to Part III of the Hanford Site-wide Permit
5.0 Procedures for Reaching a Final Decision on the Draft Permit Modification
6.0 State Environmental Policy Act

1.0 Hanford Site-wide Permit Background

Ecology's Nuclear Waste Program (NWP) manages dangerous waste within the State by writing permits to regulate its treatment, storage, and disposal.

Ecology has the authority to regulate dangerous waste and the dangerous waste components of mixed (radioactive and dangerous) waste, under 70.105 RCW and WAC 173-303. The Hanford Site-wide Permit has requirements for the treatment, storage, and disposal of dangerous and mixed waste at Hanford. Ecology does not regulate waste that is solely radioactive. USDOE has the exclusive authority to regulate radioactive materials and radioactive waste at Hanford.

Ecology first issued the Hanford Site-wide Permit in 1994. Since 1994, the permit has been modified many times to incorporate changes or updates and to incorporate and closeout several Dangerous Waste Management Units (DWMUs).

The Hanford Site-wide Permit provides standard and general facility conditions, as well as unit group conditions for the operation, closure, and post closure care of mixed and dangerous waste Treatment, Storage and Disposal (TSD) Units at Hanford. These TSDs are administratively grouped into operating,

closure, or post-closure unit groups in the Hanford Site-wide Permit. Each unit group may contain one or more DWMU.

The Hanford Site-wide Permit is organized as follows:

Part I	Standard Conditions.
Part II	General Facility Conditions.
Part III	Operating Units.
Part IV	Corrective Action for Past Practice Units.
Part V	Closure Units.
Part VI	Post-Closure Units.

Upon approval and issuance of this permit modification the Capsule Interim Storage Operating Unit Group, (OUG 19) will be added to Part III Operating Units, of the Hanford Site-wide Permit.

2.0 Capsule Interim Storage Operating Unit Group Description

Capsule Interim Storage (CIS) is a dangerous waste miscellaneous storage operating unit group located in the 200 East Area. CIS contains one dangerous waste management unit (DWMU), the Capsule Storage Area (CSA). In addition to the CSA, CIS includes an Operating Pad for staging and maneuvering equipment and a graveled area for drainage and radiological buffering. The Operating Pad and graveled area are not used for treatment, storage, or disposal of dangerous waste.

CIS stores two mixed waste streams, which are cesium chloride and strontium fluoride salts separated from Hanford tank waste. These salts contain several dangerous waste-designated metals estimated at less than 10% by weight each but in varying amounts per capsule. The cesium and strontium salts are stored within Cask Storage Systems (CSSs). Each CSS consists of a Vertical Concrete Cask (VCC) housing a stainless steel Transportable Storage Canister (TSC). Each TSC is loaded with a TSC Basket holding up to 22 Universal Capsule Sleeves (UCSs). Each UCS can hold up to six standard capsules or two of the larger Type W overpacks. Total permitted storage is 1,936 capsules loaded into 25 VCCs at specific heat generation levels.

- The CSA dangerous waste management unit consists of a concrete pad with a total surface of approximately 90 feet by 184 feet. An area of approximately 90 feet by 90 feet within the inner security fence is the primary storage area housing the 25 VCCs during normal operation. If needed (e.g., for isolation and individual temperature monitoring), individual VCCs can be moved to the portion of the CSA pad between the two security fences.

- The concrete Operating Pad has a surface of approximately 45 feet by 45 feet and is located adjacent to the CSA pad between the two security fences. This pad is not part of any DWMU and cannot be used for dangerous or mixed waste loading, unloading, storage, handling, or treatment.

- The graveled area comprises the remainder of the area between the two security fences and is not part of a DWMU. No specific activities are planned in this area and it cannot be used for dangerous or mixed waste loading, unloading, storage, handling, or treatment.

Under this permit modification, CIS is not authorized to treat or ship waste. This facility will store waste until development of a more permanent solution for disposition of the cesium and strontium capsules.

TYPE AND QUANTITY OF WASTE

CIS can store a total of 1,936 cesium and strontium capsules currently stored at the Waste Encapsulation and Storage Facility (WESF); 1,335 cesium capsules (1,312 standard and 23 Type W overpack capsules) and 601 standard strontium capsules. Each standard capsule has a capacity of approximately 1 liter and the total mass of mixed waste stored is 11,131 pounds. The cesium and strontium salts are considered to be mixed waste, as defined in WAC 173-303-040, due to the radioactive cesium and strontium as well as the heavy metals barium, cadmium, chromium, lead, and silver.

BASIS FOR PERMIT CONDITIONS

Permit conditions are based upon WAC 173-303-680, Miscellaneous Units. Although the capsules are containers, as defined in WAC 173-303-040, the design and properties of the cesium and strontium salts make the CSA a miscellaneous unit rather than a container storage area. The requirements for container storage areas in WAC 173-303-630 are most appropriate for traditional containers, which typically allow access and transfer of containerized waste. The cesium and strontium capsules have unique risks and design requirements which simply were not considered for WAC 173-303-630. Additionally, the sealed and compartmentalized CSS design makes demonstrating compliance with labeling requirements in WAC 173-303-630(3) difficult or impossible.

WAC 173-303-680 requires that miscellaneous units be located, designed, constructed, operated, maintained, and closed in a manner which protects human health and the environment. In addition to these general requirement, miscellaneous units must meet appropriate requirements for tanks, containers, or surface impoundments.

The cesium and strontium salt production and encapsulation procedures ensure the capsules do not contain free liquids, ignitable or reactive waste, or waste which is incompatible with other stored waste. The stainless steel and Hastealloy capsules are compatible with the stored waste, which will not be changed by additional layers of stainless steel and concrete in the CSS design.

Additionally, the CSS design includes a series of sealed layers which provide integrated containment. If the CSA were a traditional container storage area, it would be exempt from the requirement for secondary containment under WAC 173-303-630(7)(c). However, as a miscellaneous unit, the design considers the unique characteristics of the stored waste to integrate safety features which protect human health and the environment as required in WAC 173-303-680(2).

Ecology has drafted unit specific permit conditions that are applicable to General Waste Management, Waste Analysis Requirements, Reporting and Recordkeeping, Security, Preparedness and Prevention, Contingency Plan, Inspections, Training, Closure, and Miscellaneous Unit Management Standards.

Permit conditions focus on preventing exposure to the strontium and cesium salts through design features, administrative procedures, and maintenance if it becomes necessary. Once assembled, the VCCs are robust passive structures with no moving parts or need for human intervention in normal operation. CIS design includes sloped concrete pads and sufficient drainage to remove precipitation, security fences and easily-maintained lighting systems for safety, and two hydrants to supply water in case of a fire at or near CIS. The permittees are required to follow the VCC and CIS designs because they are the primary methods of ensuring compliance with WAC 173-303-680.

The permittees are also required to monitor the temperature of outlet vents to ensure that passive ventilation systems remain unobstructed. If monitoring systems are nonfunctional due to power loss or other circumstances it would not directly endanger the capsules, workers, or the public. In such

circumstances, the permittees may substitute visual observation of vents as a backup procedure for temperature monitoring. Ecology does not intend for this to be the normal operating mode; therefore, the permittees must provide a notification and an estimated schedule for returning to temperature monitoring.

The VCCs are heavy, customized storage systems. Safely moving a cask for individual monitoring or maintenance requires equipment designed or reviewed for the purpose such as the Vertical Cask Transporter or air pallets. Therefore, Ecology is requiring the permittees maintain the ability to move a cask to support the Inspection Plan, Contingency Plan, and eventual disposal of the cesium and strontium salts.

3.0 Class 3 Permit Modification Process for the Capsule Interim Storage Operating Unit Group

The permittees formally submitted a Class 3 permit modification to add the Capsule Interim Storage Operating Unit Group (OGU 19) to the Hanford Site-wide Permit on November 16 2017. The 60-day public comment period as required by WAC 173-303-830(4)(c) began on November 27, 2017, and ended on January 31, 2018. The permittees also held a public meeting on December 13, 2017, at the Richland Public Library. Ecology responded to 102 comments in six sets of public comments submitted during that comment period.

Ecology issued a Completeness Determination Letter for the Class 3 Permit Modification Request on February 13, 2018 (18-NWP-026) in accordance with WAC 173-303-830(4)(c)(vi) and WAC 173-303-840(1)(b). Ecology and the permittees resolved the technical deficiencies identified in 18-NWP-026 as well as additional items through a Response Comment Record and workshop procedure, which is documented in the administrative record for this permit modification. After Ecology worked with the permittees to resolve the deficiencies, USDOE Richland Operations Office submitted a revised permit modification application that addressed the deficiencies on July 31, 2019. At the request of the permittees, Ecology has modified this submittal to add the Training Manager position to Addendum G. This position was inadvertently not included in the certified submittal.

Ecology has issued a completeness determination on November 4, 2019, with this draft permit modification. The draft permit modification to Rev. 8C of the Hanford Site-wide Permit is 8C.2018.1D and is available for public review in locations listed in Section 5.0.

Ecology addressed public comments received during the permittees' comment period in a response to comment document. This response to comment document accompanies the draft permit modification, and is available online at https://ecology.wa.gov/Waste-Toxics/Nuclear-waste/Public-comment-periods.

4.0 Proposed Modification to Part III of the Hanford Site-wide Permit

The proposed draft permit modification 8C.2018.1D adds Operating Unit Group 19, Capsule Interim Storage to Part III of the Hanford Site-wide Permit. This draft modification is the second portion of the Class 3 modification.

The draft permit modification consists of unit group specific permit conditions, Part A, Waste Analysis Plan, Process Information, Security, Preparedness and Prevention, Training, Closure, Inspection and Contingency/Building Emergency Plan Addenda for the design and operation of the Capsule Interim Storage Operating Unit Group (OUG 19)

Because the permittees are requesting to add a new Operating Unit Group to the Hanford Site-wide Permit they were required to submit a complete permit application as detailed in WAC 173-303-806. The associated unit specific permit conditions and addenda have been drafted based on the application material provided by the permittees.

As detailed in Section 2.0 above, this Permit Modification will add a new Operating Unit Group, Capsule Interim Storage (CIS) to the Hanford Site-wide Permit. The CIS is a dangerous waste miscellaneous storage operating unit group located in the 200 East Area. CIS contains one DWMU, the CSA. In addition to the CSA, CIS includes an Operating Pad for staging and maneuvering equipment and a graveled area for drainage and radiological buffering. The Operating Pad and graveled area are not used for treatment, storage, or disposal of dangerous waste.

5.0 Procedures for Reaching a Final Decision on the Draft Permit Modification

The Washington State Dangerous Waste Regulations in WAC 173-303-830 describe the types of changes or modifications that may be made to a Dangerous Waste Permit issued by Ecology.

Parts I and II Conditions and the Attachment 9 Permit Applicability Matrix will be modified after the public comment period to incorporate elements of Operating Unit Group 19, when the permit modification becomes effective.

This draft permit modification was prepared according to the procedures in WAC 173-303-840(2). As required by WAC 173-303-840(3)(d), draft permits issued by Ecology will have at least a 45-day public comment period. The public comment period for this draft permit will be October XX through December XX, 2019.

Comments must be post-marked, received by e-mail, or hand-delivered no later than close of business (5:00 p.m. PST) December XX, 2019.

Direct all comments to (electronic preferred):

Daina McFadden

Washington State Department of Ecology
3100 Port of Benton Boulevard
Richland, Washington 99354

eComments link: http://wt.ecology.commentinput.com/?id=ibkWY

Ecology will consider and respond to all written comments on this draft permit modification that are submitted by the December 20, 2019, deadline. At the completion of the 45-day public comment period Ecology will make a final permitting decision. If the final decision is to issue the permit, Ecology will issue a final permit for Part III, OUG 19, Capsule Interim Storage to the permittees, that will become effective 30 days after the issuance date. If the final decision includes substantial changes to the draft permit modification because of public comment, Ecology will consider initiating a new public comment period.

A public hearing is not scheduled, but if there is enough interest, we will consider holding one.

To request a hearing or for more information contact:

Daina McFadden
Washington State Department of Ecology
(509) 372-7950

E-mail address: hanford@ecy.wa.gov

NWP will also issue a Response to Comments document to the permittees and the public. The final permit decision may be appealed within 30 days after issuance of that decision. If there is no appeal, the permit will stand as issued.

Copies of the following documents for Part III, Operating Unit Group 19, Capsule Interim Storage are available for review at the Hanford Public Information Repositories locations listed below:

- Unit Group Specific Conditions
- Addendum A, Part A
- Addendum B, Waste Analysis Plan
- Addendum C. Process Information
- Addendum F. Preparedness and Prevention
- Addendum G, Personnel Training
- Addendum H, Closure Plan
- Addendum I, Inspections
- Addendum J, Contingency Plan/Building Emergency Plan
- And any associated supplemental information necessary to support review of the permit modification

For additional information call (509) 372-7950 or e-mail hanford@ecy.wa.gov.

Hanford Public Information Repositories

Richland, Washington

Ecology Nuclear Waste Program Resource Center
3100 Port of Benton Blvd. Richland, WA 99354
509-372-7950

U.S. Department of Energy Administrative Record
2440 Stevens Drive, Room 1101 Richland, WA 99354
509-376-2530

Washington State University Tri-Cities
Department of Energy Reading Room
2770 Crimson Way, Room 101L Richland, WA 99354
509-375-7443

Other Locations:

Portland

Portland State University
Branford Price Millar Library
1875 Southwest Park Avenue
Portland, Oregon 97201
(503) 725-4542

Seattle

University of Washington Suzzallo Library
P.O. Box 352900
4000 15th Avenue Northeast
Seattle, Washington 98195
(206) 543-5597

Spokane

Gonzaga University
Foley Center
502 East Boone Avenue
Spokane, Washington 99258
(509) 313-6110

Information on the proposed permit modification is also available online at http://www.ecy.wa.gov/programs/nwp/commentperiods.htm. If special accommodations are needed for public comment, contact Ecology's Nuclear Waste Program at (509)372-7950.

6.0 State Environmental Policy Act

On February 16, 2016, Ecology issued a Determination of Significance/Notice of Adoption (SEPA #201700820) which adopted the Final Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington (TC-WM EIS). TC-WM EIS addressed the potential transfer of cesium and strontium capsules from pool storage at the Waste Encapsulation and Storage Facility to dry storage. However, there were several differences between the analyzed scenarios and the final design of CIS.

The permittees and Ecology agreed an amended Record of Decision (ROD) addressing the differences between TC-WM EIS and final CIS design would meet State Environmental Policy Act requirements for the project authorized by this permit modification. The amended ROD was published in the Federal Register on May 18, 2018. Prior to final permit issuance, Ecology will issue a SEPA determination for CIS based upon TC-WM EIS and the amended ROD. For more information, please see letter 18-NWP-014.

Hanford Site Dangerous Waste Permit Modification for Capsule Interim Storage

Public comment period

November 4 to December 20, 2019

Please submit comments

Electronically (preferred) via:

http://nw.ecology.commentinput.com/?id=CpErH

By U.S. Mail, or hand-delivery:

Daina McFadden
3100 Port of Benton Blvd
Richland WA 99354

Public hearing

A public hearing is not scheduled, but if there is enough interest, we will consider holding one. To request a hearing or for more information, contact:

Daina McFadden
509-372-7950
Hanford@ecy.wa.gov

Special accommodations

To request ADA accommodation including materials in a format for the visually impaired, call Ecology at 360-407-6831 or visit https://ecology.wa.gov/accessibility.

People with impaired hearing may call Washington Relay Service at 711. People with speech disability may call TTY at 877-833-6341.

Public comment invited

The Washington State Department of Ecology (Ecology) invites you to comment on a draft permit modification to the *Hanford Facility Resource Conservation and Recovery Act (RCRA) Permit, Revision 8c* (Site-wide Permit).

This modification would add a new operating unit group, Capsule Interim Storage Operating Unit 19, to the Site-wide Permit.

The permittees are:

U.S. Department of Energy Richland Operations Office
PO Box 550
Richland, Washington 99352

CH2M HILL Plateau Remediation Company
PO Box 1600
Richland, WA 99352

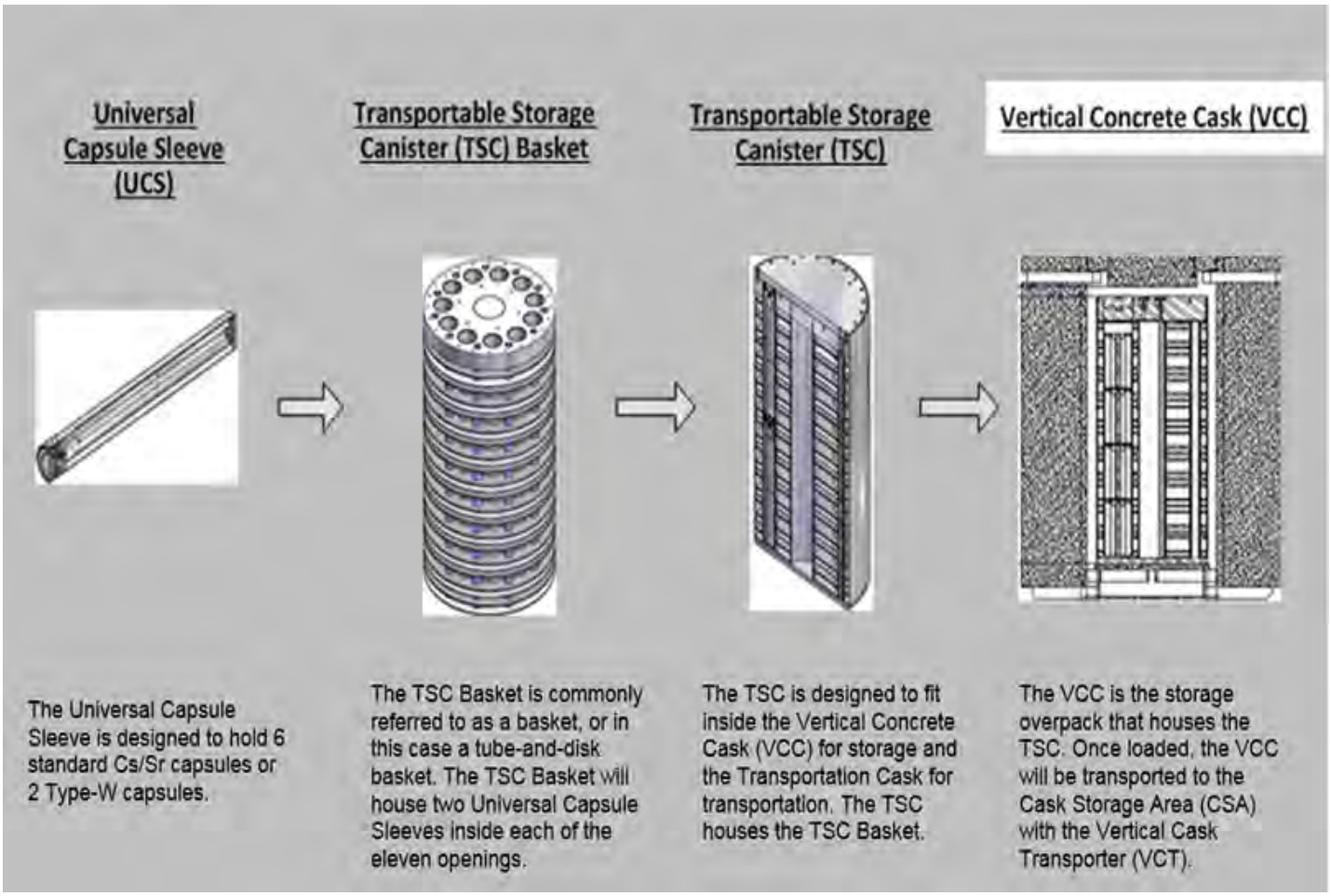
Ecology invites you to comment on this proposed permit modification. The public comment period begins November 4, 2019, and ends December 20, 2019.

Modification overview

Currently 1,936 capsules storing radioactive cesium chloride and strontium fluoride salts are stored in pools at the Waste Encapsulation and Storage Facility (WESF). The permittees separated these salts from tank waste from 1967 to 1985 to reduce the temperature of storage tanks.

The process of separating also recovered small amounts of heavy metals such as lead, chromium, and cadmium. This mixed waste is now contained in double-walled stainless steel capsules and stored under water for cooling and radiation shielding.

The permittees have requested a permit modification to construct a new Capsule Interim Storage (CIS) operating unit group to replace the current pool storage at WESF. CIS would contain the Capsule Storage Area (CSA) dangerous waste management unit. Within the CSA, 25 cask storage systems would hold capsules in cylindrical casks approximately 10 feet in diameter by 11 feet tall. Each cask storage system would be constructed of concrete and steel to provide radiation shielding, waste protection and containment, and sufficient cooling through passive air ventilation.



Capsule Storage System Design

Why capsule transfer matters

Transferring the capsules from WESF to dry storage will provide increased safety and resiliency. At WESF, active cooling and water circulation is needed to dissipate the heat generated by capsules. WESF is beyond its 30-year design lifespan and the concrete pool cell walls show signs of deterioration due to radiation exposure. A spill or release would create a significant volume of contaminated water to clean. If the pools were breached in an event such as an earthquake, the capsules would be left uncooled and unshielded.

Transferring the capsules to dry storage also eliminates the risk of power loss or equipment failure impacting the cooling system at WESF. The cesium and strontium salts have gone through at least one half-life since being placed into pool storage, and they show reduced activity and heat generation. The capsules are still extremely hazardous, but can be safely shielded and cooled in storage casks.

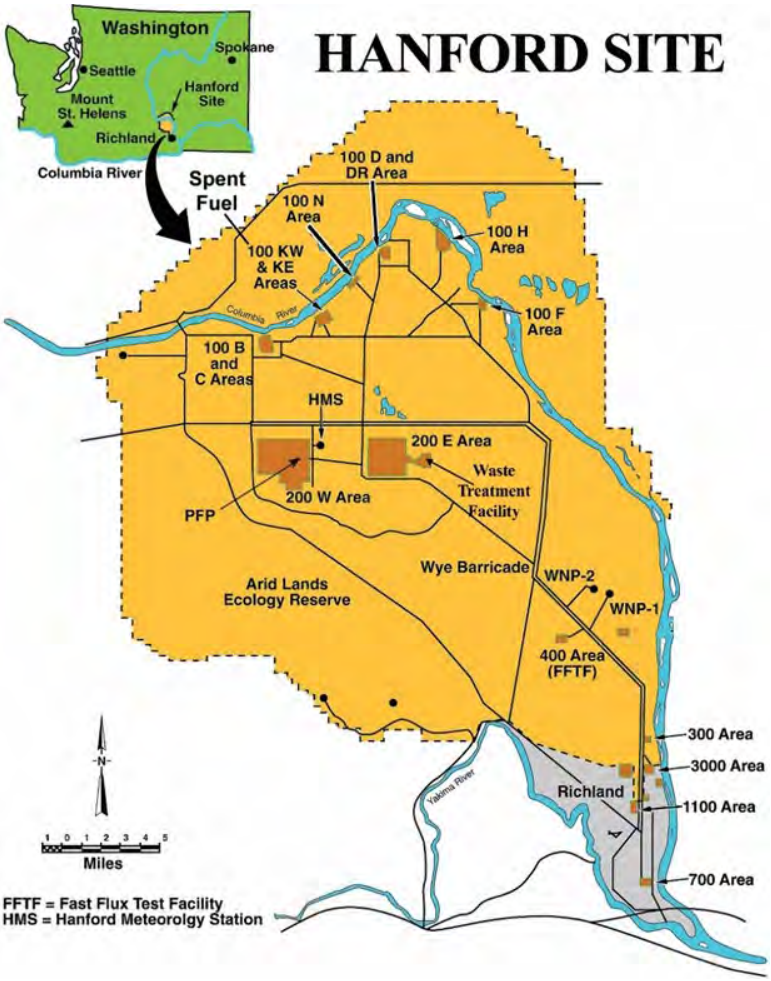
In an emergency, such as a significant earthquake, the potential for spread of contamination to soil and groundwater is more limited in dry storage than it would be in pool storage.

Moving these capsules is also essential to initiate cleanup and closure of WESF and B Plant. Although the capsules will still be on site at Hanford, Capsule Interim Storage will have a much smaller physical and environmental footprint than existing facilities. This transfer advances the overall goal of Ecology and the permittees to clean and restore the Hanford Site.

Why capsules will be retained on site

Currently there are no viable alternatives to continued storage of the cesium and strontium capsules at the Hanford Site. There are no facilities in the United States permitted to treat or permanently store this material. Therefore, continued interim storage in a manner protective of human health and the environment is the only current option.

The permittees must continue to periodically evaluate more permanent disposition options under the Hanford Federal Facility Agreement and Consent Order. When an option is available, the cesium and strontium capsules will be treated and/or stored permanently at a different facility.



Reviewing the proposed changes

Ecology invites you to review and comment on this proposed permit modification for the Capsule Interim Storage Operating Unit Group. See Page 1 for comment period dates and information on how to submit comments.

Copies of the application for the proposed modification and supporting documentation will be available during the public comment period online at Ecology's website on the Public Comment Period page. The documents will also be available at the Hanford Public Information Repositories listed on the last page.

Ecology will consider and respond to all comments received during the public comment period. We will document our responses and issue a response to comments document when we make our final permitting decision.

Nuclear Waste Program
3100 Port of Benton Blvd
Richland, WA 99354

Hanford's Information Repositories and Document Review Locations

Washington

Richland
Ecology Nuclear Waste Program
Resource Center
3100 Port of Benton Blvd.
Richland, WA 99354
509-372-7950

U.S. Department of Energy
Administrative Record
2440 Stevens Drive, Room 1101
Richland, WA 99354
509-376-2530

Washington State University Tri-Cities
Department of Energy Reading Room
2770 Crimson Way, Room 101L
Richland, WA 99354
509-375-7443

Seattle
University of Washington
Suzzallo Library
P.O. Box 352900
Seattle, WA 98195
206-543-5597

Spokane
Gonzaga University
Foley Center
502 E Boone Avenue
Spokane, WA 99258
509-313-6110

Oregon

Portland
Portland State University
Millar Library
1875 SW Park Avenue
Portland, OR 97207
503-725-4542

DEPARTMENT OF
ECOLOGY
State of Washington

Response to Comments
Proposed Capsule Storage Area

November 27, 2017 to January 31, 2018

Summary of a public comment period and responses to comments

November 2019

Publication no. 19-05-016

Publication and Contact Information

This publication is available on the Department of Ecology's (Ecology) website at https://fortress.wa.gov/ecy/publications/SummaryPages/1905016.html

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Washington State Department of Ecology – www.ecology.wa.gov

- Headquarters, Lacey 360-407-6000
- Northwest Regional Office, Bellevue 425-649-7000
- Southwest Regional Office, Lacey 360-407-6300
- Central Regional Office, Yakima 509-575-2490
- Eastern Regional Office, Spokane 509-329-3400

Ecology publishes this document to meet the requirements of Washington Administrative Code 173-303-840 (9).

To request ADA accommodation including materials in a format for the visually impaired, call Ecology at 360-407-6831 or visit https://ecology.wa.gov/accessibility. People with impaired hearing may call Washington Relay Service at 711. People with speech disability may call TTY at 877-833-6341.

Response to Comments

Proposed Capsule Storage Area

November 27, 2017 to January 31, 2018

Nuclear Waste Program
Washington State Department of Ecology
Richland, Washington

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Introduction

The Washington State Department of Ecology's Nuclear Waste Program (Ecology) manages dangerous waste within the state by writing permits to regulate its treatment, storage, and disposal. When a new permit or a significant modification to an existing permit is proposed, Ecology holds a public comment period to allow the public to review the change and provide formal feedback. (See Washington Administrative Code [WAC] 173-303-830 for types of permit changes.)

The Response to Comments is the last step before issuing the final permit, and its purpose is to:

- Specify which provisions, if any, of a permit will become effective upon issuance of the final permit, providing reasons for those changes.
- Describe and document public involvement actions.
- List and respond to all significant comments received during the public comment period and any related public hearings.

This Response to Comments is prepared for:

Comment period:	Proposed Capsule Storage Area November 27, 2017, to January 31, 2018
Permit:	*Hanford Facility Resource Conservation and Recovery Act (RCRA) Permit for the Treatment, Storage, and Disposal of Dangerous Waste, Part III, Operating Unit Group 19 (WA7890008967), Capsule Interim Storage*
Permittee(s):	*U.S. Department of Energy Richland Operation Office*

To see more information related to the Hanford Site and nuclear waste in Washington, please visit our website: https://www.ecology.wa.gov/Hanford.

Reasons for issuing the permit

Currently 1,936 capsules storing radioactive cesium chloride and strontium fluoride salts are stored in pools at the Waste Encapsulation and Storage Facility (WESF). The permittees separated these salts from tank waste from 1967 to 1985 to reduce the temperature of storage tanks.

The separation process also recovered small amounts of heavy metals such as lead, chromium, and cadmium. This mixed waste is now contained in double-walled stainless steel capsules and stored under water for cooling and radiation shielding.

The permittees have requested a permit modification to construct a new Capsule Interim Storage (CIS) operating unit group to replace the current pool storage at WESF. CIS would contain the Capsule Storage Area (CSA) dangerous waste management unit. Within the CSA, 25 cask storage

systems would hold capsules in cylindrical casks approximately 10 feet in diameter by 11 feet tall. Each cask storage system would be constructed of concrete and steel to provide radiation shielding, waste protection and containment, and sufficient cooling through passive air ventilation.

Transferring the capsules from WESF to dry storage will provide increased safety and resiliency. At WESF, active cooling and water circulation is needed to dissipate the heat generated by capsules. WESF is beyond its 30-year design lifespan and the concrete pool cell walls show signs of deterioration due to radiation exposure. A spill or release would create a significant volume of contaminated water to clean. If the pools were breached in an event such as an earthquake, the capsules would be left uncooled and unshielded.

Transferring the capsules to dry storage also eliminates the risk of power loss or equipment failure impacting the cooling system at WESF. The cesium and strontium salts have gone through at least one half-life since being placed into pool storage, and they show reduced activity and heat generation. The capsules are still extremely hazardous, but can be safely shielded and cooled in storage casks. In an emergency, such as a significant earthquake, the potential for spread of contamination to soil and groundwater is more limited in dry storage than it would be in pool storage.

Moving these capsules is also essential to initiate cleanup and closure of WESF and B Plant. Although the capsules will still be on site at Hanford, Capsule Interim Storage will have a much smaller physical and environmental footprint than existing facilities. This transfer advances the overall goal of Ecology and the permittees to clean and restore the Hanford Site.

Public involvement actions

The U.S. Department of Energy Richland Operations Office (USDOE-RL) encouraged public comment on the Proposed Capsule Storage Area during a 60-day public comment period held November 27, 2017, through January 31, 2018.

The following actions were taken to notify the public:

- Mailed a public notice announcing the comment period to 1500 members of the public. Copies of the public notice were distributed to members of the public at Hanford Advisory Board meetings.
- Placed a public announcement legal display advertisement in the *Tri-City Herald* on November 27, 2017.
- Emailed a notice announcing the start of the comment period to the Hanford-Info email list, which has 1250 recipients.

USDOE-RL held a public meeting on December 13, 2017, at 6:30 at Richland Public Library.

The Hanford information repositories located in Richland, Spokane, and Seattle, Washington, and Portland, Oregon, received the following documents for public review:

- Public notice
- Transmittal letter
- Statement of Basis
- Draft Permit Modification

The following public notices for this comment period are in Appendix A of this document:

- Statement of Basis
- Public notice (focus sheet)
- Classified advertisement in the *Tri-City Herald*
- Notice sent to the Hanford-Info email list

List of Commenters

The table below lists the names of organizations or individuals who submitted a comment on the Proposed Capsule Storage Area permit modification. The comments and responses are in Attachment 1.

Commenter	Organization
Stephens, Don	Citizen
Conlan, Mike	Citizen
Holder, Carl	Citizen
Serres, Dan	Columbia Riverkeeper
Vanni, Jean	Confederated Tribes and Bands of the Yakama Nation
Skeen, Rodney	Confederated Tribes of the Umatilla Indian Reservation

Attachment 1: Comments and responses

Description of comments:

Ecology accepted comments from November 27, 2017, through January 31, 2018. This section provides summary of comments that we received during the public comment period and our responses, as required by RCW 34.05.325(6)(a)(iii). Comments are grouped by individual and each comment is addressed separately.

I-1: DON STEPHENS

Comment I-1-1

Please do everything consistent with safety to efficiently clean these wastes up as soon as possible.
Thanks.

Response to I-1-1

The Department of Ecology and USDOE believe that movement of the capsules out of the pool cells to dry storage will ensure a safe storage configuration for the capsules for an extended period of time. It is Ecology's expectation that USDOE will continue to evaluate final treatment, storage, and/or disposal pathways for the cesium and strontium capsules.

I-2: MIKE CONLAN

Comment I-2-1

1. Remove all nuclear waste, 2. Do not allow anymore nuclear waste into the facility, 3. Replace all the single storage tanks, 4. Stop all the nuclear leakage entering the Columbia River

Response to I-2-1

Ecology is working to ensure that long-term storage, treatment and disposal of the waste is protective of human health and the environment.

The proposed permit changes are not to allow new waste, but to better manage the waste already at Hanford.

Single-shell tanks are not in the scope of this comment period. The movement of the cesium and strontium capsules out of the Waste Encapsulation and Storage Facility (WESF) Pool Cells to dry storage at the Capsule Interim Storage (CIS) will reduce the risk of releases from these capsules and eliminate the possibility that any releases could reach the Columbia River. Stopping any potential nuclear waste from impacting the Columbia River is not within the scope of the CIS Permit. Prevention of groundwater and surface water impacts are addressed in operations associated with other units.

I-3: CARL HOLDER

Comment I-3-1

I advocate for the beneficial use of gamma radiation from the Cesium Cs-137 capsules.
Cs-137 is a national asset that continues to provide a hard gamma radiation that has beneficial use, such as the sterilization of medical supplies, food irradiation, waste water sterilization, and a last defense against harmful pathogens.

Some of the cesium capsules were previously used in a food irradiation facility away from the Hanford site - where the test use failed. But this failure should not void the application of this gamma radiation source for future beneficial use.

As this source continues to decay, both the radiation and the decay heat are significantly less than at the time of production almost two half-lives ago. The double-encapsulated canisters can now withstand the decay heat without being immersed in water. The ambient air storage of the canisters is now adequate for heat removal. Thus, now would be the time to evaluate the use of the canisters into a gamma irradiation facility.

The USA is in a supply deficit position for gamma irradiation isotopes. The value of the gamma radiation from the cesium capsules should not be underestimated.

Response to I-3-1

Thank you for your comment. As you noted, USDOE did provide capsules for research and commercial irradiation but terminated these activities after discovery of a single compromised capsule.

O-1: COLUMBIA RIVERKEEPER,

Comment O-1-1

The Washington Department of Ecology (Ecology) and U.S. Department of Energy (Energy) should remove cesium and strontium capsules from WESF in a manner that protects worker and public safety, as well as the Columbia River. In pursuing removal of capsules from aging basins and into dry storage, Riverkeeper supports Ecology and Energy's proposal to construct and operate the Capsule Storage Area (CSA). This proposed facility will provide interim dry storage of the capsules that are currently in wet storage. Further, Ecology and Energy should study the degradation of concrete in WESF, potentially providing important data for assessing risks at other basins storing radioactive material.

Response to O-1-1

Thank you for your comment. We appreciate the Columbia Riverkeeper support for the permitting of the Capsule Interim Storage (CIS) Operating Unit Group (OUG).

At this time there is no plan to study the concrete in the Waste Encapsulation and Storage Facility (WESF) pool cells. When closure activities are initiated for WESF, USDOE and Ecology will consider this suggestion.

Comment O-1-2

Ecology and Energy have been aware for years that WESF presents one of the most significant risks at the Hanford site. Storing 1936 highly radioactive cesium and strontium capsules in aging concrete basins poses an unnecessary and unacceptable threat to human health and the environment, particularly in the event of a loss of cooling water. As Ecology is aware, over long time periods, concrete structures may degrade as a result of sufficient exposure to ionizing radiation. [Reference 1: Addendum H. Waste Encapsulation and Storage Facility Hot Cell A Through F. Dangerous Waste management Unit Closure Plan. July 2017. P. H.49] Any failure of cooling water containment for capsules stored in WESF could have dramatic impacts, potentially releasing large quantities of radiation into the environment in a manner that would threaten human health, worker safety, and the environment. Accordingly, addressing WESF and proceeding with the CSA is an urgent matter.

Response to O-1-2

Ecology and USDOE both agree that this is an import scope of work to successfully complete. We appreciate your support for movement of these capsules from the pool cells to dry storage.

Comment O-1-3

The timeline for accomplishing capsule removal and dry storage gives us serious concerns. In its Waste Encapsulation and Storage Facility (WESF) and Capsule Storage Area (CSA) Permitting Plan, Energy proposes to begin construction of the facilities in July 2019. [Reference 2: Shoop, Doug. U.S. DOE. Letter transmitting Waste Encapsulation and Storage Facility (WESF) and Capsule Storage Area (CSA) Permitting Plan. December 2017. p. 7.] Further, in its new Agreement in Principle regarding changes to the TPA for this process, Energy proposes, "Milestone M-092-21 requires DOE to complete the transfer of the Cs/Sr capsules from the Waste Encapsulation and Storage Facility (WESF) to a new interim safe storage facility by August 31, 2025." [Reference 3: U.S. Department of Energy. Agreement in Principle for the Negotiation of Hanford Federal Facility Agreement Consent Order For Milestone M-092-00, Change Form M-92-17-XX. December 2017. Page 2 of 2.]

Based on this information, we are concerned that Ecology and Energy may be moving too slowly in the process of removing capsules from wet storage. We urge Ecology and Energy to move quickly and to expedite removal of capsules to dry storage prior to 2025.

Response to O-1-3

USDOE and Ecology agree that safely transferring and storing the capsules is a priority. Both the permittees and Ecology are actively working to prepare draft permits for the Capsule Interim Storage (CIS) Operating Unit Group and the Waste Encapsulation and Storage Facility (WESF) in order to support the movement of these capsules from the WESF Pool Cells to dry storage at the CIS Facility.

Comment O-1-4

Please see the attached document for 236 individuals (excluding duplicates and counting dual signatures) supporting Columbia Riverkeeper's submittal and 105 additional personal comments. Those who signed the Columbia Riverkeeper letter came from 31 states, Washington DC, and several other countries. Individual comments are summarized because there were no comments specific to revising content the Capsule Interim Storage permit application.

Comments expressed the need to protect human health and the environment, concerns regarding nuclear power itself and disposal or practical reuse of waste, personal connection and proximity to the natural resources which could be contaminated, and a request for urgency in both completing this project and finding a permanent solution for the cesium and strontium capsules. In several cases comments expressed frustration with the pace of permitting or the fact that nuclear waste continues to be stored at the Hanford Site.

Response to O-1-4

Ecology appreciates the feedback and the effort of Columbia Riverkeeper to collect and submit this information. Ecology considered each individual comment in the preparation of the draft Operating Permit for Capsule Interim Storage.

These comments demonstrate that there is a significant public interest in this project in the surrounding community, region, throughout the United States, and even outside the United States. Ecology encourages the members of Columbia Riverkeeper and all other members of the public to continue to get involved in environmental permitting and regulation locally, regionally, and nationally. Although comments and recommendations did vary there was a strong theme of protecting human health and the environment.

It is Ecology's intent to ensure the permit to support the operation of the CIS facility does protect human health and the environment.

T-1: CONFEDERATED TRIBES AND BANDS OF THE YAKAMA NATION JEAN VANNI

Comment T-1-1

The Yakama Nation Environmental Restoration Waste Management Program (YN) considers the cesium and strontium capsules to be mixed High-Level Radioactive Waste (HLW), not the designated mixed waste as stated in this document. The cesium and strontium was removed from single shell tanks (SST) waste, encapsulated to reduce tank heat load, with no future use for these radionuclides but to remain sealed in the capsules. Operational procedures of Hanford Waste Treatment Plant Project (WTP) facility are designed to remove the cesium/strontium (radionuclides with the most curies) from tank waste and place these materials into HLW canisters for final disposal in a deep geologic repository. Waste Encapsulation and Storage Facility (WESF) has already gone through this process and the cesium/strontium capsules are waiting to be disposed of as HLW in a deep underground repository. Dry storage of the cesium/strontium capsules as proposed through this modification should not preclude or curtail the final disposal of these capsules in a deep geologic repository. Long-term storage of these containers continues to be one of our main concerns with cleanup of the Hanford Site.

Response to T-1-1

The term high-level waste is not defined in Washington Administrative code (WAC) 173-303. For the purposes of Washington's Dangerous Waste Regulations, the cesium and strontium capsules contain mixed waste as defined in WAC 173-303-040.

Tri-Party Agreement Major Milestone M-092-00 requires that a long-term solution, such as an underground repository, be completed by December 31, 2047. It is the expectation of Ecology that the content of these capsules will be disposed of in a deep geologic repository.

Comment T-1-2

We [YN] request detailed description of all activities necessary during the closure period, including a clear integration of the details of future CERCLA actions, to ensure that all partial WESF closures satisfy the closure performance standards. We request details be included in the Part B Application on long-term monitoring and data collection regarding the integrity of the concrete pad.

Response to T-1-2

The Waste Encapsulation and Storage Facility (WESF) is outside of the scope of this permit modification. The storage pad for the CIS Operating Unit Group will be visually inspected annually, as detailed in Addendum I, Inspections.

Comment T-1-3

Lastly, in addition to comments in Attachment 1, YN requests the United States Department of Energy (DOE) review YN comments provided on the WESF modification documents (DOE/RL-2017-46, Rev 0.).

Response to T-1-3

Ecology and USDOE are currently reviewing public comments received on the WESF Class 3 Permit Modification.

A response to comment document will be issued specifically for comments received during the WESF public comment period.

Comment T-1-4

The Factsheet should have more clearly identified the cesium and strontium capsules to be mixed High-Level Radioactive Waste (HLW), not simply RCRA designated mixed waste.

Response to T-1-4

For the purposes of Washington's Dangerous Waste Regulations the cesium and strontium capsules contain mixed waste as defined in WAC 173-303-040.

Comment T-1-5

The Factsheet identifies the modification is proposed for a 'Capsule Storage Area' and the Part B Application identifies it as the Capsule Interim Storage Operating Unit Group. YN requests clarification.

Response to T-1-5

The Capsule Storage Area (CSA) is a dangerous waste management unit (DWMU) as defined in WAC 173-303-040. A DWMU is a contiguous area where dangerous waste will be placed. Capsule Interim Storage (CIS) is an operating unit group (OUG), which is an area containing one or more DWMUs grouped together based upon proximity or function to simplify the Hanford Site permit.

CIS is a larger area which contains the CSA, an additional pad for storage and staging of equipment, and a graveled buffer area between inner and outer fences. Please see Addendum C, Figure C-1 for a visual representation of how CSA will fit within CIS.

Comment T-1-6

The Factsheet should have clearly stated that the proposed modification is for the purpose compliance with the final facility permit Part B general (WAC 173-303-806(4)) and specific information requirements of WAC 173-303-806(4)(i). The statement that the modification is needed for the construction and operation of a proposed Capsule Storage Area to provide interim storage of cesium and strontium capsules is somewhat misleading. Citing these regulations would have pointed the reader to the information required by these dangerous waste regulations, and information that should be captured in the submitted Part B Application. This would support a more fully informed public decision-making review. This is a re-occurring concern with every Factsheet or Statement of Basis. Please include citation of appropriate the Dangerous Waste regulations of WAC 173-303 in future public information documents.

Response to T-1-6

The purpose of the permit modification as stated by the permittees in their Fact sheet is accurate. This Class 3 Permit modification was a Permittee initiated modification to the Hanford Site-wide Permit. Ecology did not supply any of the descriptive language used to explain this requested modification. Ecology reviewed all of the supplied documents to support this modification as detailed in WAC 173-303-830(4)(c) for Class 3 Modification.

Comment T-1-7

The Factsheet should include citation of the regulation WAC 173-303-830(4)(c)(ii)(F) and the contact information of Ecology's Nuclear Waste Program Public Disclosure Coordinator. Ecology's listed point of contact frequently forwards any information request to this person, who then provides the information. This will help promote Ecology's efforts for better public understanding of the modification process and elimination of added delays in obtaining information.

Response to T-1-7

On the Fact sheet the permittees listed the contact name that was provided by Ecology. Ecology has determined who their point of contact is for all permit related activities and has determined that having a single point of contact is helpful to ensure that all requests are adequately addressed.

Comment T-1-8

The Factsheet should have included reference link to DOE/RL-2012-47, 2013, Mission Needs Statement for the Management of the Cesium and Strontium Capsules and the fact that there was a Defense Nuclear Safety Board inspection of WESF (including a link and resulting requests/suggestions, etc.). Please ensure that this information is captured in the Part B Application documents.

Response to T-1-8

The Waste Encapsulation and Storage Facility (WESF) is not addressed by this permit modification and is therefore outside of the scope. A certain amount of background information regarding WESF has been provided to support the permitting of the Capsule Interim Storage (CIS) Operating Unit Group. Ecology has communicated to the Permittees what historical information we believe is required to support the permitting of the CIS.

Comment T-1-9

For better public understanding, the factsheet should have included the history/failure of commercial use of the capsules.

Response to T-1-9

A certain amount of background information regarding the history of the WESF and the capsules has been provided to support the permitting of the Capsule Interim Storage (CIS) Operating Unit Group. Ecology has communicated to the Permittees what historical information we believe is required to support the permitting of the CIS.

Comment T-1-10

The Factsheet should have included information regarding closure of the RCRA TSD portion of WESF that is anticipated to be coordinated with the B Plant Remedial Action under CERCLA. YN requests this information be captured in the Part B Application documents.

Response to T-1-10

The Waste Encapsulation and Storage Facility (WESF) is a separate operating unit group which is not part of this permit modification. Therefore, closure activities for WESF are beyond the scope of this permit modification.

Comment T-1-11

The Factsheet should have included a discussion of the SEPA determination and provide a link to the SEPA checklist. This discussion should have included information extracted from the TWRS EIS 8/30/1996 and TC-WM EIS 04/21/2016 EIS documents.

YN notes that in these EIS documents, storage of the Sr & Cs capsules were evaluated using the scenario of transfer into a building, not to an open, fenced pad area. YN requests clarification as to how this different storage design was evaluated and how the additional risk factors inherent with this design have been calculated. This information should have been included in the Factsheet. If there is not coverage, YN requests a supplemental analysis be performed to ensure all risks have been appropriately acknowledged and there is SEPA coverage for this specific design.

Response to T-1-11

The permittees developed the Fact Sheet to support the submittal of the application for the initial public comment period. Ecology will make a final State Environmental Policy Act (SEPA) determination prior to making our permitting decision for the Capsule Interim Storage Operating Unit Group. Regarding the updated dry storage scenario, please see 18-NWP-014 Final Waste Encapsulation and Storage Facility (WESF) and Capsule Storage Area (CSA) Permitting Plan, December 2017 Section 1.2.1. This agreement between Ecology and USDOE required an amended Record of Decision to address the change from transport to the Waste Treatment Plant for dry storage to the proposed CSA. This amendment is available in the Federal Register Volume 83, No. 97, May 18, 2018.

Comment T-1-12

YN also notes that the Factsheet makes statements that the capsule storage casks do not release radiation, provide robust worker radiation shielding, and are designed to meet criteria for licensed offsite transportation. These statements are not supported by statements in the Part B Application documents (e.gs. Design is not finalized; inspections are limited due to high radiation). YN requests Ecology require the Permittee to address these conflicting statements. Furthermore, YN requests Ecology provide a more robust and accurate Factsheet with its public comment period for the draft Class 3 Permit modification for the Capsule Storage Area.

Response to T-1-12

Additional documentation on cask design has been added to the supporting files for the CIS permit. Ecology will take these comments into consideration when we draft our Fact Sheet to support the second public comment period for this Operating Unit Group.

Comment T-1-13

YN requests that the Permittee review WAC 173-303-840(2)(f) and edit all future Factsheets to more fully reflect its informational requirements to ensure compliance with WAC 173-303-830(4)(c). Details are sorely lacking in this document. We request Ecology's subsequent draft permit Factsheet provide more of the requirements.

Response to T-1-13

The requirements in WAC 173-303-840 are applicable to Ecology. Ecology will write a Fact Sheet as required by WAC 173-303-840(2)(f) to support the issuance of the draft permit and the second public comment period. This requirement is not applicable to the Permittees.

Comment T-1-14

[Part A Form: Addendum A] YN requests edits to the descriptive text in Section XI to state the number of capsules currently stored to be identified as 1,936 Additionally, YN requests identification of number of strontium fluoride capsules and number of cesium chloride capsules (601/1335) and the dangerous waste constituents (i.e. barium: cadmium: chromium, lead, and silver).

Response to T-1-14

Section XI describes the "Nature of Business" for the facility. The Permittees have stated the number of capsules currently stored as 1,936. The dangerous waste constituents are designated in Part A Section XIV and the exact number of capsules are described in the Part A Form and Part B of the application.

Comment T-1-15

[Part A Form: Addendum A Section XI] YN requests clarification of total cesium and strontium mass volume (5049 kg) values. The value identified (5049 kg) is the estimated annual waste quantity identified on the WESF Part A, Section XIV.
However, WESF's Part A form identifies only 0.264 gallons/capsule (1209 total gallons) of cesium and strontium salts.

Response to T-1-15

The Permittees have revised the "CSA Storage Capacity" section of Part A Section XI to state that the total volume is 1,936 liters with each capsule being designed to be one liter in storage volume.

The total mass stored is 5,049 kg which was originally determined by weighing the empty and full capsules during production, which is also clarified in Section XI.

Comment T-1-16

[Waste Analysis Plan: Addendum B] Addendum H does not provide information on the quantity of cesium- 137 (Curies — per capsule and total), it also does not provide information on Cesium-135 that is also present in these capsules and is estimated to be 0.7 curies. Cesium-137 has a half-life of 30 years. Cesium-135 has a half-life of 2.3 million years. Cesium-137 is the initial main contributor to radioactivity, but after several hundred years, Cs-135 will become the dominant source. (Ref: US Nuclear Waste Technical Review Board on Cesium and Strontium Capsules, Revision 1, dated November 2017).

Response to T-1-16

Cesium chloride, Cesium-137, and Cesium-135 are not dangerous wastes regulated under WAC 137-303. The cited information is relevant to the federal regulations which have been developed from the Atomic Energy Act, but are beyond the scope of this dangerous waste permit modification.

Comment T-1-17

[Waste Analysis Plan: Addendum B] Addendum H only discusses the 411 "standard" strontium capsules that contain chemical impurities including barium, lead, cadmium: chromium, and silver. There is an additional 189 strontium capsules, referred as "waste capsules," that were filled with strontium fluoride that had fallen onto surfaces such as floors and tables during the strontium chipping process. One strontium capsule, called the tracer capsule, is filled with non-radioactive strontium The strontium "waste capsules" also contain inorganic materials from the drying room surfaces and some of these capsules contain pieces of equipment, building materials, metals and metal fluorides, and other chemicals that were inadvertently mixed with the waste while collecting strontium fluoride from facility surfaces. Some strontium waste capsules may contain as much as 50% foreign materials (Ref Sandia National Laboratory- 2014).

YN requests DOE provide additional information on all capsules including impurities. Section B2.2.

Response to T-1-17

Ecology assumes this comment is referencing Addendum B, based upon the discussion provided in the comment. The Permittees have updated their documents and provided an additional reference regarding the assumed silver content in the capsules and additional information regarding the analytical testing which has occurred on capsule contents.

Comment T-1-18

[Waste Analysis Plan: Addendum B] YN request inclusion of the following text: If sampling or analysis of wastes associated with the CSA Dangerous Waste Management Unit (DWMU) is to be conducted, the Closure Plan be modified to incorporate an appropriate sampling and analysis plan and a quality assurance plan.

Response to T-1-18

The cesium and strontium salts might be analyzed under certain conditions, but this sampling would most likely not require a modification to Addenda H, Closure Plan.

Comment T-1-19

[Process Information: Addendum C Section C2.1] This section does not provide required detailed information on the proposed haul path. YN requests DOE provide and include this information including design criteria, calculations, etc.

Response to T-1-19

The haul path is outside both the Capsule Storage Area dangerous waste management unit and Capsule Interim Storage operating unit group, and therefore is not within the scope of this permit modification.

However, additional information on the haul path can be found within CHPRC-02538 Rev. 0 Capsule Storage Area Final Design Report (Project W-135).

Comment T-1-20

[Waste Analysis Plan: Addendum C Section C2.1] YN requests DOE provide and include details of what is identified as the W-135 proposed project CSA/CAP Optional VCC plan. Drawing W135-CSA-SK-C-012 should be identified with a figure number.

Response to T-1-20

Additional information is contained in CHPRC-02538, Capsule Storage Area Final Design Report (Project W-135).

The drawings in Addendum C, Appendix C-A are technical drawings identified with a Drawing Number in the lower right. How the Permittee identifies their drawings is outside the scope of a permit modification.

Comment T-1-21

[Process Information: Addendum C Section C2.2] This section states, "the Transportation Storage Canister (TSC) will have a design life of 300 years." This section does not provide information on the radioactivity of the strontium capsules. It will take more than 800 years for the radioactivity of strontium capsules to decrease sufficiently for these capsules to be classified as low-level water, 0.04 curies per cubic meter. References: (NRC 2003), (Chapter 5 Cesium-137 and Strontium-90 Capsules, the National Academies of Sciences, Engineering and Medicine. Improving the Scientific Basis for Managing DOE's Excess Nuclear Materials and SNF -- 2003), and (US Nuclear Waste Technical Review Board on Cesium and Strontium Capsules, Rev. 1, dated November 2017).

Response to T-1-21

WAC 173-303 dangerous waste regulations do not address radioactivity. Due to the nature of the material, the cesium and strontium capsules are also subject to federal regulations developed from the Atomic Energy Act. The radioactive component of these capsules are not regulated by WAC 173-303, therefore the requested details are beyond the scope of this requested permit modification.

Comment T-1-22

[Process Information: Addendum C Section C2.2.4] This subsection states, the Vertical Concrete Cask (VCC) is 11 feet tall and 10 feet in diameter, with concrete wall thickness of 2 feet; the concrete is to provide radiation shielding and protect the capsules from external hazards and elements; and the VCC is capable of storing the capsules for up to 100 years without the need to repackage. Why would DOE design a dry cask that can only hold up for 100 years when the materials inside will be radioactive and generating heat for up to 200 additional years, with the strontium capsules generating radioactivity for longer (up to 800 years)? DOE needs to provide information on why the VCC will only last for 100 years. DOE also needs to provide information on what actions will be taken if the VCC (made out of concrete) fail due to the high radiation (already the high radiation fields are deteriorating WESF pools concrete walls. How will the TSC be removed and placed into a new VCC, especially if WESF has been demolished? YN requests DOE provide information on why the VCC will only last for 100 years.

Response to T-1-22

The specific minimum design lifespan has been removed from Section 2.2.4. Tri-Party Agreement Major Milestone M-092-00 requires a more permanent storage, treatment/processing, or disposal solution be completed by December 31, 2047. This gives the casks a maximum expected use of approximately 50 years. Based upon this, the Permittees specified a minimum design lifespan of 100 years for all critical elements of the cask and canister storage systems. The steps necessary to respond to a premature failure of a cask is detailed in the Building Emergency Plan and may require a permit modification.

Comment T-1-23

[Process Information: Addendum C Section 2.2.4] YN requests DOE also provide information on what actions will be taken if the VCC (made out of concrete) fail due to the high radiation (already the high radiation fields are deteriorating CSA pools concrete walls. YN request details as how will the TSC be removed and placed into a new VCC, especially if CSA has been demolished.

Response to T-1-23

Tri-Party Agreement Major Milestone M-092-00 requires a more permanent storage, treatment/processing, or disposal solution be completed by December 31, 2047. This gives the casks a maximum expected use of approximately 50 years. Based upon this, the Permittees specified a minimum design lifespan of 100 years for all critical elements of the cask and canister storage systems. The steps necessary to respond to a premature failure of a cask is detailed in the Building Emergency Plan and may require a permit modification.

Comment T-1-24

[Process Information: Addendum C Section C2.2.5] This subsection states, "the VCCs are designed to provide cooling of the TSC via natural air circulation. Outside air enters the inlet air vents located at the bottom of the VCC structure. Outlet air vents provide a flow path for the internal circulation of air adjacent to the canister for heat removal. The vents inlets and outlets are protected from natural elements by bolted-on removable screens designed to prevent or minimize debris (e.g., soil, vegetation) and wildlife from entering. Temperature instruments in the VCC outlet air vents provide a temperature monitoring system for each CSS."

The VCCs have a 2-foot thick outside walls and a 1-foot thick lid, but no shielding on the bottom. YN requests DOE explain how a radiation "shine" will not be produced in the TSC that will cause increase radiation levels at the bottom of the VCCs.

Response to T-1-24

Addendum C, Section C2.2.4 has been clarified to state that the bottom of the cask has both a pedestal and steel plate surrounded by the concrete shell of the cask to provide shielding to this area.

Comment T-1-25

[Process Information: Addendum C Section C2.2.5] There are wildlife (such as woodpeckers, coyotes, etc.), that have the capability of chewing through steel screens (i.e., cask inlet screens). There is the potential for ice and/or snow buildup on the inlet screens that block the inlets. There

are no detailed descriptions of the procedures for locally or remotely monitoring temperature of the VCCs. Maximum outlet air temperature is undefined.

YN requests DOE provide detailed information on these issues.

Response to T-1-25

The two security fences will block larger terrestrial wildlife such as coyotes from entering the Capsule Storage Area. The "General Area" inspection is intended to detect abnormal conditions within the DWMU such as significant wildlife intrusion which appears to pose a danger to the screens. Ecology has not found any evidence that wildlife has posed a significant problem for the vents of similar spent fuel casks at the nearby Columbia Generating station.

The casks used in the Capsule Storage Area have elevated inlet vents. This design feature will help ensure that snow and ice do not accumulate to block the inlets.

A more complete discussion of temperature monitoring is now included in Addendum C and the maximum temperature difference between ambient air and exhaust air is now listed in Addendum I.

Comment T-1-26

[Process Information: Addendum C Section C2.2.7] This subsection states, "In the highly unlikely event of a leaking VCC, the TSC will be repacked in a new VCC."

YN requests DOE provide detailed information on where this repacking will take place if WESF is no longer operational.

YN requests DOE provide detailed information on how this process will be done and how long it will take.

YN requests DOE provide detailed information on where the leaking VCC will be taken until the repacking can be done.

Response to T-1-26

This sentence has been removed. Addendum C, Section 2.2.5 now addresses that a strategy would be developed to transfer a transportable storage canister to a new cask if this becomes necessary.

Comment T-1-27

[Preparedness and Prevention: Addendum F Section F1] YN suggests inclusion of a reference to Addendum J, Contingency Plan.

Response to T-1-27

While there is a relationship between Addenda F, Preparedness and Prevention and Addenda J, Contingency Plan, there is no information in Addenda J which needs to be incorporated by reference into Section F1 of Addenda F.

Comment T-1-28

[Preparedness and Prevention: Addendum F Section F2.3] YN requests DOE provide details of actions to be taken during range fires should these occur on the Hanford site.

Response to T-1-28

This information is currently located in Addendum J, Contingency Plan, which is the most appropriate location.

Comment T-1-29

[Preparedness and Prevention: Addendum F Section F3.2] YN requests DOE provide a detailed description of loading and unloading activities for each of the bulleted items (including equipment, work packages, etc). Additionally, we request information on process of transport of casks from WESF.

Response to T-1-29

Capsule Interim Storage has not yet been constructed, and therefore the specific procedures and work packages have not yet been developed. Once developed, Ecology will review and determine if any specific information will need to be included in the CIS OUG Permit through a permit modification.

Transport of casks from the Waste Encapsulation and Storage Facility occurs outside both the Capsule Storage Area dangerous waste management unit and Capsule Interim Storage operating unit group, and is therefore not within the scope of this permit modification application.

Comment T-1-30

[Preparedness and Prevention: Addendum F Section F3.3] Please see our [YN] comments regarding snow buildup beneath the casks

Response to T-1-30

The casks used in the Capsule Storage Area have elevated inlet vents which will help ensure that snow and ice do not accumulate to block the inlets.

Comment T-1-31

[Preparedness and Prevention: Addendum F Section F3.4] YN requests DOE provide details of actions to be taken during power outages.

Response to T-1-31

Section F3.4.2 of Addenda F, now addresses the actions which are taken during power outages.

Comment T-1-32

[Preparedness and Prevention: Addendum F Section F3.5] YN requests edits of redundant text and asks that DOE provide a more detailed discussion and listing of requirements for worker safety.

Response to T-1-32

The redundant text has been removed. Additional information regarding personal protective equipment and engineering/administrative controls has been added.

Comment T-1-33

[Personnel Training: Addendum G] Addendum G does not provide sufficient information to be able to determine if compliance with WAC 173-303-330 is met. Reference to an unidentifiable CSA DWTP does not suffice.

YN requests DOE include the necessary details within this addendum (including descriptions of job positions) or attach the DWTP as an appendix. Without it, this section does not comply with WAC 173-303-330 requirements.

YN requests clarification as to why personnel identified as Nuclear Chemical Operators are the only staff required to have training in inspections.

Response to T-1-33

Addendum G, Personnel Training has been significantly revised to provide more information to demonstrate compliance with WAC 173-303-330, including specific course numbers, course descriptions, and job descriptions.

Nuclear Chemical Operators will be the staff primarily conducting inspections of facilities and equipment, but inspections have also been added to management training courses.

Comment T-1-34

[Closure Plan: Addendum H] YN requests clarification within Addendum H—Closure Plan that the Washington State Department of Ecology will maintain regulatory oversight and approval of all RCRA closure related activities, including those performed under CERCLA actions. Ecology must oversee all closure activities in order to approve the certification that closure actions were conducted in accordance with the approved closure plan.

Response to T-1-34

As detailed in Addenda H, Closure Plan, "the CSA will be clean closed by removal of the concrete pad under Washington State's Hazardous Waste Management Act, Chapter 70.105 Revised Code of Washington, and implementing regulations of WAC 173-303." There is no plan to perform any of the closure activities associated with CSA under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) actions.

Comment T-1-35

[Closure Plan: Addendum H Section H1.3] YN requests DOE include details within this addendum regarding the W- 135 Project.

Response to T-1-35

A reference has been added to Addendum H, Section H1.3 to point to Addenda C for more information on the W-135 Project.

Comment T-1-36

[Closure Plan: Addendum H Section H2] YN requests more specificity as to identification of the closure performance criteria. YN request the following for cleanup standards for soils that will satisfy the most stringent (lowest) of: [i.e. WAC 173-340-700] specifically:

i. Direct contact consistent with WAC 173-340-740(3)

ii. Soil concentrations to protect groundwater: derived using WAC 173-340-747(4) and WAC 173-340-740(5) to evaluate hexavalent chromium using the site-specific Kd value of 0 mL/g supporting a 0.19 mg/kg [soil protective of groundwater];

iii. Protection of ecological receptors achieved through one of the following methods:

   1. Excavation of contaminated soil to a minimum of 15 feet below ground surface, or

2. Excavation of contaminated soil such that residual soil concentrations do not exceed ecological screening levels listed in WAC 173-340-900 (Table 749-3), or
3. A site-specific demonstration that remedial standards eliminate threats to ecological receptors.

Response to T-1-36

Approval of this permit modification will require complete removal of the concrete pad and verification that there is no evidence of contamination to reach clean closure. Based upon the fact that this is a new facility with no history of releases, the waste is contained in multiple sealed layers of steel, and any release will be readily detectable due to secondary material characteristics (i.e., radioactivity) Ecology is currently requiring that the Permittees conduct visual inspection and records review prior to removal of the concrete pad to identify any potential site contamination.

If the possibility of contamination exists, the Permittees must work with Ecology to develop a Sampling and Analysis Plan which would address the standards to be met prior to Ecology's certification of clean closure.

Comment T-1-37

[Closure Plan: Addendum H Section H4] There is a lack of necessary details to be able to meet compliance with WAC 173-303-610 closure. Compliance with WAC 173-303-610(3)(a) requires detailed descriptions of all necessary closure activities to be included in the closure plan. Details of the activities for the removal offsite and final disposition of the Cs/Sr Capsules are completely unaddressed.

This section does not provide any information on the final disposal of the cesium and strontium capsules inside the VCCs. It only addresses removal of the concrete pad, fences, and soil sampling (to verify no contamination spread from the pad to the underlying soils). YN considers the cesium and strontium capsules to be mixed high-level radioactive waste and not simply mixed waste. Until these capsules radioactively decay to allow disposal in a Class C Low-Level Burial Ground, final disposal is a deep geological repository--the same as the HLW canister from the WTP that will also contain large amounts of cesium and strontium. In addition, there is no discussion of the heat load issue with the strontium capsules after the radiological decay, which according to the NAS and the NRC evaluations, will take another 800 years for the capsules radioactivity to decrease for low-level radioactive waste disposal.

YN requests DOE include detailed description of final disposition of the cesium and strontium capsules.

YN requests DOE include details of the evaluation of heat load issues after initial radiological decay.

Response to T-1-37

At this time, there is no viable disposal pathway for the cesium and strontium capsules. Tri-Party Agreement Major Milestone M-092-00 requires a more permanent storage, treatment/processing, or disposal solution be completed by December 31, 2047. Milestone M-092-20 requires an evaluation of disposition pathways every four years, with the first report due March 31, 2022. The activities described in the Closure Plan require that a disposition

pathway is secured and the casks be removed from the Capsule Storage Area prior to commencing clean closure.

Comment T-1-38

Closure Plan: Addendum H] There is a lack of details on construction of the haul road and staging areas and their clean closure.

YN requests details regarding the 'existing staging area' and location of alternative staging area for the CSA.

YN requests details of closure of the haul road and staging areas for the CSA.

Response to T-1-38

Haul roads and staging areas for emergency response are outside the Capsule Storage Area dangerous waste management unit and will not be closed as part of the CIS OUG Closure Plan.

Comment T-1-39

[Closure Plan: Addendum H] There is lack of clear integration of the details of the CERCLA actions. YN requests detailed description of all activities necessary during the closure period including a clear integration of the details of future CERLCA actions, to ensure that all partial WESF closures satisfy the closure performance standards. Additionally, we also request clarification within Addendum H--Closure Plan that the Washington State Department of Ecology will maintain regulatory oversight and approval of all RCRA closure related activities, including those performed under CERCLA actions. Ecology must oversee all closure activities in order to approve the certification that closure actions were conducted in accordance with the approved closure plan (e.g., the isolation of Hot Cell G).

Response to T-1-39

The Capsule Storage Area dangerous waste management unit will not be closed through the Comprehensive Environmental Response, Compensation, and Liability Act. As stated in the Closure Plan, "the CSA will be clean closed by removal of the concrete pad under Washington State's Hazardous Waste Management Act, Chapter 70.105 Revised Code of Washington, and implementing regulations of WAC 173-303." Closure activities at the Waste Encapsulation and Storage Facility are beyond the scope of this permit modification amendment. Ecology will continue to apply properly promulgated and delegated authority over such activities.

Comment T-1-40

[Closure Plan: Addendum H] Lines 26-29, page H-3: YN disagrees with definition of term "clean closure" as defined. Edit Line 26 sentence to read: The term "clean closure" refers to performing closure activities that result in full removal of all wastes and full removal or decontamination of all structures and containment system components, equipment, debris, environmental media (i.e., soil and groundwater) materials affected by releases from the unit so as to satisfy the closure performance standards of WAC 173-303-610(2)(b)(i)&(ii).

Response to T-1-40

The text has been revised as suggested.

Comment T-1-41

[Closure Plan: Addendum H Page H-3] Line 33: YN requests inclusion of bullets for removal of casks off-site and evaluations (i.e. sampling) of the haul road.

Response to T-1-41

At this time, there is no viable disposal pathway for the cesium and strontium capsules. Tri-Party Agreement Major Milestone M-092-00 requires a more permanent storage, treatment/processing, or disposal solution be completed by December 31, 2047. Milestone M-092-20 requires an evaluation of disposition pathways every four years, with the first report due march 31, 2022. The activities described in the Closure Plan require that a disposition pathway is secured and the casks be removed from the Capsule Storage Area prior to commencing clean closure.

The location of the haul road is outside the footprint of the CIS OUG and is not required to be included in the Closure Plan associated with this permit modification application.

Comment T-1-42

[Closure Plan: Addendum H Section H4.1] YN request sampling rather than assumption to verify clean debris surface standard should there be any staining, cracks, holes or other breaches to the liner or concrete structure.

Response to T-1-42

The Permittees are proposing full removal of the concrete pad rather than decontamination to reach the definition of clean debris surface. If there is the potential that dangerous waste might have been released to the environment, based upon the visual examination and records review, a Sampling and Analysis Plan will be developed to ensure contaminated environmental media is properly decontaminated or removed, as detailed in Section 4H.1 of the Closure Plan.

Comment T-1-43

[Closure Plan: Addendum H Section H4.2] YN requests inclusion of bullet for removal of haul road.

Response to T-1-43

The haul road is not part of the CIS OUG and will not be closed as part of the Closure Plan associated with this permit modification application.

Comment T-1-44

[Closure Plan: Addendum H Section H4.2.1 through H4.2.3.1] All these sections need more details. Please provide.

YN also requests clarification if there will be a Section 106 review required for the removal of all utility lines.

Additional edits to Section 4.2.3: YN requests the following text to be included: Residuals from decontamination (e.g., rinse water and concrete dust) may be subject to regulation as dangerous wastes and may be required to carry the dangerous waste codes associate with the waste management unit undergoing closure. [Ecology Publication 94-111, Section 5.3.3, Decontamination Residuals.]

Response to T-1-44

Some additional detail has been added to sections H4.2.1 and H4.2.3 of the Closure Plan. If there is no possible contamination, removal of the Capsule Storage Area concrete pad will be a straightforward demolition and removal.

Utility lines will not be removed as part of the closure plan associated with the Capsule Storage Area dangerous waste management unit.

The Permittees have not proposed decontamination, therefore rinse water will not be produced as part of closure activities. Concrete dust is expected to be contained in the rubblized concrete to the greatest degree possible for removal from the site. The permittees will implement dust suppression activities to ensure that any dust produced during demolition will be kept to a minimum.

Comment T-1-45

[Closure Plan: Addendum H Section H4.3] Specify procedures and methods for determining whether the removed material is a dangerous waste and for handling it as such, including parameters and test methods that provides these procedures.

YN requests a more fully detailed description of the activities required for waste removal and management be included. Provide more details regarding potential types of removal equipment, safety procedures, packaging, etc. It is unclear how compliance with cited regulations is met.

Response to T-1-45

The Capsule Storage Area (CSA) is a unique miscellaneous unit. Rather than traditional containers which are designed for addition and removal of material, the TSCs are designed to prevent release through the use of multiple sealed impermeable steel layers. The most similar facilities, those storing spent nuclear fuel rods using dry storage casks under Nuclear Regulatory Licenses, have had no instances of structural failures or releases in their history.

At this time the available information indicates that there would not be zero to minimal potential for a release outside of a natural disaster or catastrophic circumstances during the expected CSA lifespan. Additionally, to protect human health and the environment it is likely that any release would need to be identified and analyzed through radiological methods rather than traditional dangerous waste sampling and analysis.

Because of these unique circumstances, Ecology has determined that it would be most appropriate to develop a Sampling and Analysis Plan (SAP), at the time of closure, if necessary, based upon all available information to ensure that all potential contamination and process history is evaluated and analyzed in the SAP.

Similarly, waste removal activities are expected to be relatively simple if it is confirmed there is no contamination. Rubblizing concrete and removing fence and concrete debris is a common and simple process if it is confirmed that they are not contaminated. If operating history of the CIS OUG indicates the potential for contamination, it is expected that the currently detailed removal steps described in Addendum H, Closure Plan will no longer be appropriate and the Closure Plan would need to be significantly revised through a permit modification.

Comment T-1-46

[Closure Plan: Addendum H Section H4.3] Describe management of any spills and any accumulated precipitations.

Response to T-1-46

In total, the concrete pad in the Capsule Storage Area and paved operating pad in Capsule Interim Storage OUG cover approximately 6,075 square feet, are sloped 1%, will be surrounded by a 4" leveled gravel bed, and will be located in an area with a 100-year 24-hour precipitation event of approximately 2.1 inches (National Oceanic and Atmospheric Administration Atlas 2, Volume IX- Washington). There should not be any accumulated rainfall on site during normal operation or closure activities, due to the design of the concrete pad.

The closure plan activities cannot be implemented until Tri-Party Agreement Major Milestone M-092-00 has been met and the casks have been removed from the site, therefore spills of the stored hazardous waste would not occur during the activities described in section 4.3. If during demolition activities, a spill occurs the permittees will manage that spill in accordance with WAC 173-303-201(2).

Comment T-1-47

[Closure Plan: Addendum H Section H4.4] Describe the steps to characterize and designate any new waste streams and to create an adequate waste profile for these.

Response to T-1-47

If a new waste must be designated the process is described in WAC 173-303-070. If a new waste stream is generated by the permittees, those activities would be considered generator activities and they fall outside of the scope of the Resource Conservation and Recovery Act (RCRA) Permit for this OUG.

Comment T-1-48

[Closure Plan: Addendum H Section H5] YN requests clarification that the IQRPE's report will be retained in the unit specific operating record and the Administrative Record We also request inclusion of the following bullet as a review document for the IQRPE:

Unit(s) inspection records and documentation of remedial actions taken in response to spills and releases.

Response to T-1-48

Section H5 of the Closure Plan has been updated to state the Independent Qualified Registered Professional Engineer's (IQRPE) report will be contained in the Capsule Interim Storage portion of the Hanford Facility Operating Record.

To verify that the closure activities were performed in accordance with the closure plan the IQRPE will review the records and documentation determined to be relevant and appropriate. The Permittees must make these records available to support the IQRPE's review and evaluation.

Comment T-1-49

[Closure Plan: Addendum H Section H7] Lines 20-21: YN requests edits to add following text to end of sentence: provided it meet the performance standards.

Line 22: YN requests edits reflecting clean closure is confirmed by Ecology. Ecology reserves the authority to make decision as to the clean closure of a DWMU after review of certification of clean closure documents.

Response to T-1-49

The sentence formerly in lines 20-21 of Section H7 has been revised to the following: "Once the CSA concrete pad has been removed, no possible contaminated environmental media is identified, and it meets the closure performance standards, the CSA DWMU will be considered clean closed, at which point only bare soil will remain."

The sentence formerly in line 22 of Section H7 has also been clarified to state that Ecology confirms clean closure.

Comment T-1-50

[Closure Plan: Addendum H Section H8] Lines 29-31 : YN requests deletion of text stating approval of closure plan grants an extend closure period. The closure schedule presented is endless because it has no start date. YN requests identification of start date for removal of casks off-site.

Response to T-1-50

The Permittees now specifically request an extension in Section H8. Because this permit modification is necessary to allow the permittees to initiate construction of the OUG, it is premature to establish a start date for closure of this DWMU. As detailed in the Closure Plan, amendments to this closure plan will be submitted as a permit modification in accordance with WAC 173 303-610(3)(b) and WAC 173-303-830, "Permit Changes," as applicable.

Tri-Party Agreement Major Milestone M-092-00 requires a more permanent storage, treatment/processing, or disposal solution be completed by December 31, 2047. Members of the Tri-Party agreement would prefer that this be accomplished sooner, which is reflected in the text of the milestone. Therefore, the milestone deadline is not being used as the proposed date to begin closure activities.

Comment T-1-51

[Closure Plan: Addendum H Section H8] YN request replacement text: In accordance with WAC 173-303-610(4)(b), closure activities will be completed no more than 180 days after the start of closure. Should unexpected circumstances arise and an extension to the 180 closure activity expiration date be deemed necessary, a Class 1 Prime permit modification will be submitted to Ecology for approval at least 30 days prior to the 180 day expiration date, in accordance with WAC 173-303-610(4)(c) and WAC 173-303-830, Appendix I, Section D.1.b. The extension request would also demonstrate that all steps to prevent threats to HHE, including compliance with all applicable permit requirements and criteria, have been and will continue to be taken.

Response to T-1-51

The following text has been added to Section H8: "In the event of a proposed change in facility design or operation or an unexpected event that affects the closure plan, a permit modification request to amend the closure plan will be submitted to Ecology per WAC 173-303-610(3)(b)(iii)."

While a simple extension of closure alone would be a Class 1 Prime modification under current WAC there is the potential that such an application would have other factors which would change the classification. Specifying the modification type could create a conflict between the permit and regulatory compliance.

Comment T-1-52

[Closure Plan: Addendum H Table H-1 and Figure H2] YN requests inclusion of scheduling for capsule removals.

YN believes year dates ought to be included. We believe establishing dates in the Permit and TPA milestones will support funding requests

Response to T-1-52

Currently there is no viable disposition pathway for the cesium and strontium capsules. A start date for removal written into Addendum H would be arbitrary and would not be based upon what is technologically or legally possible.

Tri-Party Agreement Major Milestone M-092-00 requires a more permanent storage, treatment/processing, or disposal solution be completed by December 31, 2047. Members of the Tri-Party agreement would prefer that this be accomplished sooner, which is reflected in the text of the milestone. Therefore, the milestone deadline is not being used as the proposed date to begin closure activities.

Comment T-1-53

[Closure Plan: Addendum H Figure H-1] YN requests inclusion of figure, which provides location of the CSA relative to WESF and the WTP facilities. Figure A-1 of Addendum A and the Factsheet figures are at a scale unfamiliar with the public.

Response to T-1-53

The Waste Encapsulation and Storage Facility and Waste Treatment Plant are not part of the Capsule Interim Storage operating unit group or the Capsule Storage Area dangerous waste management unit. These facilities will not be part of the activities for the closure plan associated with this permit modification and are beyond the scope of Addendum H.

Comment T-1-54

[Inspection Plan: Addendum I Section I1.4] This section states, "The dry storage cask system that forms the basis for the CSS has been approved by the US NRC through evaluating the design for resistance to accident conditions and technical review of safety aspects. The NRC's safety oversight program for spent fuel includes inspections and assessments, and focuses on minimizing risk to public health and safety and protecting the environment."

YN requests DOE include the necessary details within this addendum regarding information on the NRC approval of the CSS including evaluating the design for resistance to accident conditions and technical review of safety aspects.

Response to T-1-54

Thank you for your comment. The quoted text has been removed because it was potentially confusing.

USDOE required that its capsule storage system (CSS) design/fabrication contractor to base the design and analysis for the CSS components on the Nuclear Regulatory Commission (NRC)-approved Certificate of Compliance equipment. The design is based on previous NRC-certified designs adapted as necessary to accommodate the differences between spent nuclear fuel and cesium and strontium capsules, but is consistent with the final approved design basis. The final CSS design does not require, and will not receive, NRC approval because it will not be put into use to store spent fuel rods at licensed nuclear power plants or independent fuel storage locations.

Comment T-1-55

[Inspection Plan: Addendum I Section I1.4] The NRC has mandated that all dry- casks storage systems be evaluated for the potential to generate hydrogen gas. YN requests DOE include details of this evaluation.

NRC license requirements limit the air outlet temperature to no more than 30 degrees above ambient air inlet temperature. YN requests details of how this standard will be met.

Response to T-1-55

The Permittees addressed the possibility of hydrogen generation by assessing the possibility of foreign material on the capsules. It was determined that there are no foreign material deposits on the capsules which might pose such a hazard. The Permittees, based upon their specific design, have proposed allowable temperature differentials from 110 to 131 degrees Fahrenheit depending upon the capsule loading type. This has been determined to be protective of the Cask Storage System, temperature monitoring system, storage pad, and stored mixed waste. Ecology is not aware of a requirement that all NRC-licensed facilities maintain a maximum temperature differential of 30 degrees in any standard temperature unit.

Comment T-1-56

[Inspection Plan: Addendum I Section I1.4] YN requests clarification as to why the Hanford Dry Casks are not required to meet the same design requirements as for spent nuclear fuel dry casks.

YN further requests DOE evaluation regarding use of used nuclear fuel containers for storage. Review should include results of accidents that could happen in real-world conditions.

Response to T-1-56

The Permitees based the capsule storage system (CSS) upon previous NRC-certified designs adapted as necessary to accommodate the difference between spent nuclear fuel and cesium and strontium capsules. The vertical concrete casks will not be used in a monitored retrievable storage installation operated by the Department of Energy or an independent fuel storage installation, as defined in Code of Federal Regulations Title 10 Part 72. Therefore, they are not subject to the licensing and design criteria for such storage.

Language has been added to Addendum C, Process Information addressing accident scenarios. More information is also included in CHPRC-02538 Rev. 0, Capsule Storage Area Final Design Report (Project W-135), which is included in the supporting materials for this permit modification.

Comment T-1-57

[Inspection Plan: Addendum I Section I1.4] YN notes spent nuclear fuel in NRC approved dry storage casks are completely sealed and the air movement in the casks is outside of the fuel container--the fuel heat load is transferred to the dry cask concrete where air movement removes the heat from the concrete.

YN believes the Hanford Dry Casks must meet the same structural integrity requirements as the Holtec Hi-Storm dry casks approved by the NRC and including terrorist scenarios. YN believes the dry storage cask should meet the following NRC requirements:

1. Dry Casks

The NRC must certify all container designs. Before approval, containers must meet rigorous engineering and safety criteria and be able to pass a series of hypothetical accident conditions that create forces greater than the containers would experience in actual accidents. The same container undergo in sequence:

A 30 foot free fall onto an unyielding surface.

A 40 foot fall onto a steel rod six inches in diameter.

A 30 minute exposure to fire at 1,475 degrees Fahrenheit that engulfs the entire container.

2. Submergence under three feet of water for eight hours.

Also, by a separate test, containers are to be submerged under 50 feet of water for eight hours.

Response to T-1-57

The vertical concrete casks will not be used in a monitored retrievable storage installation operated by the Department of Energy or an independent fuel storage installation, as defined in Code of Federal Regulations Title 10 Part 72. Therefore, they are not subject to the licensing and design criteria for such storage. The Permitees based the capsule storage system (CSS) upon previous NRC-certified designs adapted as necessary to accommodate the difference between spent nuclear fuel and cesium and strontium capsules.

Ecology notes that this comment references a spent fuel rod storage cask design which directly contacts cooling air with the inner multi-purpose canister in a manner which is very similar to the capsule storage system (CSS). The design does not rely on concrete for heat transfer as indicated in the comment.

Additionally, this comment may not clearly differentiate the requirements for spent fuel rod storage casks and transportable storage canisters, which are held to different standards. Transport packages (not necessarily casks) must survive several of the referenced tests, although the details may be different (such as the puncture test being a 40-inch fall, not a 40-foot fall as stated).

Comment T-1-58

[Inspection Plan: Addendum I Table I-1] Casks-Cooling Vents. YN noted statement: Due to localized radiation fields, physical inspections of cooling vents will be conducted on an annual basis. Temperature monitoring will occur weekly and used as an indicator for the cooling vents. Vent inspections look for problems (debris and wildlife blocking the casks' cooling vents), and verify that cooling vents are clear of defects and obstructions.

YN requests clarification as to why there a high radiation field around the VCCs. Please explain why these shielded casks are generating a radiation field. Is it because the bottoms of the VCCs do not have a concrete cover?

YN requests DOE rethink the VCC design so there is no radiation field around the VCCs and they can be inspected weekly in compliance with WAC 173-303-630.

Response to T-1-58

The inspection schedule has been significantly updated with temperature monitoring daily (standard Hanford site work days), weekly check of alarm systems, and a monthly check of site security and housekeeping from the exterior fence line to ensure there is no visible buildup of material which might block vents.

The radiation fields around the casks are due to the concentration and short half-life of the radioactive cesium and strontium salts. The bottom of the cask has a steel plate, pedestal, and concrete shell for shielding. Ecology notes that the radiation fields within the Capsule Storage Area are roughly equivalent to those on the storage pad at Columbia Generating Station.

Comment T-1-59

[Inspection Plan: Addendum I Table I-1] Casks — Temperature Monitoring. This inspection will be done weekly. Temperature monitoring looks for equipment not operational or temperature out of normal operating range.

There is not outlet temperature limit. The NRC limit for spent nuclear fuel dry- casks is 30 degrees above ambient air inlet temperature. YN requests DOE provide a maximum temperature limit in this application.

YN requests DOE provide more information on how the VCCs temperature monitoring will be conducted (locally or remotely) under normal and abnormal conditions including during an extended power or temperature monitoring failure. YN requests DOE provide information on what actions will be taken if the outlet temperature limit is exceeded.

Response to T-1-59

Temperature monitoring has been increased to daily on work days, maximum temperature differentials have been added to Addendum I Table I-1, and more information has been added to Addendum C regarding the temperature monitoring design. Regarding maximum temperature differential, Ecology is not aware of a requirement that NRC-licensed facilities maintain a maximum temperature differential of 30 degrees in any standard temperature unit. Columbia Generating Station, NRC License NPF-21, has a design temperature differential of 126 degrees Fahrenheit for their spent fuel rod storage casks.

The Permittees have provided documentation that even with fully plugged vents heat buildup would not cause a release of material to the environment. However, it could pose a danger to the temperature monitoring system and therefore the vents should be cleared as soon as practicable. If this occurs, the action outlined in Addendum I Section I1.3 will be implemented.

If the temperature monitoring system is not operable due to power loss or other circumstances, the permittee will conduct visual observations of vent inlets and outlets in place of required temperature monitoring.

Comment T-1-60

[Inspection Plan: Addendum I Section I-2] YN requests inclusion of a checklist as an Appendix to this Addendum. Provide an example of an inspections checklist and summarize how it ensures facility compliance with WAC 173-303-630(6) and WAC 173-303-145.

Response to T-1-60

Capsule Interim Storage OUG is not yet constructed or operational. Inspection checklists and work packages will be developed prior to commencing operations.

Comment T-1-61

[Inspection Plan: Addendum I Section I-3] Lines 39-41 : YN requests clarification that Ecology will be contacted and any remedies and schedules will be established in agreement with Ecology and permit modifications per WAC 173-303-830 submitted as needed.

Response to T-1-61

Ecology is assuming this comment is intended to reference Lines 14-16 of Section I-3 of the Inspection Addenda, based upon an identical comment submitted on DOE/RL-2017-43 for the Waste Encapsulation and Storage Facility.

Ecology encourages the Permittees to communicate any problems encountered whether or not WAC 173-303 requires a notification. However, there are potentially problems which do require notification to Ecology or a permit modification.

Comment T-1-62

[Inspection Plan: Addendum I Section I-4] Lines 17--19: YN requests clarification or deletion of sentence.

Response to T-1-62

Ecology is assuming this comment is a reference to Section I.4 of Addendum I, Lines 17-19 of the permittees application submittal for the Waste Encapsulation and Storage Facility, based upon an identical comment submitted for that application.

Section I1.4 of Addendum I for the CIS OUG does not contain identical language, but it does have a similar discussion of minimizing physical access to the casks on Page I-3 Lines 4-7. Due to the unique characteristics of the waste stored within this miscellaneous unit, Ecology has determined that WAC 173-303-630(6), which is a container storage area requirement, is not entirely appropriate or applicable to this DWMU. A combination of temperature monitoring and other inspections will be used to meet the intent of these regulatory requirements instead.

Comment T-1-63

[Contingency Plan: Addendum J and Appendix J-A Building Emergency Plan for CSA] YN requests additional details regarding the 'existing staging area.'

YN requests additional details regarding use and location of alternative staging area for the CSA.

Response to T-1-63

The staging areas are existing clearings with street access that provide safe locations for gathering of personnel and staging of equipment. There isn't anything unique enough about either location to require further description beyond identifying that staging areas have been

designated if emergency actions, as detailed in the Building Emergency Plan, must be implemented.

Comment T-1-64

[Contingency Plan: Addendum J and Appendix J-A Building Emergency Plan for CSA Section 6.1.1] This section states, "Electrical power is required for the CSA, however, loss of electricity does not constitute an emergency, but must be restored as soon as possible."

YN requests DOE provide a defined time frame when electrical power must be restored (hours, days, etc.), and what possible impacts would result from an extended loss of power.

Response to T-1-64

If power is lost, visual inspection of vents will be substituted for daily temperature monitoring. Columbia Generating Station has similar requirements for casks storing spent fuel rods, under their Nuclear Regulatory Commission license, if temperature sensors are not operational.

The casks themselves can function indefinitely without power, which is supported by submitted design documents.

Comment T-1-65

[Contingency Plan: Addendum J and Appendix J-A Building Emergency Plan for CSA Section 6.1.1] This section also states "Loss of Ventilation--Not Applicable." The VCCs use passive ventilation, but ventilation of the VCC is required in order to maintain cooling of the capsules. A loss of ventilation on a VCC could result in internal damage to the TSC and the capsules, resulting in a release of radiation.

YN requests DOE provide information on what a loss of ventilation would have on a VCC.

Response to T-1-65

Section 6.1.1 of the Building Emergency Plan covers Loss of Utilities. In this case utilities is the common definition of external services or equipment which supplies something useful such as electricity, water, air, etc.

The Capsule Storage Area does not require any external fans, ducting, or other equipment to provide cooling for the vertical concrete casks and therefore will not be subject to any potential emergencies due to the loss of such a utility.

Comment T-1-66

[Contingency Plan: Addendum J and Appendix J-A Building Emergency Plan for CSA Section 6.1.3] This section states, "Not Applicable."

YN requests DOE provide information on a potential pressure release from a cesium/strontium capsule due to excessive heat buildup. Additionally, YN requests DOE consider the possibility of a high heat condition resulting in pressurizing a capsule resulting in a crack and release of radiation and what actions would be needed to protect human health and the environment.

Response to T-1-66

Please see the revised Addendum C, Section C2.2.5 for additional discussion of how elevated temperatures will impact a transportable storage canister. Section 6.1.3 of the Building Emergency Plan would typically discuss vessels which are under significant pressure during

normal operation, not sealed containers which may be subject to some amount of gauge pressure based upon temperature variation.

Comment T-1-67

[Contingency Plan: Addendum J and Appendix J-A Building Emergency Plan for CSA Section 6.1.4] This sections states, "Depending on the fire conditions, the fire could exceed the design of the cask and result in a release of radiological material." NRC dry casks are required to withstand a 30-minute exposure to fire at 1,475 degrees Fahrenheit that engulfs the entire container. DOE is saying a fire could damage the VCCs and result in a radiation release.

YN requests DOE define what temperature could fire damage the VCCs.

Response to T-1-67

The temperature limit for the outer portions of the transportable storage canister is 1,500 degrees Fahrenheit, as described in Addendum C Section C2.2.5.

Comment T-1-68

[Contingency Plan: Addendum J and Appendix J-A Building Emergency Plan for CSA Section 6.1.6] This section states, "A failed capsule could present a hazard to operations personnel, however, due to important design features identified for the VCC the design is robust enough not to release dangerous/mixed waste material."

YN requests DOE provide more information on what robust features the VCCs have that will prevent a dangerous/mixed waste spill. The bottom of the VCC is open (no concrete). The TSC that holds the capsules and both are made out of stainless steel and under high heat conditions that could leak caused by corrosion cracking. DOE needs to rethink the VCC design to ensure the capsules are sealed with the concrete to prevent leaks, spills, etc.

Response to T-1-68

As clarified in Addendum C, the vertical concrete cask will have a pedestal, steel plate, and an outer concrete shell. Section 6.1.6 of the Building Emergency Plan has been revised to state that the unique design features of the capsule storage system, rather than vertical concrete casks, prevent release. These features include the sleeve and canister design which surrounds the capsules and would prevent release from a compromised capsule.

The casks cannot be completely sealed because passive ventilation is required to stay within the normal operating temperature differential. Stainless steel has a thermal conductivity approximately 10-40 times that of concrete and the contact between freely flowing air and steel is necessary for cooling.

Comment T-1-69

[Contingency Plan: Addendum J and Appendix J-A Building Emergency Plan for CSA Section 6.1.7] This section states, "The only shipments to the CSA will be from WESF." The VCCs will be loaded at WESF in the Truckport and Loading Area. Transporting the VCCs requires the use of a crane and a transport vehicle. Accidents could occur during the loading and loading phases of the VCCs that could result in damage or a VCC lying on its side.

YN requests DOE provide information about a loading and unloading accident involving the VCCs.

Response to T-1-69

Loading and unloading at the Waste Encapsulation and Storage Facility will be addressed in the separate application and permit modification for that operating unit group. The equipment used to transport casks is further described in the CHPRC-02538 Rev. 0, Capsule Storage Area Final Design Report (Project W-135).

Comment T-1-70

[Contingency Plan: Addendum J and Appendix J-A Building Emergency Plan for CSA Section 6.1.8] This section states, "Due to important design features identified for the VCC there will be very little to no radioactive material release from the CSA." See comments on subsection 6.1.4 and 6.1.6 above.

Response to T-1-70

Section 6.1.8 of the Building Emergency Plan has been revised to state "Due to important design features identified for the CSS, there will be very little to no potential for radioactive material released from the CSA."

Additional information has been added to Addendum C, Process Information regarding cask design and operational limits to support capsule storage system robustness.

Comment T-1-71

[Contingency Plan: Addendum J and Appendix J-A Building Emergency Plan for CSA Section 6.2.1] This section states, "Depending on the magnitude of the event, severe structural damage can occur resulting in serious injuries or fatalities and the release of hazardous materials to the environment. Damaged electrical circuits and wiring could result in the initiation of fires." The information stated is basic for all of the Hanford Site and not specific for the CSA. A seismic event could result in tipping over VCCs and potentially damaging the concrete walls and lid.

YN requests DOE provide more information on how a seismic event could impact the CSA.

Response to T-1-71

Seismic considerations were taken into account in the concrete pad design. The pad was designed to ASCE/SEI 7-10 standards to ensure the casks will not tip during an earthquake.

Comment T-1-72

[Contingency Plan: Addendum J and Appendix J-A Building Emergency Plan for CSA Section 6.2.2] This sections states, "Though not expected to cause structural damage, the ash resulting from a volcanic eruption could cause shorts in electrical equipment and plug ventilation system filters." What ventilation system filters -- the VCCs use passive ventilation.

YN requests DOE explain the ventilation system filters. Also, Mt. St. Helens ash fall at Hanford was less than one inch, but Ritzville received several inches. At what depth of ash will block the inlet air screens on the VCCs?

YN requests DOE provide information on the air inlet screen size, location on the VCC and measurements from the ground to the screen bottom and top.

Response to T-1-72

Section 6.2.2 of the Building Emergency Plan has been revised to state "Though not expected to cause structural damage, the ash resulting from a volcanic eruption could cause shorts in electrical equipment and plug the passive ventilation system ." As noted, the casks use passive ventilation and the possibility of adding filters to protect the ventilation system in case of eruption has been eliminated as a planned response.

Exact dimensions for the casks have been submitted as confidential business information due to the unique design elements necessary to house the cesium and strontium capsules. The cask inlet vents are elevated from the ground, which will help prevent snowfall or ash accumulation from blocking air intake. As noted in Addendum C, Section C2.2.5, the transportable storage canisters have been designed to survive even complete vent blockage without releasing material.

Comment T-1-73

[Contingency Plan: Addendum J and Appendix J-A Building Emergency Plan for CSA Section 6.2.5] This sections states, "The hazards associated with a range fire are the same as those associated with a building fire plus potential site access restrictions and travel hazards such as poor visibility." The Hanford Site is covered with tumbleweeds that pile up along fence lines, next to buildings, and could even collect around the VCCs. Tumbleweeds are extremely flammable and burn at a high heat.

YN requests DOE assess the potential for burning tumbleweeds next to the VCCs. See comments on subsection 6.1.4 Fire and/or Explosion.

Response to T-1-73

Burning tumbleweeds on the pad would fall within the scope of a fire engulfing one or more casks which is described in Section 6.1.4 of the Building Emergency Plan. Therefore, tumbleweeds do not necessarily need their own discussion section. The casks are designed to tolerate being engulfed for an amount of time which should be sufficient for the Hanford Fire Department to respond and extinguish the pad.

Addendum I, Inspection Plan now includes a monthly general inspection which includes a check for accumulation of material such as tumbleweeds on or inside fences to try to minimize material buildup. This inspection also ensures that the fences remain in good shape to both prevent access to the dangerous waste management area and keep windblown material from accumulating within the casks themselves. Minimizing fuel on the pad will reduce the duration and maximum temperature casks would be exposed to in the event of a range fire.

Comment T-1-74

[Contingency Plan: Addendum J and Appendix J-A Building Emergency Plan for CSA Section 6.2.6] This sections states, "In addition to the potential for serious injuries or fatalities, an aircraft crash could result in the direct release of hazardous materials to the environment or cause a fire that could lead to the release." See comments on subsection 6.1.4 Fire and/or Explosion.

YN requests DOE ensure the VCCs can take a direct aircraft hit without damage or release of radioactive materials, the same as the NRC requires for spent nuclear fuel dry storage casks.

Response to T-1-74

Potential unintentional events and accidents were evaluated for the Hanford dry storage casks as part of the safety analysis process. Accidents were considered based on likelihood and severity. A direct aircraft hit was considered highly unlikely based on the size of the CSA pad and proximity to the airport. As such, analysis was considered, but not conducted.

Comment T-1-75

[Contingency Plan: Addendum J and Appendix J-A Building Emergency Plan for CSA Section 6.3.1] This sections states, "The major effect on the CSA is that personnel will need to perform emergency shutdown of the facility before evacuation. If an explosive device detonates, the effects are the same as those discussed under fire and explosion.

YN requests DOE explain what emergency shutdown actions would need to be performed for the CSA. The only actions that may occur would be to leave the CSA (if inside the fence line) and close up the monitoring building if located nearby. Also, clarify if a bomb is placed on one or more VCCs, what potential damage could occur? DOE needs to ensure the VCC can withstand an explosion from a bomb attached to the VCCs as well as a missile hit from a hand held rocket launcher.

Response to T-1-75

Appendix J-A, Building Emergency Plan, Section 6.3.1 has been revised to state "A bomb threat may be received by anyone who answers the telephone or receives mail. In the event of a bomb threat, CSA personnel will evacuate the area. If an explosive device detonates, the effects could result in the direct release of hazardous materials to the environment."

Potential unintentional events and accidents, not deliberate acts, were evaluated for the Hanford dry storage casks as part of the safety analysis process. The Hanford Site is controlled by a multi-tiered site-wide security system, which is credited to minimize the possibility of a deliberate attack on the CSSs.

Comment T-1-76

[Contingency Plan: Addendum J and Appendix J-A Building Emergency Plan for CSA Section 7.2] Response to Facility Operations Emergencies first paragraph last sentence states, "Attachment A provides a list of procedures (for use during emergencies)." Attachment A, on page 23, only shows procedural actions stated in the Emergency Plan Implementing Procedures, for Recognizing and Classifying Emergencies (which have not be created), Hanford Incident Command System, Notification, Reporting and Processing of Operations Information, and Emergency Termination, Reentry and Recovery. All of these procedures are upper tier documents and not facility specific. Only the facility's Building Emergency Director would use these procedures--not the workers.

There are no procedures for loss of utilities (water, ventilation, electrical power, and air), pressure release, fire and/or explosion, hazardous materials/dangerous and/or mixed waste spills, damaged or unacceptable shipments, radioactive material release, response to natural phenomena, volcanic eruption/ash-fall, high winds/tornadoes, range fire, aircraft crash, or security contingencies.

YN requests identified response procedures for the above listed operations emergencies.

Response to T-1-76

Addendum J, Building Emergency Plan provides the structure for the Building Emergency Director and first responders to develop a strategy for a specific emergency which may vary significantly based upon circumstances of the event. In many cases the details of such a response would be directed by the Hanford Fire Department, Hanford Patrol, or other external group with the appropriate experience and equipment as detailed in the Operating Unit Group Building Emergency Plan and the Hanford Emergency Management Plan.

Workers are trained to respond appropriately to evacuation and take cover alarms in an emergency; these activities are described in Addendum J, Sections 7.1.1 and 7.1.2. Site-specific tasks taken for incidents not qualifying as emergencies such as loss of utilities would be covered by site specific training courses. This information is provided to workers through the Training Plan described in Addendum G.

Comment T-1-77

[Contingency Plan: Addendum J and Appendix J-A Building Emergency Plan for CSA Section 7.2.1] This section states, "Electrical power is required for the CSA, however, loss of electricity does not constitute an emergency, but must be restored as soon as possible."

YN requests DOE provide a time when electrical power must be restored (hours, days, etc.), and 'what possible impacts would result from an extended loss of power. A loss of electrical power may result in a loss of remote temperature monitoring for the VCCs.

YN requests DOE provide information on how temperature monitoring will be done without remote capabilities.

Response to T-1-77

If temperature monitoring systems are not functional, visual inspection of vents must be conducted in place of daily temperature monitoring. Columbia Generating Station has similar requirements, under their Nuclear Regulatory Commission license, if temperature sensors are not operating or malfunction.

Comment T-1-78

[Contingency Plan: Addendum J and Appendix J-A Building Emergency Plan for CSA Section 7.2.1] Loss of Ventilation -- states, "Not Applicable." The VCCs use passive ventilation: but ventilation of the VCC is required in order to maintain cooling of the capsules. A loss of ventilation on a VCC could result in internal damage to the TSC and the capsules, resulting in a release of radiation.

YN requests DOE provide information on what a loss of ventilation would have on a VCC, including the maximum outlet air temperature for the VCCs.

Response to T-1-78

Section 7.2.1 of the Building Emergency Plan covers Loss of Utilities. In this case, utilities is the common definition of external services or equipment which supplies something useful such as electricity, water, air, etc.

The Capsule Storage Area does not require any external fans, ducting, or other equipment to provide cooling for the Vertical Concrete Casks and therefore will not be subject to any potential emergencies due to the loss of such a utility.

Comment T-1-79

[Contingency Plan: Addendum J and Appendix J-A Building Emergency Plan for CSA Section 7.2.3] This sections states "Not Applicable."

YN requests DOE provide information on a potential pressure release from a cesium/strontium capsule due to excessive heat buildup. Could a high temperature condition impact the impurities in the cesium and strontium capsules to result in a pressure buildup in a canister--with subsequent damage to the capsule? Could a high heat condition result in pressurizing a capsule resulting in a crack and release of radiation?

Response to T-1-79

Please see the revised Addendum C Section C2.2.5 for additional discussion of how elevated temperatures will impact a transportable storage canister.

Comment T-1-80

[Contingency Plan: Addendum J and Appendix J-A Building Emergency Plan for CSA Section 7.2.4] This subsection provides basic response actions for a fire and/or explosion that can occur anywhere on the Hanford Site--it is not specific to the CSA. A fire in the CSA that involves the VCC could result in a high radiation hazard that workers and fire fighters will have to deal with. YN requests DOE include information on fires/explosions involving the VCCs.

Response to T-1-80

WAC 173-303-340(4)(a) requires the Permittees familiarize emergency services with the materials stored, unless local authorities refuse to enter into arrangements. More information regarding how the design for the capsule storage system will respond to fires has been added as Addendum C, Section C2.2.5. The impact of an explosive device would be so variable they would have to be evaluated by the Building Emergency Director or Warden (as appropriate) and other emergency responders on a case-by-case basis.

Comment T-1-81

[Contingency Plan: Addendum J and Appendix J-A Building Emergency Plan for CSA Section 7.3.1] This section provides basic response actions for a seismic event on the Hanford Site not specifically at the CSA. A seismic event, depending on the magnitude, could result in tipping over VCCs, with possible damage to the concrete walls or lid.

YN requests DOE provide information the impacts a seismic event would have on the CSA, including actions for a VCC that has been tipped over on to its side.

Response to T-1-81

The pad was designed to ASCE/SEI 7-10 standards to ensure the casks will not tip during an earthquake. If an event occurred that caused a VCC to tip over on its side the permittees would need to implement their Contingency Plan and a site specific emergency response action would need to be developed to address the emergency.

Comment T-1-82

[Contingency Plan: Addendum J and Appendix J-A Building Emergency Plan for CSA Section 7.3.2] This section provides basis response actions for anywhere on the Hanford Site not specifically for the CSA.

YN requests DOE provide more information on the VCC air inlet screen locations in respect to the ground surface (distance between the ground and the inlet screens). Volcanic ash fall could be several inches. Could ash cover the air inlet screens? YN requests DOE provide information on what actions would be taken for ash buildup near the VCCs.

Response to T-1-82

Exact dimensions for the casks have been submitted as confidential business information due to the unique design elements necessary to house the cesium and strontium capsules. The cask inlet vents are elevated from the ground, which will help prevent snowfall or ash accumulation from blocking air intake. As noted in Addendum C, Section C2.2.5, the transportable storage canisters have been designed to survive even complete vent blockage without releasing material.

Comment T-1-83

[Contingency Plan: Addendum J and Appendix J-A Building Emergency Plan for CSA Section 7.3.5] This section states, "Responses to range fires are handled by preventive measures (e.g. keeping hazardous materials and waste accumulation areas free of combustible materials such as weeds and brush). If a range fire breaches the CSA boundary, the response is as described in Section 7.2.4 (Fire and/or Explosion)". See comments on Subsection 7.2.4 Fire and/or Explosions and subsection 7.3.5 Range Fire.

Response to T-1-83

More information regarding how the design for the capsule storage system will respond to fires has been added as Addendum C, Section C2.2.5. The impact of an explosive device would be so variable they would have to be evaluated by the Building Emergency Director or Warden (as appropriate) and other emergency responders on a case-by-case basis.

Comment T-1-84

[Contingency Plan: Addendum J and Appendix J-A Building Emergency Plan for CSA Section 7.3.6] This section states, "The response to an aircraft crash is the same as for a fire and/or explosion see Section 7.2.4." Aircraft crashes are not considered a natural phenomenon.

YN requests this be move to Section 7.2 Response to Facility Operations Emergencies.

See comments on Subsection 7.2.4 Fire and/or Explosion and subsection 6.2.6 Aircraft Crash.

Response to T-1-84

The Building Emergency Plan follows an template agreed-upon by Ecology and the Permittees for multiple operating unit groups at the Hanford Facility. An aircraft crash does not cleanly fit into any of the pre-established sections in the Building Emergency Plan. Ecology believes that the details and Section 7.3.6 with a reference back to Section 7.2.4 adequately communicates the emergency steps that will need to be taken in the event of an aircraft crash.

Comment T-1-85

[Contingency Plan: Addendum J and Appendix J-A Building Emergency Plan for CSA Section 7.4.3] This section states, "The discoverer of a suspicious objective reports this object to the BED and to 911 (do not use wireless communication devices for reporting a bomb threat/explosive device unless beyond 100 feet from the suspected object), if possible, and ensures that the object is not disturbed."

YN requests DOE ensure the VCCs can handle impacts from an explosive device or hand-held-missile (rocket launcher). Secondly, YN requests DOE provide for information on how an explosion will impact the VCCs.

Response to T-1-85

Potential unintentional events and accidents, not deliberate acts, were evaluated for the Hanford dry storage casks as part of the safety analysis process. The Hanford Site is controlled by a multi-tiered site-wide security system, which is credited to minimize the possibility of a deliberate attack on the CSSs.

Comment T-1-86

[Contingency Plan: Addendum J and Appendix J-A Building Emergency Plan for CSA Section 12.0] YN Requests the following edits:

MO-232 is the initial command post.

Copies of the plan and BED list are maintained for reference during emergencies at MO-232 and the WESF Shift Office.

YN requests DOE define the location and function of MO-232 in this application.

Response to T-1-86

Section 12 of the Building Emergency Plan has been updated to state the correct initial command post, which is 272HV. The location of this facility is approximately 400 feet west of Capsule Interim Storage OUG, as shown on the topographic map in Addendum A, Figure A-1. The function of a command post would be common knowledge for those executing an emergency plan and is therefore not necessary to provide a supplemental definition within Addendum J, Building Emergency Plan.

Comment T-1-87

[Contingency Plan: Addendum J and Appendix J-A Building Emergency Plan for CSA Figure 1] YN requests inclusion of figure, which provides location of the staging areas relative to WESF and the WTP facilities.

Response to T-1-87

The Waste Encapsulation and Storage Facility and Waste Treatment Plant are not part of the Capsule Storage Area dangerous waste management unit or the Capsule Interim Storage operating unit group. If an emergency were to involve multiple facilities on the Hanford Site the Building Emergency Directors and support personnel such as the Hanford Fire Department and Hanford Patrol would coordinate to determine which appropriate supplemental information (such as maps showing larger areas of the Hanford Site) would be needed. This Building Emergency Plan is specific to Capsule Interim Storage OUG.

Comment T-1-88

[Contingency Plan: Addendum J and Appendix J-A Building Emergency Plan for CSA Figure 2] YN requests details in Addendums F, H, and J regarding Hanford Site evacuations due to emergencies specific to the CSA. The figure provides no insight.

Response to T-1-88

Capsule Interim Storage is an outdoor facility and the relevant evacuation routes are shown in the referenced figure. These routes would be used due to emergencies specific to the CSA, and therefore additional information is not necessary.

Comment T-1-89

[Attachment B: RCRA Applicability Matrix] YN requests clarification as to the purpose served in having this information. It is just an additional layer of review. YN requests applicable section of DOE/RL-94-02 incorporated into the RCRA permitting documents instead.

Response to T-1-89

Attachment B of the Building Emergency Plan is the RCRA Applicability Matrix for this specific Operating Unit Group to detail which permit document address the regulatory requirements from WAC 173-303, as they apply to Preparedness and prevention (WAC 173-303-340), Contingency plan and emergency procedures (-350), Superfund Amendments and Reauthorization Act Title III coordination (-355), Emergencies (-360) and Preparedness, prevention, emergency procedures and contingency plans for large quantity generators (-201).

Comment T-1-90

[Supporting Documentation: Capsule Interim Storage Facility Description and General Provisions] YN requests clarification as to the purpose served in having this information. It is just an additional layer of review. YN requests inclusion of this information in the appropriate addendum.

Response to T-1-90

This section has been removed.

Comment T-1-91

[Supporting Documentation: Capsule Interim Storage Regulatory Crosswalk] YN requests clarification as to the purpose served in having this information. It's just an additional layer of review and added in that the regulations are not fully cited in some cases or they are not included (e.gs., Addendum H does not include reference to Ecology publication #94-111, 2005 nor does it include WAC 173-303-806(4)(i)(B) [miscellaneous units]. YN requests these and all other needed regulatory citations be listed on a reference page for each addendum instead.

Response to T-1-91

The information provided supporting information which assisted Ecology in determining the application was complete. A completeness determination was issued February 13, 2018. This crosswalk has been removed from the draft permit.

Comment T-1-92

[CIS Inspection Frequency Justification Table] Please see our comments on Addendum I.

Response to T-1-92

Addendum I comments have been reviewed. The Inspection Frequency Justification Table has been significantly updated to provide more detail and to address increased inspection frequency.

T-2: CONFEDERATED TRIBES OF THE UMATILLA INDIAN RESERVA RODNEY SKEEN

Comment T-2-1

The CTUIR will always have a clear and consistent end-state vision for the lands that now comprise the Hanford Nuclear Reservation. This vision is for tribal members to once again safely use these lands, as they did before Hanford, for the rights and resources reserved in the Treaty of 1855. The peoples of the CTUIR look forward to the day when they can hunt; fish; gather foods, medicines, and raw materials; and pasture livestock on the lands that are now Hanford.

With this vision in mind, the CTUIR continues to be concerned with long-term, outside storage of nuclear materials such as is proposed in this document. Safe long-term outside storage assumes proper site management for many lifetimes. This is a condition that cannot be guaranteed and creates an uncertain future for the environment. In light of this we request the Department of Ecology and the USDOE consider better storage methods that permanently isolate the waste from the environment.

Response to T-2-1

Thank you for your comment. USDOE must continue to evaluate treatment, storage, and disposal pathways for the cesium and strontium capsules. Tri-Party Agreement Milestone M-092-20 requires USDOE to submit evaluations of potential options to Ecology of every four years. The first evaluation is due March 31, 2022.

Comment T-2-2

The dimensions provided for the Universal Capsule Sleeve (UCS) depict a geometry that does not match that of the schematics nor is it compatible with the dimensions provided for cesium and strontium salt capsules and Type-W overpack capsules.

Please verify and correct the dimensions of the UCS provided in Section C2.2.1 (Page C-6).

Response to T-2-2

The dimensions in Section C2.2.1, Addendum C, Process Information were updated to be more accurate and to better describe the assembly of transportable storage canisters for standard and Type W capsules. Additionally, capsule design drawings are now included in Addendum C, Appendix C-A.

Comment T-2-3

The performance lifespan of the Transportable Storage Canister (TSC) is reported to be 300 years while the Vertical Concrete Cask (VCC) is reported capable of storing a TSC for up to 100 years without the need to repackage.

Please clarify what the intended lifespan of each Cask Storage System (CSS) component is and how a CSS will operate for the full 300 year lifespan if some components have a shorter lifespan.

Response to T-2-3

Capsule Interim Storage is planned to be in use up to approximately 50 years. Tri-Party Agreement Major Milestone M-092-00 requires a more permanent treatment, storage, or disposal option be located by December 31, 2047.

The design minimum lifespans of vertical concrete casks and transportable storage canisters significantly exceed 50 years, but the stainless steel is more resilient than concrete long-term. This is beneficial because the steel capsules, sleeves, baskets, and canisters provide containment for stored material. The casks primarily provide radiation shielding and physical protection of the canisters.

Additional information has been added to Part A Section XI to address Major Milestone M-092-00. Specific design lifespan has been removed from the application to eliminate potential confusion between expected facility lifespan and equipment design standards. Minimum design lifespan is addressed in CHPRC-02538 Rev. 0, Capsule Storage Area Final Design Report (Project W-135).

Appendix A: Copies of all public notices

Public notices for this comment period:

- Public notice (focus sheet)
- Classified advertisement in the *Tri-City Herald*
- Notice sent to the Hanford-Info email list

Public Comment Period on Proposed Update to Hanford Dangerous Waste Permit

Proposed Capsule Storage Area

The U.S. Department of Energy Richland Operations Office (DOE-RL) is holding a 60-day public comment period from November 27, 2017, to January 31, 2018, for a Class 3 Permit Modification to the Hanford Dangerous Waste Permit. The modification is needed for the construction and operation of a proposed Capsule Storage Area, which would provide interim dry storage of cesium and stontium capsules currently at the Waste Encapsulation and Storage Facility (WESF).

This fact sheet is for one of two related public comment periods running concurrently. Another fact sheet, located on the Hanford Events Calendar, is for the modifications needed at WESF to facilitate transfer of the capsules to the proposed Capsule Storage Area.

November 2017 U.S. Department of Energy

Sequence of Class 3 Permit Modifications

As per WAC 173-303-830, "Permit Changes," this Class 3 Permit Modification will go through the required public review process that includes this fact sheet, newspaper advertisement, and public meeting.

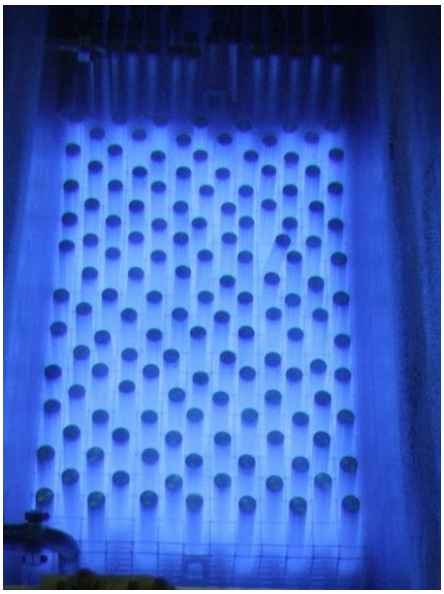
Capsules Background

From 1974 to 1985, radioactive cesium and strontium isotopes, recovered from high-level waste tanks, were placed in stainless steel capsules and stored in concrete pool cells in WESF, where they remain today.

The waste has been designated as mixed waste and is managed under the *Resource Conservation and Recovery Act of 1976* (RCRA).

The 1,335 cesium chloride capsules and 601 strontium fluoride capsules are currently stored in pools filled with water to protect workers from high levels of radioactivity, and to help keep the capsules cool.

DOE-RL has proposed moving the capsules to interim dry storage at a location to be called the Capsule Storage Area. While the capsules are currently in a safe and compliant configuration, WESF is an aging facility. The possibility of a release of radioactive material from the WESF pool cells exists, should an unlikely event cause the loss of pool water.



Waste Encapsulation and Storage Facility Capsules

Public Comment

We want your feedback on this proposed modification. The public comment period will run **November 27, 2017 to January 31, 2018.**

A public meeting will be held at 6:30 p.m., Wednesday, December 13, 2017, at the Richland Public Library, 955 Northgate Drive.

Summary of Proposed Capsule Storage Area

Conceptual Capsule Storage Area Illustration

DOE-RL is submitting a Class 3 Permit Modification Request to build the proposed Capsule Storage Area. The storage area would be located in the 200 East Area, close to WESF, and would consist of a reinforced concrete pad surrounded by fencing.

At WESF, the capsules would be removed from the pool cells and loaded into concrete and steel casks for interim storage. These casks naturally become heated by the cesium and strontium. The cask storage system is designed for "passive cooling" by the airflow within the cask. Cool, clean air is drawn into the cask and warm air goes out, without the need for fans or mechanical equipment. Since the capsules are sealed within the cask and do not come into contact with the cooling air, no radiation is released when the warm air leaves. The same passive cooling approach is used for dry storage of used nuclear fuel at other locations. These concrete and steel casks also provide robust radiation shielding to protect workers and eliminate the possibility of a release of radioactive material.

After being loaded, the casks will be transported to and stored on the concrete pad. The new storage area will not produce any products for use or accept any additional waste. Interim storage at the Capsule Storage Area will continue until a final capsule disposal decision is made. The casks are designed to meet criteria for licensed offsite transportation.

Path Forward

This proposed modification includes a 60-day public comment period, along with an opportunity to learn more at a public meeting. The public meeting will be held on Wednesday, December 13 at the Richland Public Library and will include a question-and-answer session.

DOE-RL recognizes the importance for the public to be informed in a format that provides the entire sequence of activities. To fully understand the background and details, the meeting will also include a presentation on the related plans for preparing WESF to transfer the capsules. The WESF presentation will begin at 5:30 p.m. and the proposed Capsule Storage Area presentation will follow at 6:30 p.m.

Proposed Capsule Storage Area Location

The permittees' compliance history during the life of the permit being modified is available from the Washington State Department of Ecology's contact person.

Electronic access to the proposed permit modification and supporting documentation is available at the Administrative Record, 2440 Stevens Drive, Richland, WA. The documentation is also available in the Public Information Repositories.

How to get involved…

A 60-day public comment period on this proposed modification to the *Hanford Facility Site-wide Dangerous Waste Permit* will run from November 27, 2017 to January 31, 2018. The public meeting will be held on December 13, 2017, at the Richland Public Library, 955 Northgate Drive, Richland, WA. The WESF preparations presentation will start at 5:30 p.m. and the Capsule Storage Area presentation will follow at 6:30 p.m.

The DOE-RL point of contact is Rich Buel, Richard.buel@rl.doe.gov, (509) 376-3375.
The Ecology point of contact is Stephanie Schleif, Stephanie.schleif@ecy.wa.gov, (509) 372-7929.

Please submit comments on the proposed changes by **January 31, 2018,** via eComments, to:

CSA: http://wt.ecology.commentinput.com/?id=ibkWY
or mail to: Daina McFadden
Washington State Department of Ecology
3100 Port of Benton Boulevard
Richland, WA 99354

Supporting Documentation: http://www.hanford.gov/pageAction.cfm/calendar?&IndEventID=8720

Electronic access is available for review at the locations listed below

HANFORD PUBLIC INFORMATION REPOSITORY AND RESOURCE CENTER LOCATIONS

Portland
Portland State University Library
Branford Price Millar Library
1875 SW Park Avenue
Portland, OR 97201
Attn: Bertrand Robinson (503) 725-4128
Map: http://bit.ly/1K7BfuK

Richland
U.S. Department of Energy Public Reading Room
Washington State University, Tri-Cities
Consolidated Information Center, Room 101-L
2770 University Drive
Richland, WA 99352
Attn: Janice Parthree (509) 375-7443
Map: http://bit.ly/1LpZKUa

Ecology Nuclear Waste Program Resource Center
3100 Port of Benton Blvd. Richland, WA 93354
Attn: Teresa Booth 509-372-7950
Online: http://www.ecy.wa.gov/programs/nwp/commentperiods.htm

Seattle
University of Washington
Suzzallo Library
4000 15th Avenue NE
Seattle, WA 98195
Attn: Hilary Reinert (206) 543-5597
Map: http://bit.ly/1QMtUog

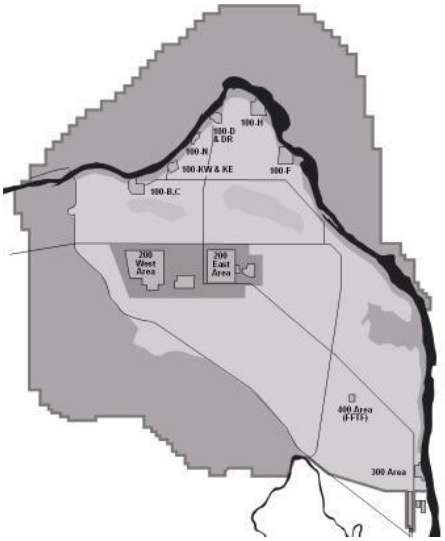
Spokane
Gonzaga University
Foley Center Library
East 502 Boone Avenue
Spokane, WA 99258
Attn: John Spencer (509) 313-6110
Map: http://bit.ly/1Cp0mRT

Administrative Record
2440 Stevens Center Place, Room 1101
Attn: Heather Childers (509) 376-2530
Online: http://pdw.hanford.gov/arpir/

Hanford Events Calendar:
http://www.hanford.gov/pageAction.cfm/calendar

Hanford Public Comment Opportunities:
http://www.hanford.gov/page.cfm/Outreach/PublicCommentOpportunities

Hanford
Public Involvement Opportunity



We want to hear from you on the proposed modification for the Hanford Sitewide Permit!

Comment Period: November 27, 2017 – January 31, 2018
Public Meeting: December 13, 2017, 6:30 p.m., Richland Public Library

Dangerous Waste Permit Modification Fact Sheet
U.S. Department of Energy
Richland Operations Office
P.O. Box 550, H5-20
Richland, WA 99352

THE FAMILY CIRCUS By Bil Keane

"I don't want to be a Mo!"

Auctions

Abandoned Vehicle Sale
Clearwater Collision & Towing LLC
4023 W Clearwater, Kennewick
Thursday, 11/30/2017,
11:00 A.M.
Clearwater Collision &
1.) 1996 Ford Taurus
VIN #1FALP52U6TA234072
LIC #AAB2438
Mid Columbia Towing
1.) 1995 VW Jetta
VIN #3VWWC81H5SM119275
LIC #BCY5280

Merchandise

Antiques

ANTIQUE/COLLECTIBLE
Flea Market
Spokane Co Fair & Expo Center
December 2 & 3
Sat.9-6 Sun.9-3
Admission; $4.00
Info. 503-363-9564 or
www.wesknodelgunshows.com

Auto Savers
Vehicles $6,000 or less,
4 lines for 14 days

Sell it fast!
Call 586-6181
Tri-City Herald
Voice of the Mid-Columbia

Firearms

GUN SHOW
Spokane Co Fair & Expo Center
December 2 & 3
Sat.9-6 Sun.9-3
Admission; $8.00
Info. 503-363-9564
www.wesknodelgunshows.com

Bargains under $200

8 PLATE XMAS DINNERWARE 8 CUPS 735-9298 $100 OBO

ANTIQUE WOODEN 2 WHEELED HANDPLOW $125 509-734-1323

BEIGE RECLINER NOW ONLY $185 call 735-9298

BLACK -WHITE KITCHEN STOVE SELF-CLEANING $150 OBO call 735-9298

Woodstoves & Firewood

Apple & Cherry, $170/per Cord
392-9601 & 440-1619 & 588-4582

Seasoned Firewood Apple & Cherry, Southridge area, U Haul, U Load, $70 pickup load . 783-5919 or 308-6521

Animals & Pets

Dogs

AKC English/American Yellow Lab Puppies AKC. Grand Champion and Master Hunter lines. Dew claws removed. 200 cash deposit. Located in Placerville CA. Ready Dec 15. $600 916-407-7331

Bull Terrier Puppies
Born 9/12/17Will be ready to re-home by 12/10/17.
Up to date on all shots, dew claws removed. Bread to have no medical issues and good personalities/non aggressive. Contact for any questions/ photos. 900 each.
509-551-6406, rlshilling62@icloud.com

Golden Retriever Puppies Purebred Golden Retriever registered puppies. Born on 11/03/17 rehome 12/22/17. Call for photos. $1,100. 541-321-9643, michellej.zehr@gmail.com

Mastiff Puppies Ready Dec. 10
Beautiful, well socialized, & great family pet. $800 ea. 509-781-0896

Miniature Schnauzer Puppies 2 Left- 1 F, 1 M.Walla Walla- $500 M/$600 F Jsdawsonwalla@yahoo.com

Wolf hybrid cubs for sale Wolf cubs hand raised in my home. Loving and sweet . We have 3 females . mckenzie /arctic's . 11 wks old , also 5 pregnant females . arctic timbers. due November on . colors gray , red and white . cost 2,000 , 2,500 and white 3,500 . call Katie at 541-726-0224 or wolfhaven@live.com . greatest friend or animal you will ever have . come with papers , shots . vet check . we love our babies . $1,500

Pets Services & Supplies

MOBILE PET GROOMING Tired of taking your dog or cat to the groomer? Mobile Pet Works COMES TO YOU! Call or text today to make an appointment. (509)591-5913 groom@mobilepetworks.com

Automotive

Automobiles

2002 Lincoln Towncar Signature Series, white/gray, 165k miles, $900. 509-947-1475

Bargains
Free 3-line ad for items priced under $200

Tri-City Herald
Voice of the Mid-Columbia

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Call 586-6181

CLASSIFIED LEGALS

NOTICE OF MEETING
OF THE
BOARD OF EQUALIZATION

NOTICE IS HEREBY GIVEN that the Secretary of the South Columbia Basin Irrigation District has completed the Assessment Roll of the South Columbia Basin Irrigation District and has delivered the same to the Board of Directors of said District. The Board of Directors of said District, acting as a Board of Equalization, will meet in the office of said Irrigation District at 1135 East Hillsboro, Suite A, Pasco, Washington, this being the officially designated meeting place of said District, on the 14th of December 2017, at 9:00 a.m., for the purpose of equalizing the assessments so made, and shall continue in session from day to day so long as may be necessary, not to exceed ten (10) days, exclusive of Sundays, to hear and determine objections to said Assessment Roll as may come before the Board.
David Solem, Secretary
South Columbia Basin Irrigation District
#3391653 11/27, 11/28, & 11/29/2017

Notice to Creditors
Notice of Merger for Monad Federal Credit Union
Monad Federal Credit Union is merging into Numerica Credit Union.
Any creditor of Monad Federal Credit Union must notify Numerica Credit Union of its claim.
Notice shall be in writing and shall state the amount of the claim and the circumstances under which the claim arose.
The notice shall be sent to the following address:
Numerica Credit Union
P.O. Box 4000
Spokane Valley, WA 99037
Attn: General Counsel
Any claim not so made within 30 days of the last date of publication of this notice may be barred and the debt extinguished under RCW 31.12.461.3.
Dated this 13th day of November, 2017
#3386920 11/13, , 11/15, , 11/18, 11/20, 11/22, 11/25, 11/27, 11/29, & 12/01/2017

Pasco School District is seeking citizens interested in being appointed to a committee to write the pro or con statements for the upcoming levy election for the Franklin County Voters' Pamphlet. Those interested should send their name, address, email address, phone number and which position they represent to Howard Roberts at the Booth Building, 1215 West Lewis Street, Pasco, WA or via email at Hroberts@psd1.org by Wednesday, December 6, 2017. The Board will take action on the appointments at its December 12, 2017 regular board meeting.
#3397426 11/20 & 11/27/2017

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4 lines for 14 days

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Call 586-6181
Tri-City Herald
Voice of the Mid-Columbia

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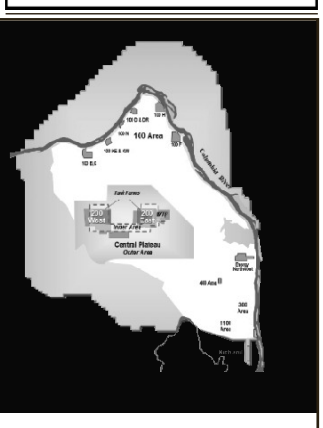
Save time and money. Go to **www.tricityherald.com**, click on Classifieds and follow the user-friendly steps to place your ad.
- Do-It-Yourself Convenience
- Easy to Use
- Upload Photos and Graphics
- Print and Online Options
- Basic/Deluxe/Premium Packages

Tri-City Herald
Voice of the Mid-Columbia

The U.S. Department of Energy Wants Your Feedback on a New Storage Area for Hanford's Cesium and Strontium Capsules



The U.S. Department of Energy is holding a 60-day public comment period on a Class 3 Permit Modification to the Hanford Facility Sitewide Dangerous Waste Permit. The modification addresses the construction and operation of the proposed Capsule Storage Area for interim dry storage of cesium and strontium capsules currently at the Waste Encapsulation and Storage Facility.

The public comment period runs from November 27, 2017, to January 31, 2018. A public meeting will be held on December 13, 2017, at 6:30 p.m., in the Richland Public Library, 955 Northgate Drive. The meeting will also be accessible via webinar. To register go to: https://attendee.gotowebinar.com/register/10159526041363763 3
Webinar ID: 581-185-931

The permittee's compliance history during the life of the permit being modified is available from the Ecology contact person.

For More Information Please Contact:
DOE-RL, Rich Buel at 509-376-3375, or Ecology, Stephanie Schleif at 509-372-7929

Please submit comments on the proposed changes found at, http://bit.ly/2hI5oar by January 31, 2018, via eComments, to:
http://wt.ecology.commentinput.com/?id=ibkWY

Daina McFadden
Washington State Department of Ecology
3100 Port of Benton Boulevard
Richland, WA 99354
Phone: (509) 372-7950

The proposed permit modification can be viewed online at the link above or in hard copy at 2440 Stevens Center Place, Room 1101, Richland, WA.

The U.S. Department of Energy Wants Your Feedback on Changes Needed at Hanford's Waste Encapsulation Storage Facility to Move Capsules

The U.S. Department of Energy is holding a 60-day public comment period on a Class 3 Permit Modification to the Hanford Facility Sitewide Dangerous Waste Permit. The modification addresses changes needed to the Waste Encapsulation Storage Facility so the cesium and strontium capsules stored there can be transferred to a proposed interim Capsule Storage Area.

The public comment period runs from November 27, 2017, to January 31, 2018. A public meeting will be held on December 13, 2017, at 5:30 p.m., in the Richland Public Library, 955 Northgate Drive. The meeting will also be accessible via webinar. To register go to: https://attendee.gotowebinar.com/register/10159526041363763 3
Webinar ID: 581-185-931

The permittee's compliance history during the life of the permit being modified is available from the Ecology contact person.

For More Information Please Contact:
DOE-RL, Rich Buel at 509-376-3375, or Ecology, Stephanie Schleif at 509-372-7929

Please submit comments on the proposed changes found at, http://bit.ly/2hTaYKU by January 31, 2018, via eComments, to:
http://wt.ecology.commentinput.com/?id=QkDYA

Daina McFadden
Washington State Department of Ecology
3100 Port of Benton Boulevard
Richland, WA 99354
Phone: (509) 372-7950

The proposed permit modification can be viewed online at the link above or in hard copy at 2440 Stevens Center Place, Room 1101, Richland, WA.

To place your Legal Announcement, Call 585-7213.

From:	^TPA
To:	HANFORD-INFO@LISTSERV.WA.GOV
Subject:	Two public comment periods start today on proposed changes to the Hanford Site-Wide Dangerous Waste Permit for the Waste Encapsulation Storage Facility and the proposed Capsule Storage Area
Date:	Monday, November 27, 2017 10:27:07 AM
Attachments:	1-WESF Fact Sheet 11-15-17 FINAL.PDF 1-CSA Fact Sheet 11-15-17 FINAL.PDF

This is a message from the U.S. Department of Energy

Notice of Two 60-Day Public Comment Periods on Proposed Changes to the Hanford Site-Wide Dangerous Waste Permit

The U.S. Department of Energy Richland Operations Office (DOE-RL) is holding concurrent 60-day public comment periods for two, related Class 3 Permit Modifications to the Hanford Site-Wide Dangerous Waste Permit. The first modification addresses the preparation of the Waste Encapsulation and Storage Facility (WESF) for the transfer of the cesium and strontium capsules to the proposed Capsule Storage Area. The second modification addresses the construction and operation of the proposed Capsule Storage Area that will provide interim dry storage of the capsules that are currently in wet storage at WESF. These two permit modifications were sent to the Washington State Department of Ecology (Ecology) in November.

The two comment periods run concurrently from **Nov. 27, 2017, to Jan. 31, 2018,** with two public meetings on **Dec. 13, 2017,** in the Richland Public Library (955 Northgate Drive). The WESF meeting begins at 5:30 p.m., followed by the Capsule Storage Area presentation at 6:30 p.m. The meetings will also be accessible via webinar. To register, go to: https://attendee.gotowebinar.com/register/1015952604136376 33 (webinar ID: 581-185-931)

In the 1970s, radioactive isotopes of the elements cesium and strontium were removed from waste and placed in 1,936 sturdy, stainless steel capsules and stored in concrete pool cells in WESF, where they remain today. Workers carefully monitor the capsules; water in the pool cells provides shielding to workers and keeps the capsules cool.

While the capsules are currently in a safe configuration, WESF is an aging facility. Dry storage would significantly reduce the possibility of a release of radioactive material, should an unlikely event cause the loss of pool storage water, which may result in the overheating and breach of one or more capsules.

The proposed modifications and supporting documentation are available for review online at WESF http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0067755H and CSA http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0067756H, on Ecology's website, and online at Hanford Administrative Record and Public Information Repositories located in Richland, Seattle, Spokane and Portland. Copies can be reviewed in person at the Hanford Administrative Record Public Information repository at 2440 Stevens Center Place in Richland. The permittee's compliance history during the life of the permit being modified is available from the Washington State Department of Ecology's contact person, Stephanie Schleif, at Stephanie.Schleif@ecy.wa.gov, or (509) 372-7929.

Please submit comments on the proposed changes by **Jan. 31, 2018,** via eComments (preferred)

Waste Encapsulation and Storage Facility: http://wt.ecology.commentinput.com/?id=QkDYA
Capsule Storage Area: http://wt.ecology.commentinput.com/?id=ibkWY

Or mail comments to:
Daina McFadden
Washington State Department of Ecology
3100 Port of Benton Boulevard
Richland, WA 99354

Questions? Please contact Richard Buel, DOE-RL, at richard.buel@rl.doe.gov.

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From:	Wireman, Ginger (ECY)
To:	HANFORD-INFO@LISTSERV.ECOLOGY.WA.GOV
Subject:	Two Public Meetings Wednesday on Proposed Changes for the Waste Encapsulation Storage Facility and the Capsule Storage Area
Date:	Wednesday, December 13, 2017 10:07:15 AM
Attachments:	1-WESF Fact Sheet 11-15-17 FINAL.PDF 1-CSA Fact Sheet 11-15-17 FINAL.PDF

Reminder

This is a message from the U.S. Department of Energy

Notice of Two Public Meetings on Proposed Changes to the Hanford Site-Wide Dangerous Waste Permit for Cesium and Strontium Capsules

The U.S. Department of Energy Richland Operations Office (DOE-RL) is holding two public meetings on **Dec. 13, 2017,** in the Richland Public Library (955 Northgate Drive). The Waste Encapsulation Storage Facility (WESF) meeting begins at 5:30 p.m., followed by the Capsule Storage Area presentation at 6:30 p.m. The first meeting addresses the preparation of WESF for the transfer of the cesium and strontium capsules to the proposed Capsule Storage Area. The second meeting's conversation will center on the construction and operation of the proposed Capsule Storage Area that will provide interim dry storage of the capsules that are currently in wet storage at WESF. The meetings will also be accessible via webinar. To register, go to: https://attendee.gotowebinar.com/register/1015952604136376 33 (webinar ID: 581-185-931)

These two meetings are part of two 60-day public comment periods for related Class 3 Permit Modifications to the Hanford Site-Wide Dangerous Waste Permit, which were sent to the Washington State Department of Ecology (Ecology) in November. The two comment periods run concurrently from **Nov. 27, 2017, to Jan. 31, 2018.**

The proposed modifications and supporting documentation are available for review online at WESF http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0067755H and CSA http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0067756H, on Ecology's website, and online at Hanford Administrative Record and Public Information Repositories located in Richland, Seattle, Spokane and Portland. Copies can be reviewed in person at the Hanford Administrative Record Public Information repository at 2440 Stevens Center Place in Richland. The permittee's compliance history during the life of the permit being modified is available from the Washington State Department of Ecology's contact person, Stephanie Schleif, at Stephanie.Schleif@ecy.wa.gov, or (509) 372-7929.

Please submit comments on the proposed changes by **Jan. 31, 2018,** via eComments (preferred)
Waste Encapsulation and Storage Facility: http://wt.ecology.commentinput.com/?id=QkDYA
Capsule Storage Area: http://wt.ecology.commentinput.com/?id=ibkWY

Or mail comments to:
Daina McFadden
Washington State Department of Ecology

3100 Port of Benton Boulevard
Richland, WA 99354

Questions? Please contact Richard Buel, DOE-RL, at richard.buel@rl.doe.gov.

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Addendum A

Part A Form

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WASHINGTON STATE DEPARTMENT OF ECOLOGY

Dangerous Waste Permit Application

Part A Form

Date Received.	Reviewed by:	Date:
Month Day Year	Approved by:	Date:

I. This form is submitted to: (place an "X" in the appropriate box)

☐	Request modification to a final status permit (commonly called a "Part B" permit)	
☐	Request a change under interim status	
☒	Apply for a final status permit. This includes the application for the initial final status permit for a site or for a permit renewal (i.e., a new permit to replace an expiring permit).	
☐	Establish interim status because of the wastes newly regulated on:	(Date)
	List waste codes:	

II. EPA/State ID Number

W A 7 8 9 0 0 0 8 9 6 7

III. Name of Facility

U.S. Department of Energy – Hanford Facility

IV. Facility Location (Physical address not P.O. Box or Route Number)

A. Street

Refer to Permit Attachment 2 – Hanford Facility Permit Legal Description

City or Town	State	ZIP Code
Near Richland	WA	

County Code (if known)	County Name
0 0 5	Benton

B. Land Type	C. Geographic Location Latitude (degrees, mins, secs)	Longitude (degrees, mins, secs)	D. Facility Existence Date Month Day Year
F	Refer to TOPO map (Section XV).		1 1 1 9 1 9 8 0

V. Facility Mailing Address

Street or P.O. Box		
P.O. Box 550		
City or Town	**State**	**ZIP Code**
Richland	WA	99352

VI. Facility contact (Person to be contacted regarding waste activities at facility)		
Name (last)	**(first)**	
Vance	Brian	
Job Title	**Phone Number (area code and**	
Manager	(509) 376-7395	
Contact Address		
Street or P.O. Box		
P.O. Box 550		
City or Town	**State**	**ZIP Code**
Richland	WA	99352

VII. Facility Operator Information	
A. Name	**Phone Number**
U.S. Department of Energy Owner/Operator CH2M HILL Plateau Remediation Company, Co-Operator for the Capsule Interim Storage	(509) 376-7395 (509) 376-0556
Street or P.O. Box	
U.S. Department of Energy P.O. Box 550	CH2M Hill Plateau Remediation Company P.O. Box 1600

City or Town	State	ZIP Code
Richland	WA	99352

B. Operator Type	F	
C. Does the name in VII.A reflect a proposed change in operator?	☐ Yes ☒ No	
If yes, provide the scheduled date for the change:	**Month**	**Day** / **Year**
D. Is the name listed in VII.A. also the owner? If yes, skip to Section VIII.C.	☐ Yes ☒ No	

VIII. Facility Owner Information	
A. Name	**Phone Number (area code and number)**
U.S. Department of Energy Owner/Operator	(509) 376-7395
Street or P.O. Box	
P.O. Box 550	

City or Town	State	ZIP Code
Richland	WA	99352

B. Owner Type	F	
C. Does the name in VIII.A reflect a proposed change in owner?	☐ Yes ☒ No	

If yes, provide the scheduled date for the change:	Month	Day	Year

IX. NAICS Codes (5/6 digit codes)

A. First		B. Second	
562211	Waste Treatment & Disposal	924110	Administration of Air & Water Resource & Solid Waste Management Programs
C. Third		**D. Fourth**	
541715	Research & Development in the Physical, Engineering, & Life Sciences	562910	Remediation Services

X. Other Environmental Permits (see instructions)

A. Permit Type	B. Permit Number	C. Description
E	ST0004511	WAC 173-216 State Waste Discharge Permit Program, Sitewide Permit for Miscellaneous Streams

XI. Nature of Business (provide a brief description that includes both dangerous waste and non-dangerous waste areas and activities)

The Capsule Interim Storage (CIS) is designed in accordance with the Management of Cesium and Strontium Capsule (W-135) Project in the western portion of the 200 East Area to store radioactive cesium and strontium salts previously encapsulated and stored at the Waste Encapsulation and Storage Facility (WESF). The radioactive cesium is stored as cesium chloride, and the strontium is stored as strontium fluoride. Due to the impurities, the salts were designated as mixed waste. The CSA will store the cesium and strontium capsules until addressed by Major Milestone M-092. Major Milestone M-092 addresses the disposition path for the cesium and strontium capsules, with a milestone due date of December 31, 2047 to complete the acquisition and modification of facilities necessary for the storage, treatment/processing, and disposal of the capsules.

CIS consists of the operating Capsule Storage Area (CSA) dangerous waste management unit (DWMU). The CSA has been classified as an X99 (miscellaneous) unit due to the unique packaging and radiological characteristics of the cesium and strontium that necessitate specialized management systems and requirements other than those applicable to container storage units. Miscellaneous units do not clearly fit into a regulatory category, such as a container storage unit, containment building, or tank system. WAC 173-303-680, "Dangerous Waste Regulations," "Miscellaneous units," requires that miscellaneous units be located, designed, constructed, and operated in a way that protects human

health and the environment according to those provisions most appropriate to the unit being permitted. Terms and provisions most appropriate to CIS are those applicable requirements in WAC 173-303-630, "Use and management of containers."

CIS does not generate dangerous waste from routine maintenance.

NAICS code 562910, Remediation Services, does not apply to the CIS operating unit group.

CSA Description

CSA is an uncovered, unenclosed, rectangular storage pad constructed of reinforced concrete measuring ~27 m (90 ft) wide by 56 m (184 ft) long and 46 cm (18 in.) thick. Waste managed at the CSA consists of 1,936 capsules previously stored at the WESF.

Capsules are stored at the CSA within 25 Cask Storage Systems (CSS), which provide additional containment for the capsules. Designed as a passive system, the CSS has natural circulation that provides cooling as outlet air vents offer a flow path for the internal circulation of air adjacent to the canister for heat removal. Instruments at the outlet air vents provide temperature monitoring.

The CSS consists of the following components: universal capsule sleeve (UCS), transportable storage canister (TSC) basket, TSC, and vertical concrete cask (VCC). Up to six standard capsules or two Type-W capsules are contained within a UCS that are sealed closed. The loaded UCS are placed in the TSC basket that has 11 cell locations. Each cell location holds up to two UCS, and each of the cells has a shield plug and closure lid. A maximum of 132 capsules can be stored in each TSC.

The TSC houses the TSC basket and serves as an overpack. The lid of the TSC is sealed shut. The TSC is contained within a VCC ~3.4 m (11 ft) tall and 3.0 m (10 ft) in diameter. The thickness of the VCC concrete wall is ~0.6 m (2 ft), and the lid is ~0.3 m (1 ft). The VCC provides radiation shielding, protection from external hazards, and protection from the environment (e.g., wind, rain, snow).

No capsule loading operations will occur at the CSA; the capsules are loaded into the CSS at the WESF.

CSA Storage Capacity

CSA does not produce products or have any production processes. After initial receipt of the capsules, no additional waste will be received. The maximum waste stored at the CSA DWMU is the 1,936 cesium and strontium capsules; therefore, the maximum storage capacity for the CSA is the 1,936 capsules. Since each capsule has a maximum volume of 1 L (0.264 gal), this equates to a total capacity of 1,936 L (511.4 gal). The total mass of cesium and strontium salts was calculated by subtracting the empty capsule weight from the gross weight of a loaded capsule. The total mass of the salts is 5,049 kg (11,131 lb).

Section XII. Process Codes and Design Capacities								Section XIII. Other Process Codes								
Line Number		A. Process Codes (enter code)			B. Process Design Capacity		C. Process Total Number of Units	Line Number		A. Process Codes (enter code)			B. Process Design Capacity		C. Process Total Number of Units	D. Process Description
					1. Amount	2. Unit of Measure (enter code)							1. Amount	2. Unit of Measure (enter code)		
X	1	S	0	2	1,600	G	002	X	1	T	0	4	700	C	001	In situ Vitrification
X	2	T	0	3	20	E	001									
X	3	T	0	4	700	C	001									
	1	X	9	9	1,936	L	001		1	X	9	9	1,936	L	001	Capsule Storage Area
	2								2							
	3								3							
	4								4							
	5								5							
	6								6							
	7								7							
	8								8							
	9								9							
1	0							1	0							
1	1							1	1							
1	2							1	2							
1	3							1	3							
1	4							1	4							
1	5							1	5							
1	6							1	6							
1	7							1	7							
1	8							1	8							
1	9							1	9							
2	0							2	0							
2	1							2	1							
2	2							2	2							
2	3							2	3							
2	4							2	4							
2	5							2	5							

XIV. Description of Dangerous Wastes

Example for completing this section: A facility will receive three non-listed wastes, then store and treat them on-site. Two wastes are corrosive only, with the facility receiving and storing the wastes in containers. There will be about 200 pounds per year of each of these two wastes, which will be neutralized in a tank. The other waste is corrosive and ignitable and will be neutralized then blended into hazardous waste fuel. There will be about 100 pounds per year of that waste, which will be received in bulk and put into tanks.

Line Number	A. Dangerous Waste No.				B. Estimated Annual Quantity of Waste	C. Unit of Measure	D. Processes (1) Process Codes									(2) Process Description [If a code is not entered in D(1)]
X 1	D	0	0	2	400	P	S	0	1	T	0	1				
X 2	D	0	0	1	100	P	S	0	2	T	0	1				
X 3	D	0	0	2												Included with above
1	D	0	0	5	5,049	K	X	9	9							Storage
2	D	0	0	6												Included above
3	D	0	0	7												Included above
4	D	0	0	8												Included above
5	D	0	1	1												Included above
6																
7																
8																
9																
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XV. Map

Attach to this application a topographic map of the area extending to at least one (1) mile beyond property boundaries. The map must show the outline of the facility; the location of each of its existing and proposed intake and discharge structures; each of its dangerous waste treatment, storage, recycling, or disposal units; and each well where fluids are injected underground. Include all springs, rivers, and other surface water bodies in this map area, plus drinking water wells listed in public records or otherwise known to the applicant within ¼ mile of the facility property boundary. The instructions provide additional information on meeting these requirements.

XVI. Facility Drawing

All existing facilities must include a scale drawing of the facility (refer to Instructions for more detail).

See Attachment A.

XVII. Photographs

All existing facilities must include photographs (aerial or ground-level) that clearly delineate all existing structures; existing storage, treatment, recycling, and disposal areas; and sites of future storage, treatment, recycling, or disposal areas (refer to Instructions for more detail).

See Attachment A.

XVIII. Certifications

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Operator Name and Official Title (type or print) Brian Vance, Manager U.S. Department of Energy Richland Operations Office		**Date Signed** 7/31/2019
Co-Operator Name and Official Title (type or print) L. Ty Blackford President and Chief Executive Officer CH2M HILL Plateau Remediation Company		**Date Signed** 7/25/19
Co-Operator – Address and Telephone Number P.O. Box 1600 Richland, WA 99352 (509) 376-0556		
Facility-Property Owner Name and Official Title (type or print) Brian Vance, Manager U.S. Department of Energy Richland Operations Office	**Signature**	**Date Signed** 7/31/2019

XIX. Comments

Attachment A contains a topographic map, facility drawing, and photograph of CIS. See Ecology Administrative Record for the Hanford Facility topographic map.

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CAPSULE INTERIM STORAGE
CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have a "**Last Modification Date**" which represents the last date the portion of the unit has been modified. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Last modification to Capsule Interim Storage **October 30, 2019**

Addenda	Last Modification Date	Modification Number
Unit-Specific Conditions		
A. Part A Form		
B. Waste Analysis Plan		
C. Process Information		
D. Reserved		
E. Security		
F. Preparedness & Prevention		
G. Personnel Training		
H. Closure Plan		
I. Inspection Plan		
J. Contingency Plan		

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CAPSULE INTERIM STORAGE
PART III, OPERATING UNIT GROUP 19 PERMIT CONDITIONS
CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have its own change control log with a modification history table. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Modification History Table

Modification Date	Modification Number

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PART III, OPERATING UNIT GROUP 19 PERMIT CONDITIONS
CAPSULE INTERIM STORAGE

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PART III, OPERATING UNIT GROUP 19 PERMIT CONDITIONS
CAPSULE INTERIM STORAGE

UNIT DESCRIPTION

Capsule Interim Storage (CIS) is a dangerous waste operating unit group located in the 200 East Area. CIS contains one Dangerous Waste Management Unit (DWMU), the Capsule Storage Area (CSA). The CSA is a miscellaneous unit due to the unique nature of the waste and storage system design. CIS also includes an Operating Pad for staging and maneuvering equipment and a graveled area for drainage and radiological buffering.

The CSA stores cesium chloride and strontium fluoride salts separated from Hanford tank waste from 1969 through 1984. These salts contain several dangerous waste-designated metals estimated at less than 10% by weight each as contaminants. The cesium and strontium salts are stored within Cask Storage Systems (CSSs). Each CSS consists of a Vertical Concrete Cask (VCC) housing a stainless steel Transportable Storage Canister (TSC). The TSC is loaded with a TSC Basket holding up to 22 Universal Capsule Sleeves (UCSs). A UCS can hold up to six standard capsules or two of the larger Type W overpacks. Total permitted storage is 1,936 capsules loaded into 25 VCCs to specific aggregate heat generation thresholds.

- The CSA dangerous waste management unit consists of a concrete pad with a surface of approximately 90 feet by 184 feet. An area of approximately 90 feet by 90 feet within the inner security fence is the primary storage area housing the 25 VCCs during normal operation. If needed (e.g., for isolation and individual monitoring), VCCs can be moved from the inner area to the portion of the CSA pad between the two security fences.
- The concrete Operating Pad has a surface of approximately 45 feet by 45 feet and is located adjacent to the CSA pad between the two security fences. This pad is not part of any DWMU and cannot be used for dangerous or mixed waste loading, unloading, storage, handling, or treatment.
- The graveled area comprising the remainder of the area between the two security fences is not part of a DWMU. This area provides a physical buffer and drainage, but cannot be used for dangerous or mixed waste loading, unloading, storage, handling, or treatment.

Addendum A, Attachment A, contains maps and diagrams of the CIS layout. CSSs are received at the CSA, completely assembled, from the Waste Encapsulation and Storage Facility (WESF) and no additional waste sampling is required for receipt of the specific capsules identified in Addendum C. CSA is not currently authorized to receive or store any other wastes.

LIST OF ADDENDA SPECIFIC TO OPERATING UNIT GROUP 19

Addendum A	Part A Form
Addendum B	Waste Analysis Plan - Reserved
Addendum C	Process Information
Addendum D	Groundwater Monitoring - Reserved
Addendum E	Security
Addendum F	Preparedness and Prevention
Addendum G	Personnel Training
Addendum H	Closure Plan
Addendum I	Inspection Plan
Addendum J	Contingency Plan

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DEFINITIONS

The terms **capsule(s)**, **cesium and strontium capsule(s)**, and **cesium capsule(s)** are assumed to include both **standard capsules** and **Type W overpacks** unless the type is specified.

Standard capsules are the 1,913 double-walled capsules containing cesium chloride and strontium fluoride mixed waste constructed at WESF from 1974 through 1985 which have not been overpacked. These capsules have an approximate inner capacity of 1 liter.

Type W overpacks are the 23 larger capsules produced from 1997 through 1999 to encapsulate bulging cesium **standard capsules** and loose cesium chloride mixed waste. There are no **Type W overpacks** containing strontium fluoride mixed waste.

A **Vertical Concrete Cask** or "**VCC**" is the passively-ventilated outer concrete shell of a **Capsule Storage System** or "**CSS**." A single **Transportable Storage Canister** or "**TSC**" can be inserted into the storage space inside the VCC.

A **Transportable Storage Canister** or "**TSC**" is the combination of sealed stainless steel shell, Transportable Storage Canister Basket, Universal Capsule Sleeves, capsules, and spacers in a configuration described in Addendum C Section C.2.1.

A **Vertical Cask Transporter** or "**VCT**" is a mobile structure capable of lifting a fully-assembled **CSS** for transport under power of a **Tug** which is equivalent to the device described on page C-13 of CHPRC-02538 Rev. 0. A VCT and Tug are the standard method for moving a CSS.

A **Tug** is a self-propelled piece of mobile equipment capable of towing a **VCT** and fully-assembled **CSS** to a new position.

ACRONYMS

CIS	Capsule Interim Storage
CSA	Capsule Storage Area
CSS	Capsule Storage System
DWMU	Dangerous Waste Management Unit
LDR	Land Disposal Restrictions
OUG	Operating Unit Group
TSC	Transportable Storage Canister
VCC	Vertical Concrete Cask

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III.19.A COMPLIANCE WITH UNIT-SPECIFIC PERMIT CONDITIONS

III.19.A.1 The Permittees will comply with all Permit conditions in this Chapter and its Addenda with respect to dangerous waste management and Dangerous Waste Management Units (DWMU) in Operating Unit Group 19, CIS, in addition to requirements in Permit Part I and II.

III.19.B GENERAL WASTE MANAGEMENT

III.19.B.1 The Permittees are authorized to accept mixed waste for storage in this DWMU that satisfies the waste acceptance criteria in Permit Addendum B according to the waste acceptance procedures in Permit Addendum B. (Washington Administrative Code (WAC) 173-303-300)

III.19.B.2 The Permittees are authorized to store in the CSA, the specific mixed wastes identified in Addendum C, Section C.2.1. These mixed wastes will be stored according to the requirements of this Chapter and will be received and stored in the CSS, which includes the VCC and TSC, according to the requirements detailed in Addendum C, Section C.2.

III.19.C WASTE ANALYSIS

III.19.C.1 If sampling or analysis of wastes associated with the CSA is to be conducted, the Permittees will submit to Ecology a permit modification request in accordance with WAC 173-303-830 to incorporate an appropriate sampling and analysis plan and a quality assurance plan into the permit. [WAC 173-303-300(2)]

III.19.C.2 The Permittees will have an accurate and complete description of each waste stream managed at the CSA as necessary to document designation according to WAC 173-303-070, applicable land disposal restriction treatment standards pursuant to WAC 173-303-140, and any other information necessary to ensure management of the waste streams in accordance with requirements of this Permit.

III.19.C.2.a For the specific mixed wastes identified in Addendum C, Section C.2.1, the description of waste streams will consist of, at a minimum, the supporting references cited in Addendum B, Section B.2.

III.19.C.2.b This description of waste streams will be maintained in the Hanford Facility Operating Record, CIS File required by Permit Condition II.I.1 and must be available upon request. [WAC 173-303-380(1)(a)]

III.19.D RECORDKEEPING AND REPORTING

III.19.D.1 The Permittees will place the following into the Hanford Facility Operating Record, CIS File required by Permit Condition II.I.1. (WAC 173-303-380)

III.19.D.1.a The quantity and profile of each mixed waste stream managed at CSA. [WAC 173-303-380(1)(a), and -(b)]

III.19.D.1.b Records required by WAC 173-303-380(1)(o), incorporated by reference.

III.19.D.1.c An inspection log, summarizing inspections conducted pursuant to Permit Condition III.19.H.1. [WAC 173-303-380(1)(e)]

III.19.D.1.d Summary reports and details of all incidents that require implementation of the Contingency Plan according to the requirements of Permit Condition II.A.1. [WAC 173-303-380(1)(d)]

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III.19.E SECURITY

III.19.E.1 The Permittees will comply with the Security requirements specific to CIS in Addendum E and Permit Attachment 3 as required by Permit Condition II.M. [WAC 173-303-310(2)(c)]

III.19.F PREPAREDNESS AND PREVENTION

III.19.F.1 The Permittees will comply with the Preparedness and Prevention requirements specific to CIS in Addendum F and Permit Condition II.B. (WAC 173-303-340)

III.19.G CONTINGENCY PLAN

III.19.G.1 The Permittees will comply with Contingency Plan requirements specific to CIS in Addendum J in addition to the requirements of Permit Condition II.A when applicable. (WAC 173-303-350)

III.19.H INSPECTIONS

III.19.H.1 The Permittees will comply with the Inspection Plan requirements specific to CIS in Addendum I and Permit Condition II.O. [WAC 173-303-320(2)]

III.19.I TRAINING PLAN

III.19.I.1 The Permittees will comply with the Personnel Training requirements specific to CIS in Addendum G and Permit Condition II.C. (WAC 173-303-330)

III.19.J OTHER GENERAL REQUIREMENTS

Reserved

III.19.K CLOSURE

III.19.K.1 The Permittees will close the CIS dangerous waste management units in accordance with Addendum H, *Closure Plan* and Permit Condition II.J. [WAC 173-303-610(3)(a)]

III.19.L MISCELLANEOUS UNITS

III.19.L.1 The Permittees will construct and maintain the physical structure of CIS as documented in Addendum A, Attachment A, Figure A-2 and Addendum C, Section C1.1. [WAC 173-303-680(2), WAC 173-303-630(7)(c)(i)]

III.19.L.2 The Permittees will construct and maintain each CSS as documented in Addendum C, Section C.2.2, including maintaining CSS physical structure and the integrity of each mixed waste containment. [WAC 173-303-680(2), WAC 173-303-630(7)(c)(ii)]

III.19.L.3 The Permittees will handle and store each CSS in a manner which will not cause the TSC to rupture or cause it to leak. [WAC 173-303-680(2)]

III.19.L.4 In the event damage to or degradation of a CSS may reasonably lead to a spill or release from a TSC, the Permittees will initiate the Contingency Plan, if appropriate, in accordance with Permit Condition III.19.G.1 and will develop a strategy to repair, replace, or transfer components of the CSS in a manner which will prevent release of stored mixed waste. When such criteria are met, the Permittees will perform such repairs, replacements, or transfers as soon as practicable with consideration of worker safety, protection of human health and the environment, and the risk posed by the condition of the affected CSS. [WAC 173-303-680(2)]

III.19.L.5 The Permittees will ensure that equipment which is capable of safely moving a CSS will be available and properly maintained. [WAC 173-303-680(2)]

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III.19.L.6 If a CSS temperature monitoring system is not functional, visual inspection of the associated CSS passive ventilation system inlet and outlet vents will be substituted for daily temperature monitoring required by Addendum I. Operating in this manner is not, by itself, a failure to properly operate and maintain CSS passive ventilation systems or CSS temperature monitoring systems. If visual inspections are conducted because the CSS temperature monitoring system is not functional the Permittees will notify Ecology and provide a timeline for resuming normal operations of the temperature monitoring system.

III.19.L.7 The Permittees will comply with any applicable requirements for evaluation of alternatives for long-term storage or disposal of the mixed waste at a location other than the CSA as well as requirements for acquisition or modification of facilities for treatment, storage, and/or disposal of the capsules required by and enforceable under Hanford Federal Facility Agreement and Consent Order Milestone M-092.

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Part A Attachment A

Figures

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Figures

Figure A-1. CIS Topographic Map A-A-1
Figure A-2. Capsule Storage Area Civil Plan A-A-3
Figure A-3. Proposed Area for the Capsule Interim Storage (August, 2017) A-A-5

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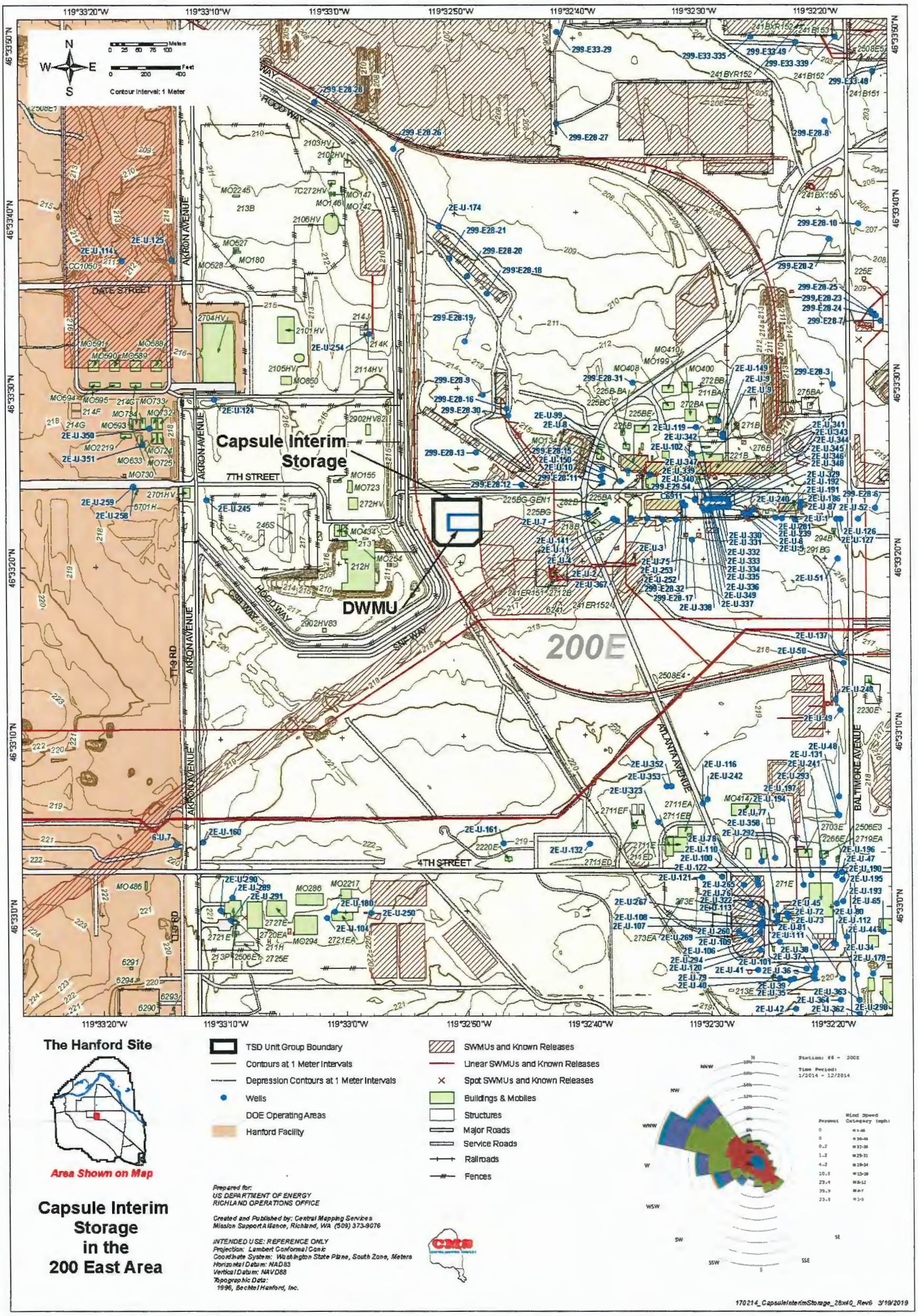

Note: Figure date is March 2019.

Figure A-1. CIS Topographic Map

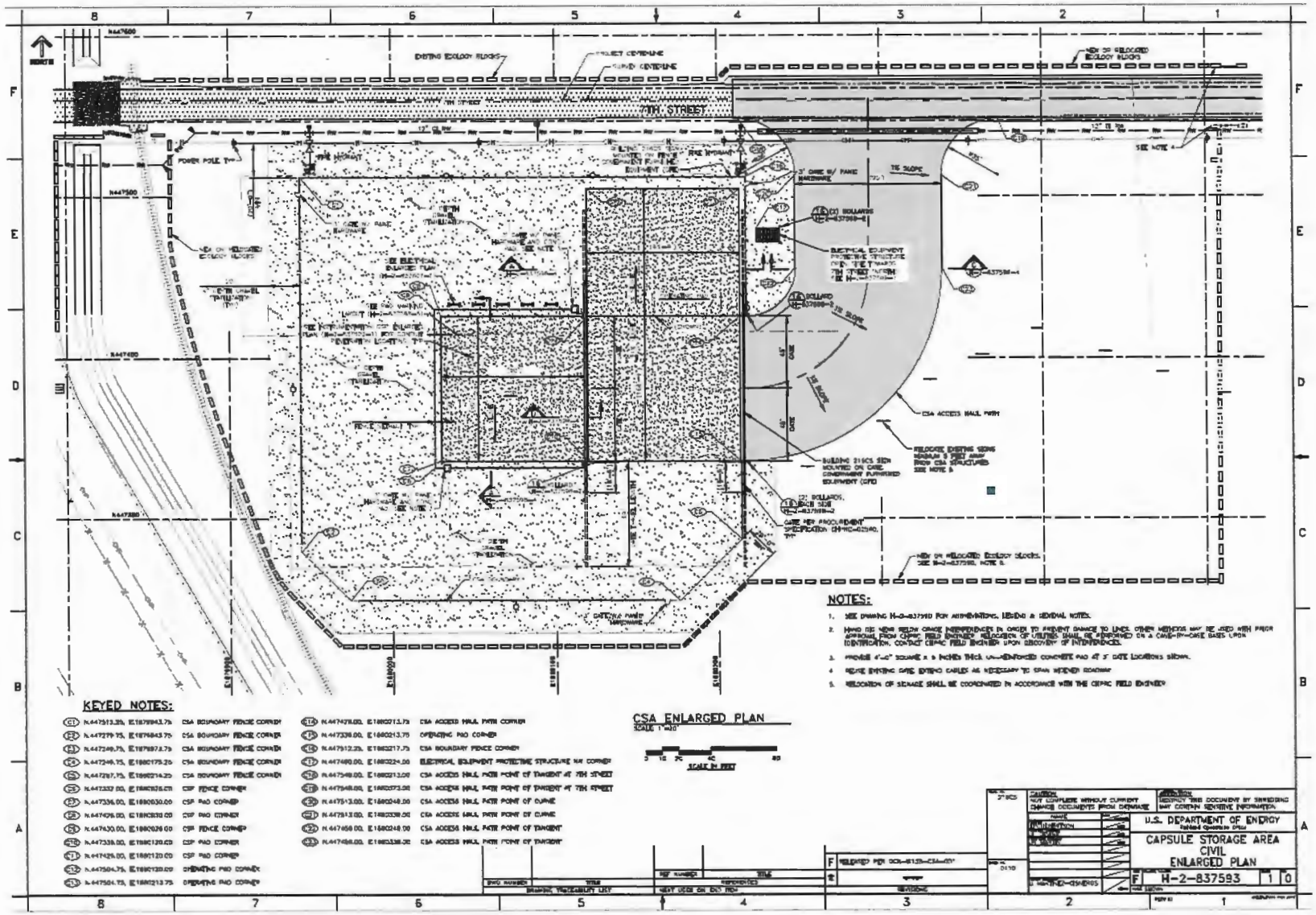

Figure A-2. Capsule Storage Area Civil Plan

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Figure A-3. Proposed Area for the Capsule Interim Storage (August, 2017)

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CAPSULE INTERIM STORAGE UNIT
ADDENDUM B
WASTE ANALYSIS PLAN

CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have its own change control log with a modification history table. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Modification History Table

Modification Date	Modification Number

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ADDENDUM B
WASTE ANALYSIS PLAN

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ADDENDUM B
WASTE ANALYSIS PLAN

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B.3 Recordkeeping 8
B.4 References 8

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Table B-3 Impurities in Strontium Salt 7

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B.1 Introduction and Unit Description

This addendum details the Waste Analysis Plan (WAP) required by Washington Administrative Code (WAC) 173-303-300, Dangerous Waste Regulations, *General waste analysis*, in effect at the Capsule Interim Storage (CIS) Operating Unit Group (OUG).

The purpose of this CIS WAP is to provide a clear outline of the waste management activities that occur for storage of waste at CIS. This WAP demonstrates compliance with the applicable requirements of WAC 173-303-300(1) through (5). Information of CIS storage operations is detailed in CIS Addendum C, *Process Information*.

The CIS OUG is comprised of the Capsule Storage Area (CSA) Dangerous Waste Management Unit (DWMU). The CSA is an uncovered, unenclosed, concrete storage pad, as described in Addendum C.

B.2 Waste Management Activities

Waste management within CIS includes continued safe storage and maintenance of the Cask Storage System storing 1,936 capsules containing cesium and strontium radioactive mixed waste. Waste managed at CIS consists of waste previously accepted at the Waste Encapsulation and Storage Facility (WESF). CIS does not produce products for use, have any production processes, nor receive waste from offsite facilities. CIS does not treat or dispose of waste.

B.2.1 Identification and Classification of Waste

All waste stored in the CSA DWMU was designated prior to being placed in the storage casks [WAC 173-303-300(1) and (2)]. Three studies, described in the following subsections, were conducted to determine impurities in the WESF capsules, and are the basis used to support waste acceptance into the CSA. Based on process knowledge and available analytical methods, the capsules do not exhibit ignitable or reactive characteristics, as defined in WAC 173-303-090, *Dangerous waste characteristics*. Of the 23 total impurities found, only 4 are designated as dangerous waste per WAC 173-303-070, *Designation of dangerous waste*. The analyses of the cesium and strontium salts have identified possible dangerous waste designations of barium (D005), cadmium (D006), chromium (D007), and lead (D008). The silver (D011) concentration was not estimated but was added from process knowledge described in *Process Test Report for Silver Decontamination of Strontium in the Waste Encapsulation and Storage Facility (WESF)* (SD-WM-PTR-003); therefore, it is not listed on the tables in this section.

Initial characterization of the contents of the cesium and strontium capsules predated promulgation of WAC 173-303 and was conducted such that sampling and analysis was as accurate and representative as possible, given the nature and properties of the materials.

Reanalysis based on WAC 173-303-300(5)(d) is not planned because the salts stored within the casks have been maintained in sealed capsules since encapsulation and no changes are expected due to the properties of the waste. The waste encapsulated in Type W overpacks was verified to be consistent with the original capsules, as described in HNF-2928, *Certification that CsCl Powder and Pellet Materials Meet WESF Acceptance Criteria.* The CIS will only accept the mixed waste capsules previously stored at WESF; thus, reanalysis is not necessary in accordance with WAC 173-303-300(4).

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B.2.1.1 Cesium Impurities

Impurities in the cesium salt are estimated as listed in PNL-5170, *A Review of Safety Issues that Pertain to the Use of WESF Cesium Chloride Capsules in an Irradiator*. Table B-1 lists the impurities of the cesium feed solution and salt analyzed for corrosion analysis. Concentrations are listed as weight percent solids.

Table B-1 Impurities in Cesium Feed Solution and Salt

Element	Cesium Feed Solution[a] (Wt%)	Salt Analysis[a] (Wt%)	Mass Spectrometry Salt Analysis[b] (Wt%)	Dangerous Waste Designation
Aluminum (Al)	1.7	0.14	0.3	N/A
Boron (B)	--	0.14	0.4	N/A
Barium (Ba)	0.94	0.55	--[e]	D005[c]
Calcium (Ca)	1.0	--	0.05	N/A
Cadmium (Cd)	--	0.02	--	D006[c]
Cobalt (Co)	--	0.10	0.02	N/A
Chromium (Cr)	0.27	1.4	0.1	D007[c]
Iron (Fe)	0.38	--[d]	0.5	N/A
Potassium (K)	0.79	0.68	0.1	N/A
Magnesium (Mg)	0.25	--	--	N/A
Sodium (Na)	0.70	2.8	0.2	N/A
Nickel (Ni)	0.33	0.1	0.1	N/A
Lead (Pb)	1.4	0.14	--	D008[c]
Rubidium (Rb)	0.52	--	0.02	N/A
Silicon (Si)	7.0	0.21	5	N/A
Strontium (Sr)	0.18	0.02	0.001	N/A
Titanium (Ti)	--	0.07	--	N/A
Zinc (Zn)	--	0.03	0.08	N/A

a. Analyzed by dissolving in nitric acid, diluting, and analyzing by inductively coupled plasma atomic emissions spectroscopy. Numbers are averages of several analyses normalized to the chloride form.

b. Analyzed by spark source mass spectrometry.

c. Waste has been designated per WAC 173-303-070, Dangerous Waste Regulations, *Designation of dangerous waste*.

d. Iron percentage was very high and non-reproducible, indicating probable contamination of cesium chloride solution.

e. Ba was not analyzed since Ba-137 was not distinguished from Cs-137, therefore, it was included with the cesium.

N/A = not applicable

Impurities in the cesium salts analyzed at the U.S. Department of Energy Oak Ridge Site are listed in HNF-2928. Concentrations are listed in Table B-2 by weight percent.

Encapsulated cesium chloride salt contains dangerous waste chemical impurities from the fractionation process consisting of lead, barium, chromium, cadmium, and silver. Barium is generated continuously as a result of the cesium-137 decay chain.

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Table B-2 Impurities in Cesium Salts Analyzed at the Oak Ridge Site

Element	Wt%[a]	Dangerous Waste Designation
Aluminum (Al)	0.68	N/A
Boron (B)	5.2	N/A
Barium (Ba)	3.0	D005[b]
Calcium (Ca)	0.68	N/A
Copper (Cu)	0.016	N/A
Iron (Fe)	0.043	N/A
Potassium (K)	1.2	N/A
Magnesium (Mg)	0.044	N/A
Molybdenum (Mo)	0.0085	N/A
Sodium (Na)	7.8	N/A
Nickel (Ni)	0.085	N/A
Silicon (Si)	2.6	N/A
Strontium (Sr)	0.0097	N/A
Zinc (Zn)	0.032	N/A

a. Numbers have been rounded to two significant figures.

b. Waste has been designated per WAC 173-303-070, Dangerous Waste Regulations, *Designation of dangerous waste*.

N/A = not applicable

B.2.1.2 Strontium Impurities

Impurities in strontium salt are estimated as listed in BNWL-1967, *The Containment of $^{90}SrF_2$ at 800 to 1100°C Preliminary Results*. Table B-3 data are estimates based on process flowsheet information; concentrations are listed in weight percent.

The encapsulated strontium fluoride salt contains dangerous waste chemical impurities from the fractionization process consisting of barium, lead, cadmium, chromium, and silver.

Table B-3 Impurities in Strontium Salt

Element	Probable Concentration (Wt%)	Dangerous Waste Designation
Aluminum (Al)	<0.5	N/A
Barium (Ba)	0.1-2.0	D005*
Calcium (Ca)	0.1-2.0	N/A
Cadmium (Cd)	<0.1	D006*
Chromium (Cr)	<0.2	D007*
Copper (Cu)	<0.01	N/A
Iron (Fe)	<0.1	N/A
Hydrogen (H)	<0.01	N/A

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Table B-3 Impurities in Strontium Salt

Element	Probable Concentration (Wt%)	Dangerous Waste Designation
Potassium (K)	<0.1	N/A
Magnesium (Mg)	0.05-0.5	N/A
Manganese (Mn)	<0.1	N/A
Nitrogen (N)	<0.01	N/A
Sodium (Na)	1-4	N/A
Nickel (Ni)	<0.1	N/A
Oxygen (O)	<0.05	N/A
Lead (Pb)	<0.2	D008*
R (Rare Earths)	<2.0	N/A
Silicon (Si)	<0.02	N/A
Zirconium (Zr)	Variable (decay product)	N/A

*Waste has been designated per WAC 173-303-070, Dangerous Waste Regulations, *Designation of dangerous waste*.
N/A = not applicable

B.2.2 Waste Acceptance and Analysis Parameters

The mixed waste capsules managed at CIS were generated and accepted for storage at WESF; consequently, the capsules will be accepted at CIS without any additional sampling and analysis.

Before acceptance into the CSA, an inspection of documentation will be conducted for each cask. In addition to the inspection of documentation, 100 percent of containers will undergo physical inspection for any damage to the container and the presence of accurate labeling.

Waste will be tracked by recording the waste into a waste inventory sheet. Following completion of waste acceptance activities, the waste is considered accepted to the CIS.

B.3 Recordkeeping

Permittees will place documentation into the WA7890008967, Hanford Facility Resource Conservation and Recovery Act Permit (CIS portion), as required by Hanford Facility RCRA Permit Condition II.I (WAC 173-303-380, *Facility recordkeeping*), WAC 173-303-300(5), and WAC 173-303-806(4)(a)(iii), *Final facility permits*. Documentation will be maintained in electronic format or hard copy, and include waste transfer records (Hanford Facility RCRA Permit Condition II.I.1.j) and results of waste analysis (Hanford Facility RCRA Permit Condition II.I.1.b). Records will be maintained in accordance with Hanford Facility RCRA Permit Condition II.I.1.

B.4 References

BNWL-1967, 1975, *The Containment of $^{90}SrF_2$ at 800 to 1100°C Preliminary Results*, Battelle Pacific Northwest Laboratories, Richland, Washington. Available at: https://inis.iaea.org/search/search.aspx?orig_q=RN:7255850

HNF-2928, 1998, *Certification That CsCl Powder and Pellet Materials Meet WESF Acceptance Criteria*, Rev. 0, B&W Hanford Company, Richland, Washington. Available at: https://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0067067H

PNL-5170, 1984, *A Review of Safety Issues that Pertain to the Use of WESF Cesium Chloride Capsules in an Irradiator*, Pacific Northwest Laboratory, Richland, Washington. Available at: http://www.osti.gov/scitech/servlets/purl/6656409.

SD-WM-PTR-003, 1984, *Process Test Report for Silver Decontamination of Strontium in the Waste Encapsulation and Storage Facility (WESF)*, Rev. 0, Rockwell Hanford Operations, Richland, Washington. Available at: https://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=AR-02422

WA7890008967, *Hanford Facility Resource Conservation and Recovery Act Permit, Dangerous Waste Portion for the Treatment, Storage, and Disposal of Dangerous Waste*, Revision 8C, as amended, Washington State Department of Ecology. Available at: https://fortress.wa.gov/ecy/nwp/permitting/hdwp/rev/8c/index.html .

WAC 173-303, *Dangerous Waste Regulations*, Washington Administrative Code, Olympia, Washington. Available at: http://apps.leg.wa.gov/WAC/default.aspx?cite=173-303.

WAC 173-303-070, *Designation of dangerous waste*.

WAC 173-303-090, *Dangerous waste characteristics*.

WAC 173-303-300, *General waste analysis*.

WAC 173-303-380, *Facility recordkeeping*.

WAC 173-303-806, *Final facility permits*.

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CAPSULE INTERIM STORAGE UNIT
ADDENDUM C
PROCESS INFORMATION

CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have its own change control log with a modification history table. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Modification History Table

Modification Date	Modification Number

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ADDENDUM C
PROCESS INFORMATION

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ADDENDUM C
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C.1 Introduction and Operating Unit Group Description

This addendum provides a description of storage operations required by Washington Administrative Code (WAC) 173-303, *Dangerous Waste Regulations*, in effect at the Capsule Interim Storage (CIS) Operating Unit Group (OUG).

C.1.1 Capsule Storage Area Dangerous Waste Management Unit Description

Located in the western portion of the Hanford Facility 200 East Area and surrounded by a chain-link fence, CIS contains the Capsule Storage Area (CSA) Dangerous Waste Management Unit (DWMU) (Figure C-1). CSA is an uncovered, unenclosed, rectangular storage pad constructed of reinforced concrete measuring ~27 m (90 ft) wide by 56 m (184 ft) long and 46 cm (18 in.) thick. The concrete pad has a loading capacity of 5,000 psi, sloping one percent to the south. A second chain-link fence encircles the portion of the pad storing the casks, as shown in Figure C-1. A portion of the concrete pad located outside the CSA fence line is used for movement operations of the storage casks.

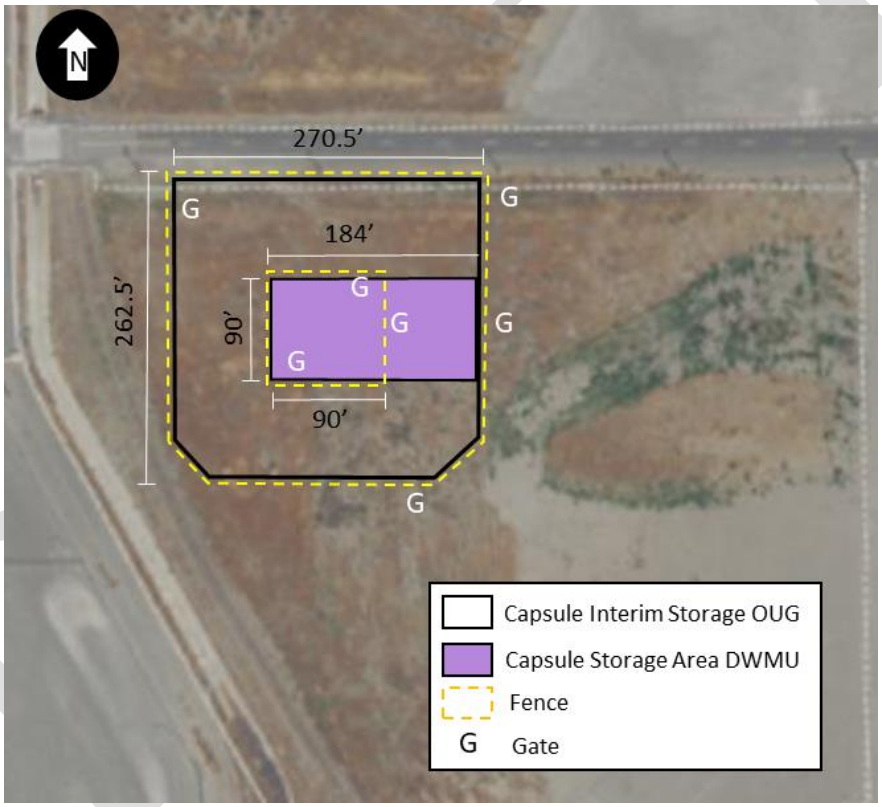

Figure C-1 Aerial Photo of Capsule Interim Storage Dangerous Waste Management Unit (2012)

C.1.2 List of Wastes

Waste managed at CIS consists of waste previously accepted, encapsulated, and loaded into Cask Storage Systems (CSS) at the Waste Encapsulation and Storage Facility (WESF). Two mixed waste streams are managed at CIS: cesium chloride and strontium fluoride salts. CIS does not generate products for use, have any production processes, nor receive waste from offsite facilities. For a comprehensive list of

waste managed in accordance with *Resource Conservation and Recovery Act of 1976* (RCRA) regulations, refer to the CIS Part A Form located in Addendum A.

C.1.2.1 Capsule Storage Area Dangerous Waste Management Unit Maximum Waste Inventory

Waste inventory is described in CIS Addendum A, *Part A*.

C.2 Process Information – Waste Management

The CIS mission is to provide safe, compliant, and cost-effective storage of the cesium and strontium mixed waste. The CIS CSSs meet the definition of "container" as noted in WAC 173-303-040, *Definitions*. However, due to the unique characteristics of the CSS and the radioactive component of the mixed waste, CIS storage operations differ from the standard container management requirements of WAC 173-303-630, *Use and management of containers*. Due to the radioactive component of the mixed waste contents and the specialized management system, CIS is considered a miscellaneous unit. For further discussion on the analysis of miscellaneous unit regulatory requirements pursuant to WAC 173-303-680, *Miscellaneous units*, refer to Section C.3. The mixed waste is stored in a manner that minimizes the potential for a release of the mixed waste contents as described in the following sections.

C.2.1 Description of Capsules

CIS stores 1,936 capsules within the CSS: 1,335 contain cesium chloride salt, while the remaining 601 contain strontium fluoride salt. There are three types of capsules: cesium mixed waste capsules, strontium mixed waste capsules, and Type W overpacks. Table C-1 contains design specifications of the capsules. See Appendix C-A for engineering drawings of the capsules.

Table C-1 Capsule Properties

Capsule Type	Containment Boundary	Material	Wall Thickness[a] (cm [in.])	Outside Diameter (cm [in.])	Total Length (cm [in.])	Cap Thickness (cm [in.])
CsCl Capsule	Inner	316L Stainless Steel	0.3 (0.1)	5.8 (2.3)	50.0 (19.7)	1 (0.4)
	Outer	316L Stainless Steel	0.3 (0.1)	6.6 (2.6)	52.8 (20.8)	1 (0.4)
SrF2 Capsule	Inner	Hastelloy® C-276	0.3 (0.1)	5.8 (2.3)	48.5 (19.1)	1 (0.4)
	Outer	316L Stainless Steel[b]	0.3 (0.1)	6.6 (2.6)	51.1 (20.1)	1 (0.4)
Type W Overpack	Single	316L Stainless Steel	0.3 (0.1)	8.4 (3.3)	55.4 (21.8)	1 (0.4)

®Hastelloy is a registered trademark of Haynes International, Kokomo, Indiana.

Note: Capsule data taken from HNF-22687, *WESF Capsule Data Book*, were rounded.

a. The specified wall thickness of the capsules was changed during production.

b. Some of the initial SrF_2 capsules were made with Hastelloy C-276 outer capsules.

CsCl = cesium chloride

SrF_2 = strontium fluoride

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The cesium capsules are double-walled (i.e., a capsule placed inside another capsule), stainless steel containers that are ~52.8 cm (20.8 in.) by 6.6 cm (2.6 in.) in length and diameter, respectively (Figure C-2). Strontium capsules have the same general dimensions but consist of a Hastelloy C-276 inner capsule and a stainless steel outer capsule (Figure C-3).

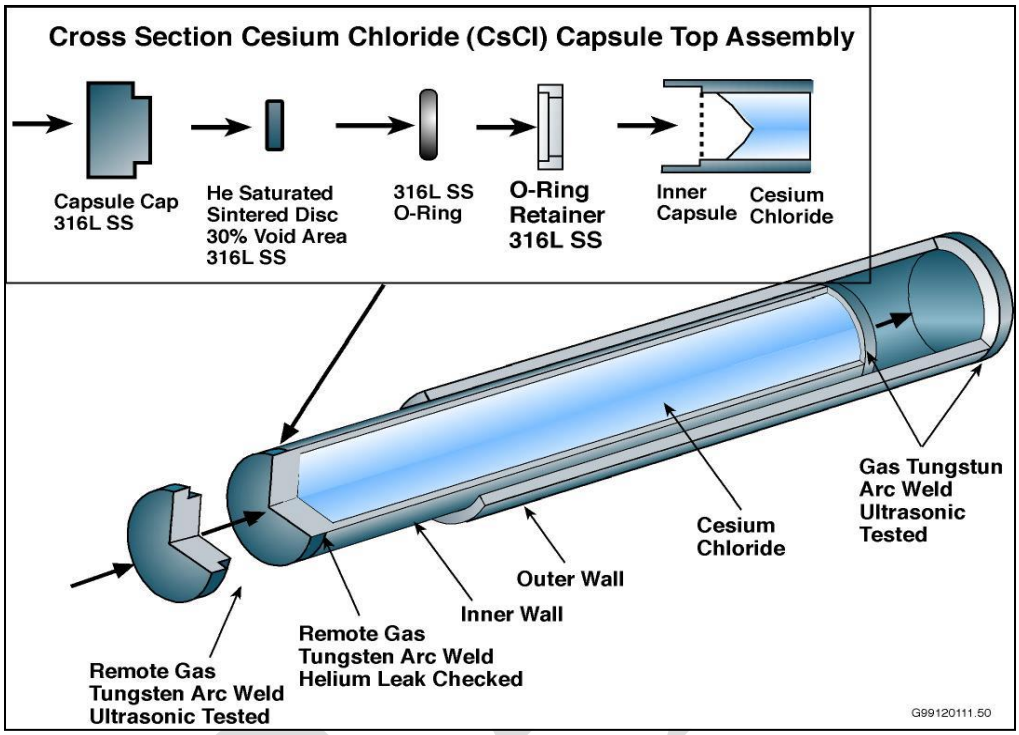

Figure C-2 Cesium Capsule

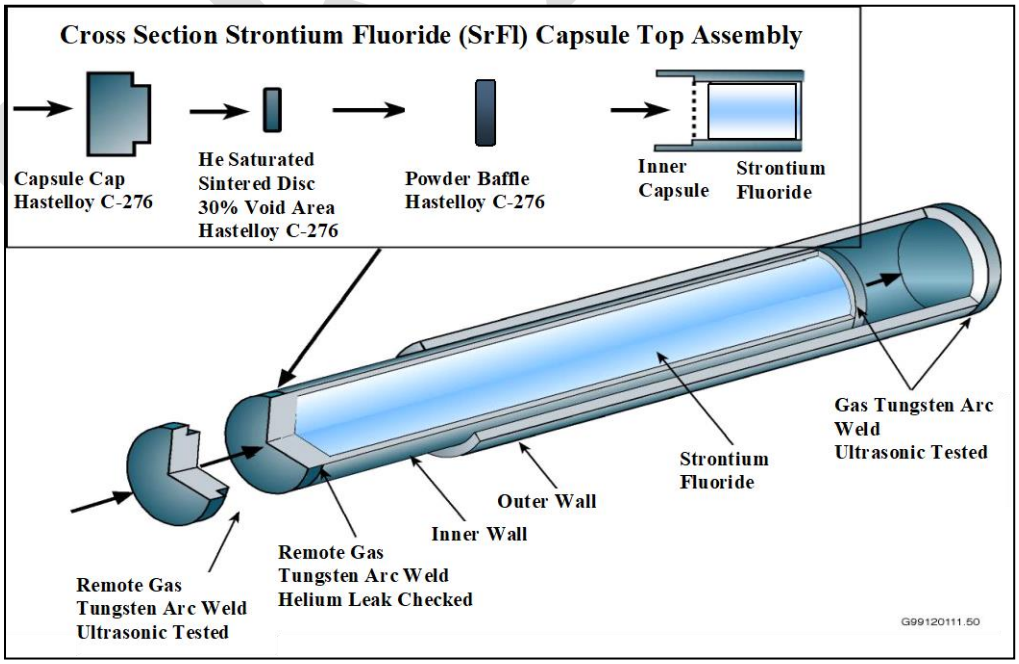

Figure C-3 Strontium Capsule

Of the cesium capsules, 23 are referred to as Type W overpacks (Figure C-4). Type W overpacks were fabricated at the 324 Building from 1997 to 1999. Of the Type W overpacks, 16 contain degraded cesium capsules, while the other 7 contain cesium chloride packaged during cleanout of the 324 Building. Type W overpacks are made of stainless steel and are 55.4 cm (21.8 in.) by 8.4 cm (3.3 in.) in length and diameter, respectively.

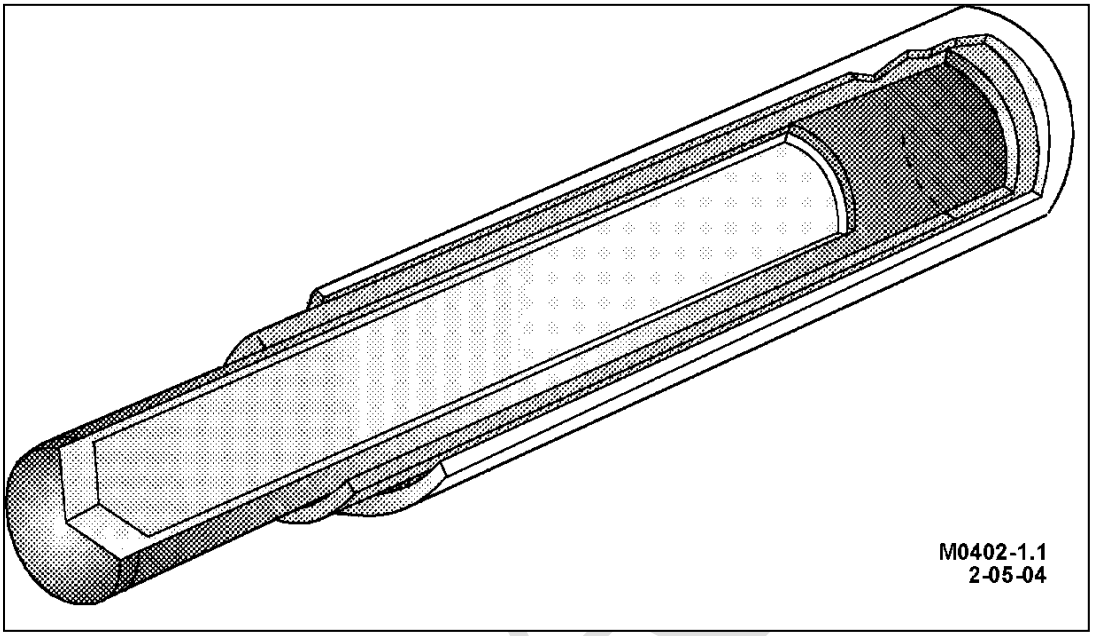

Figure C-4 Type W Overpack (Typical)

WESF encapsulation operations occurred between September 1974 and January 1985. First, the cesium chloride or strontium fluoride salt was added to the inner capsule, followed by a sintered metal disk to aid the helium leak check performance test. The capsule was then purged with helium, capped, welded, leak checked (to verify the integrity of the inner capsule weld), and decontaminated before insertion into a stainless steel outer capsule. The outer capsule cap was welded in place, and the weld was examined ultrasonically. Finally, a calorimetry test was performed prior to placing the capsule in storage. The Type W overpacks had both a helium leak check and an ultrasonic weld inspection on the outer capsule to verify weld integrity.

C.2.2 Description of the Cask Storage System

The CSS is designed to store the cesium capsules, strontium capsules, and Type W overpacks in a safe and compliant configuration. The initial design and analysis for the CSS components are based on previous Nuclear Regulatory Commission (NRC)-certified designs. The components of the NRC design have been modified to accommodate the cesium and strontium capsules. The CSS consists of the following components and is detailed in Figures C-5 and C-6:

- Universal capsule sleeve (UCS).
- Transportable storage canister (TSC) basket.
- TSC.
- Vertical concrete cask (VCC).

The CSS is designed to provide passive cooling of the capsules, shielding from radiation, protection from external hazards, and protection from the environment (e.g., rain, snow, ice). The CSS is ~3.4 m (11 ft) tall by 3.0 m (10 ft) in diameter.

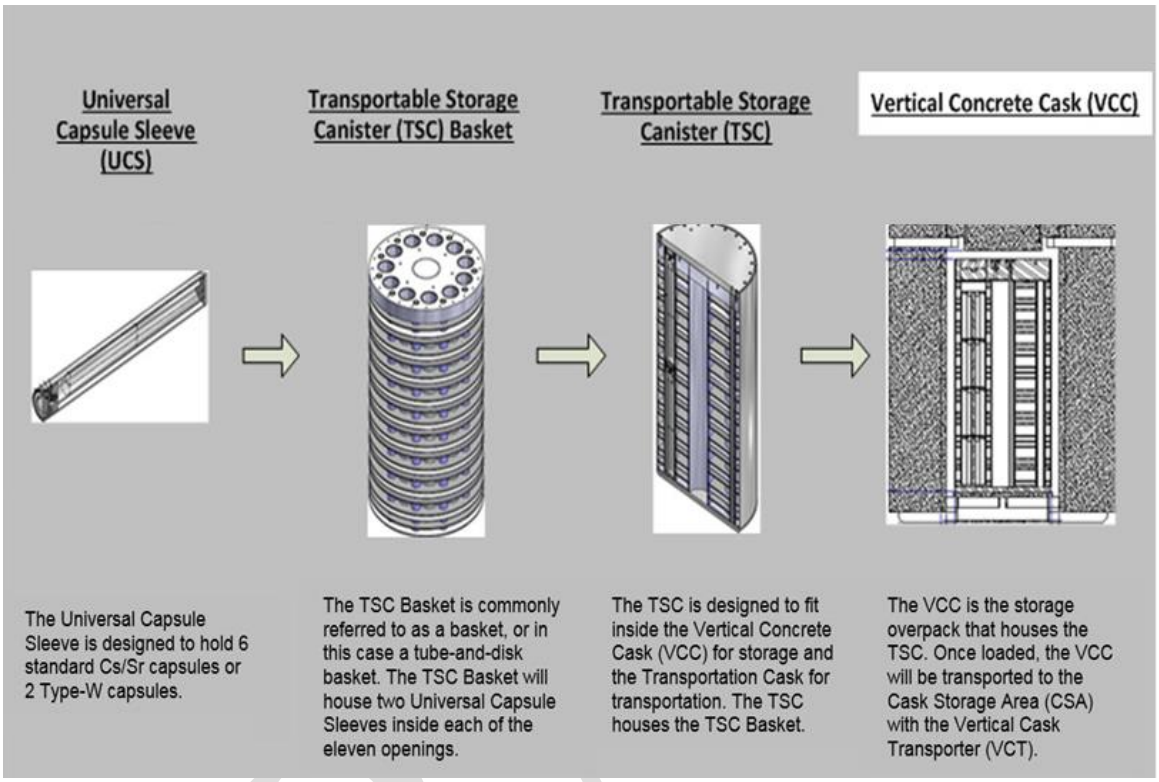

Figure C-5 Cask Storage System

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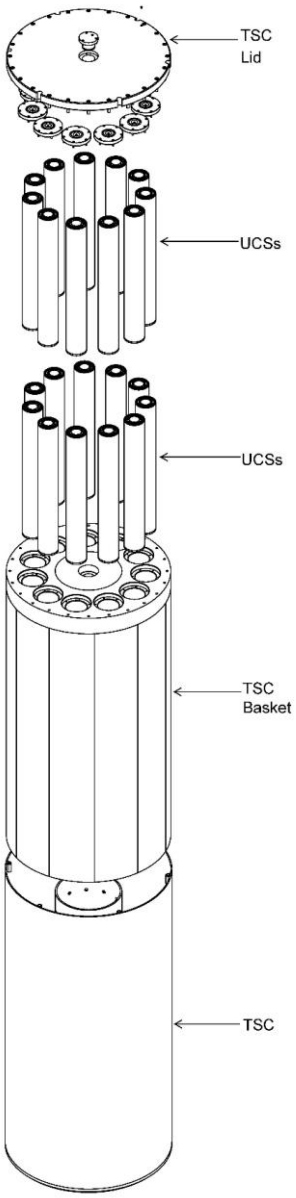

Figure C-6 The TSC, Basket, and Universal Capsule Sleeves (UCSs)

C.2.2.1 Universal Capsule Sleeve

The capsules are contained in 316L stainless steel UCSs, sealed closed. A UCS holds up to six cesium or strontium capsules or two Type W capsules. Despite having different capsules types, the UCS will have the same exterior dimensions of approximately 120 cm (49 in.) tall by 19 cm (7.5 in.) in diameter. Standard capsules are vertically stored in a UCS in a 3x2 array, while Type W capsules are loaded in a 1x2 array. A single-piece aluminum shunt within the UCS defines the capsule cell location. The UCS is closed with a threaded plug lid assembly.

C.2.2.2 Transportable Storage Canister Basket

The UCSs are inside a TSC basket constructed of aluminum and steel. A TSC basket holds up to two UCSs end-to-end inside 11 cell locations, each of which has a shield plug and closure lid.

C.2.2.3 Transportable Storage Canister

The TSC houses the TSC basket. The steel TSC incorporates a closure lid design with shield plugs, which provides confinement of the contents. The closure lid is sealed to the TSC shell to complete the TSC structure.

C.2.2.4 Vertical Concrete Casks

Each TSC is placed within a VCC consisting of a reinforced concrete structure, a 10 cm (4 in.) structural steel inner liner, a bolted on steel lid, and a pedestal equipped with a steel plate at the bottom. Concrete reinforcement consists of both inner and outer steel rebar cages, encased within concrete. The concrete shell surrounds the carbon steel liner and pedestal. The concrete cask is stable against tip-over and sliding during tornado, flood, and earthquake accidents. A 23 cm (9 in.) drop of a fully loaded VCC shows that the TSC will maintain confinement and there will be no release of waste. Each VCC is ~3.4 m (11 ft) tall by 3.0 m (10 ft) in diameter. A loaded VCC has a maximum weight of approximately 73,620 kg (162,300 lb). The thickness of the VCC concrete wall is ~0.6 m (2 ft), and the lid is ~0.3 m (1 ft) thick. The structure of the VCC provides shielding protection for personnel and protects the TSC from external hazards and the elements.

C.2.2.5 Heat Loading

Capsules were loaded into the CSS based on the total heat load of the cask. There are three heat loads for strontium casks: 14.6 kW, 17.6 kW, and 22.3 kW. Casks loaded with cesium capsules have heat loads of 15.6 kW and casks with Type W are 3.52 kW. To ensure the proper heat distribution, stainless steel capsule spacers may be included in the loading plan to take the place of a capsule.

Aluminum inserts in the UCS and TSC draw the heat away from the capsules. The casks are designed to direct the heat from the capsules through the VCC vents by means of convection. Since temperature is the limiting factor, the materials, CSS design, and loading plan have all been considered to ensure that the waste is maintained below the phase transition and melting points of the cesium and strontium waste. Cesium chloride undergoes a phase transition at temperatures as low as 330°C (626°F), therefore operating limits for the salt-capsule interface will not exceed 317°C (603°F). Strontium fluoride does not undergo a solid phase transition, and has a minimum melting point of 800°C (1,472°F). Operating limits for the strontium salt-capsule interface is set at 540°C (1004°F).

There are two primary concerns that would result in an increase in capsule temperature: fire and vent blockage. Accident scenarios have been completed for both possibilities. For a fire hazard, there will be an initial rise in temperature with a quick decrease as the fire is extinguished or moves away. The stainless steel containment components (UCS and TSC) will not reach the allowable temperature limit of 815°C (1500°F). For a scenario in which all vents are completely blocked and no air flow occurs, the temperature will steadily rise until it reaches a steady-state. At steady-state, the stainless steel containment components will not reach the allowable temperature limit.

In either of the accident scenarios, the strontium fluoride will not melt due to its high melting point. The cesium chloride may undergo a phase transition due to the increase in temperature. However, in the event that the inner layer of the capsule does fail due to the excess temperature and pressure, the cesium will not breach the outer layer of the capsule.

As the casks were designed to safely store the cesium and strontium capsules for interim storage, failure of the VCC is highly unlikely. However, in the event of degradation of a VCC, a strategy will be developed to transfer a TSC to a new VCC. In the unlikely event of an unplanned release, the *Contingency Plan* (Addendum J) will be implemented.

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C.2.2.6 Temperature Monitoring

The VCCs are designed to provide passive cooling of the TSC via natural air circulation. Outside air enters the inlet air vents [99 cm (39 in.) wide by 72 cm (28 in.) high by 2.5 cm (1.0 in.) thick] located at the bottom of the VCC structure. Outlet air vents [100 cm (39 in.) wide by 69 cm (27 in.) high by 1.3 cm (0.5 in.) thick] provide a flow path for the internal circulation of air adjacent to the canister for heat removal. The vent inlets and outlets are protected from natural elements by bolted-on removable screens designed to prevent or minimize debris (e.g., soil, vegetation) and wildlife from entering. Resistance temperature detectors (RTDs), installed outside each of the outlet air vents are connected to the temperature monitoring system (TMS) to provide temperature monitoring for each CSS. As obstructions to the vents are the primary cause of an increase in cask temperature, temperature monitoring will verify that vents are free from obstruction and the ventilation system is functioning properly. CIS Addendum I, *Inspection Plan*, provides further information on this CIS inspection requirement.

The TMS consists of the TMS cabinet designed with a weatherproof hinged window and an interface. The cabinet is protected by a three-sided structure, which is located to the northeast of the CIS outer fence (see the CSA Enlarged Plan in Appendix C-A.) The TMS interface displays the temperature of each cask, ambient temperature, and a high temperature annunciator. An alarm beacon, located on top of the TMS cabinet, is designed to alert operators of unsatisfactory conditions. The TMS provides continuous readout of temperature by location and a representation of temperature over time. The maximum temperature for normal operating conditions is based on the allowable temperature difference between the ambient temperature and the outlet air vents. For strontium casks with a maximum heat load of 14.6 kW and 22.3 kW, the allowable temperature difference is 45.6°C (114°F). For strontium casks with a maximum heat load of 17.6 kW, the allowable temperature difference is 55°C (131°F). For all cesium casks, a 43.3°C (110°F) difference is allowable.

C.2.2.7 Identification and Labeling

Each component of the CSS is marked with a unique identifier to record storage locations for tracking purposes. In addition, each VCC has a metal stamped label identifying hazardous waste, the hazards associated with the waste contents, and the accumulation start date. Casks have been loaded according to a capsule loading plan recorded as an inventory sheet, as part of the Treatment, Storage, or Disposal Facility (TSD) unit-specific operating record. In the event of missing labels, the inventory sheet may be referenced to determine waste type. The labels will be managed to facilitate compliance with the requirements outlined in CIS Addendum I.

C.2.2.8 Waste Management

CIS operations provide for the continued safe storage and maintenance of 1,936 cesium and strontium capsules stored within CSSs. The CSS will be handled, managed, and stored in a manner that maintains containment and limits personnel contact with the waste. Only qualified personnel trained in accordance with CIS Addendum G, *Personnel Training*, will conduct waste container handling activities at the CIS.

The CSSs containing the mixed waste will be transferred from the WESF for placement on the CSA concrete pad. Once a CSS has been positioned outside the truckport of WESF, the vertical cask transporter (VCT) is connected to a VCC through the use of lifting lugs. The VCT will lift the VCC in preparation of transport. The tugger will move the VCT supporting the VCC along the haul path, and place the CSS on the CSA concrete pad at its assigned destination. The VCT will be disconnected from the VCC and moved away. The previously installed RTDs will then be connected to the CIS TMS control panel via cable connections to the TMS junction box located on the side of each cask.

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The CSS may be moved from the storage configuration within the inner fence to other areas on the CSA DWMU concrete pad (e.g., heat monitoring, maintenance) as a result of actions or events related to Addendum I and Addendum J. Maintenance, repairs, or replacements which occur due to unexpected events will be conducted as quickly as practicable and in a manner that ensures protection of human health and the environment. Visual inspections and temperature monitoring will ensure each CSS remains in good condition through all expected events until Milestone M-092 is met.

C.2.3 Waste Compatibility

The CSS is constructed of materials that are both compatible with the mixed waste being stored and designed for long-term dry storage. Capsule, UCS, canister, and cask materials preclude chemical, electrochemical, or other reactions (e.g., internal corrosion) from occurring.

The mixed waste stored at CIS does not exhibit the characteristics of ignitability or reactivity as defined in WAC 173-303-040 or WAC 173-303-090(5) and (7), *Dangerous waste characteristics*.

As a best management practice, strontium capsules and cesium capsules will not be loaded in a single TSC; therefore, each TSC will consist of capsules containing the same mixed waste stream. Furthermore, this means that conventional cesium capsules and Type W overpacks may be loaded in a single TSC.

C.2.4 Equipment

The VCT provides wheeled transport for the VCCs by using hydraulics to lift and carry a VCC no more than 23 cm (9 in.) above grade. A tow tractor is the designated prime mover for the VCT, traveling no more than 15 mph.

C.2.5 Aisle Spacing

Each TSC has an internal support structure used to confine the capsules. In addition, the CSA storage design configuration provides aisle space between VCCs to allow for the unobstructed movement of personnel and emergency equipment, thereby meeting the requirements of WAC 173-303-340(3), *Preparedness and prevention*. VCC storage configuration requires ~4.6 m (15 ft) distance between center points of the VCCs, which allows ~1.5 m (5 ft) between each cask. The pad is constructed for placement of casks to be aligned with the temperature monitoring system, which are installed at the required spacing distance. If a CSS is moved outside of the designed configuration, a 1.5 m (5 ft) spacing will be maintained.

C.2.6 Inspections

Qualified personnel trained in accordance with CIS Addendum G conduct inspections of the CSA DWMU. Inspections detect any signs of malfunction, deterioration, or other anomalies. CIS Addendum I describes content and frequency of inspections.

C.2.7 Containment Requirements for Storing Capsules

All capsules are stored within the CSS to maintain the contents of the mixed waste and keep exposures as low as reasonably achievable. CIS does not store capsules with free liquids, waste that exhibit ignitability or reactivity, or waste designated as F020 through F023, F026, or F027. The casks are elevated and protect the waste from contact with accumulated liquids [WAC 173-303-630(7)(c)(ii)]. The CSA storage pad is sloped to drain liquid resulting from precipitation in accordance with WAC 173-303-630(7)(c)(i). These design features address control of run-on. Due to the configuration of capsules in CSS, contaminated runoff is not possible.

C.2.8 Prevention of Reaction of Ignitable, Reactive, and Incompatible Waste in CIS

The mixed waste contents of the capsules stored at CIS do not exhibit characteristics of ignitability, reactivity, or incompatibility. Additionally, CIS does not and will not store ignitable, reactive, or incompatible waste; therefore, WAC 173-303-630(8) and (9) requirements are not applicable to CIS.

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C.2.9 Air Emissions

This section addresses air emission standards from the following requirements:

- WAC 173-303-690, *Air emission standards for process vents*, incorporated by 40 CFR 264, *Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities*, Subpart AA, *Air Emission Standards for Process Vents*.
- WAC 173-303-691, *Air emission standards for equipment leaks*, incorporated by 40 CFR 264, Subpart BB, *Air Emission Standards for Equipment Leaks*.
- WAC 173-303-692, *Air emission standards for tanks, surface impoundments, and containers*, incorporated by 40 CFR 264, Subpart CC, *Air Emission Standards for Tanks, Surface Impoundments, and Containers*.

C.2.9.1 Applicability of Subpart AA Standards

The air emission standards in 40 CFR 264, Subpart AA apply to process vents associated with distillation, fractionation, thin-film evaporation, solvent extraction, or air or steam stripping operations for hazardous wastes with organic concentrations of at least 10 parts per million (ppm) by weight. Because CIS does not have any process vents, Subpart AA standards do not apply.

C.2.9.2 Applicability of Subpart BB Standards

The air emission standards in 40 CFR 264, Subpart BB apply to equipment that contains or contacts hazardous waste with a total organic concentration of 10% by weight or more. Because CIS does not store hazardous waste with associated organic compounds, Subpart BB standards do not apply (CIS Addendum A provides a comprehensive list of waste managed at the facility).

C.2.9.3 Applicability of Subpart CC Standards

Air emission standards from 40 CFR 264, Subpart CC apply to tank, surface impoundment, and container storage units that manage hazardous waste with average volatile organic concentrations equal to or exceeding 500 ppm by weight, based on the waste composition at the point of origination. However, containers that solely manage mixed waste are exempt per 40 CFR 264.1080(b)(6), *Applicability*. Because CIS only contains mixed waste Subpart CC standards do not apply.

C.3 Analysis of Miscellaneous Unit Regulatory Requirements Pursuant to WAC 173-303-680

The CSA has been classified as an X99 (miscellaneous) unit due to the unique radiological characteristics of the cesium and strontium that necessitate specialized management systems and requirements other than those applicable to container storage units. Miscellaneous units do not fit clearly into a regulatory category such as a container storage unit, containment building, or tank system.

WAC 173-303-680 requires that a miscellaneous unit must be located, designed, constructed, operated, maintained, and closed in a manner that will ensure protection of human health and the environment according to those provisions most appropriate to the unit being permitted. Terms and provisions most appropriate to CIS are those applicable requirements in WAC 173-303-630. Waste management process descriptions provided in this addendum describe all essential elements of waste management practices necessary to support the required demonstrations.

WAC 173-303-680(2)(a) through (c) requires consideration of the potential release or migration of waste or waste constituents to groundwater, surface water, and air. The CIS is situated in a flat, open area, approximately 11 km (6.8 mi) south of the Columbia River, with groundwater at depth approximately 94 m (310 ft) below ground surface. Because mixed wastes managed at CIS are in sealed capsules within the multilayered CSS, there is no potential for release outside the containment system or into the

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environment. CIS is not seeking to be a permitted as a disposal unit; therefore, the requirements of WAC 173-303-680(4) concerning post-closure care are not applicable.

C.4 Recordkeeping

The Permittees will place documentation into the Hanford Facility Operating Record (CIS portion) as required by WA7890008967, Hanford Facility Resource Conservation and Recovery Act Permit, Condition II.I (WAC 173-303-380, *Facility recordkeeping*).

C.5 Training

For training requirements relative to duties described in this addendum, refer to CIS Addendum G.

C.6 References

40 CFR 264, *Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities*, Code of Federal Regulations. Available at: https://www.ecfr.gov/cgi-bin/text-idx?SID=f934618132e33e188ab6c3f15442552c&mc=true&node=pt40.28.264&rgn=div5.

264.1080, *Applicability*.

Subpart AA, *Air Emission Standards for Process Vents*.

Subpart BB, *Air Emission Standards for Equipment Leaks*.

Subpart CC, *Air Emission Standards for Tanks, Surface Impoundments, and Containers*.

HNF-22687, 2004, *WESF Capsule Data Book*, Rev. 0, Fluor Hanford, Inc., Richland, Washington.

Resource Conservation and Recovery Act of 1976, 42 USC 6901, et seq. Available at: https://elr.info/sites/default/files/docs/statutes/full/rcra.pdf.

WA7890008967, *Hanford Facility Resource Conservation and Recovery Act Permit, Dangerous Waste Portion for the Treatment, Storage, and Disposal of Dangerous Waste*, Revision 8C, as amended, Washington State Department of Ecology. Available at: https://fortress.wa.gov/ecy/nwp/permitting/hdwp/rev/8c/index.html.

WAC 173-303, *Dangerous Waste Regulations*, Washington Administrative Code, Olympia, Washington. Available at: http://apps.leg.wa.gov/WAC/default.aspx?cite=173-303.

WAC 173-303-040, *Definitions*.

WAC 173-303-090, *Dangerous waste characteristics*.

WAC 173-303-340, *Preparedness and prevention*.

WAC 173-303-380, *Facility Recordkeeping*.

WAC 173-303-630, *Use and management of containers*.

WAC 173-303-680, *Miscellaneous units*.

WAC 173-303-690, *Air emission standards for process vents*.

WAC 173-303-691, *Air emission standards for equipment leaks*.

WAC 173-303-692, *Air emission standards for tanks, surface impoundments, and containers*.

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APPENDIX C-A
ENGINEERING DRAWING

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CAPSULE STORAGE AREA DWMU

Capsule Storage Area Civil Enlarged Plan H-2-837593
Capsule Storage Area Civil Grading Plan H-2-837592

CAPSULES

Strontium Inner Capsule Assembly and Details H-2-66758
Strontium Outer Capsule Assembly and Details H-2-66759
Cesium Inner Capsule Assembly and Details H-2-66760
Cesium Outer Capsule Assembly and Details H-2-66761
Cesium Capsule Type W Overpack Weldment and Details H-3-307504

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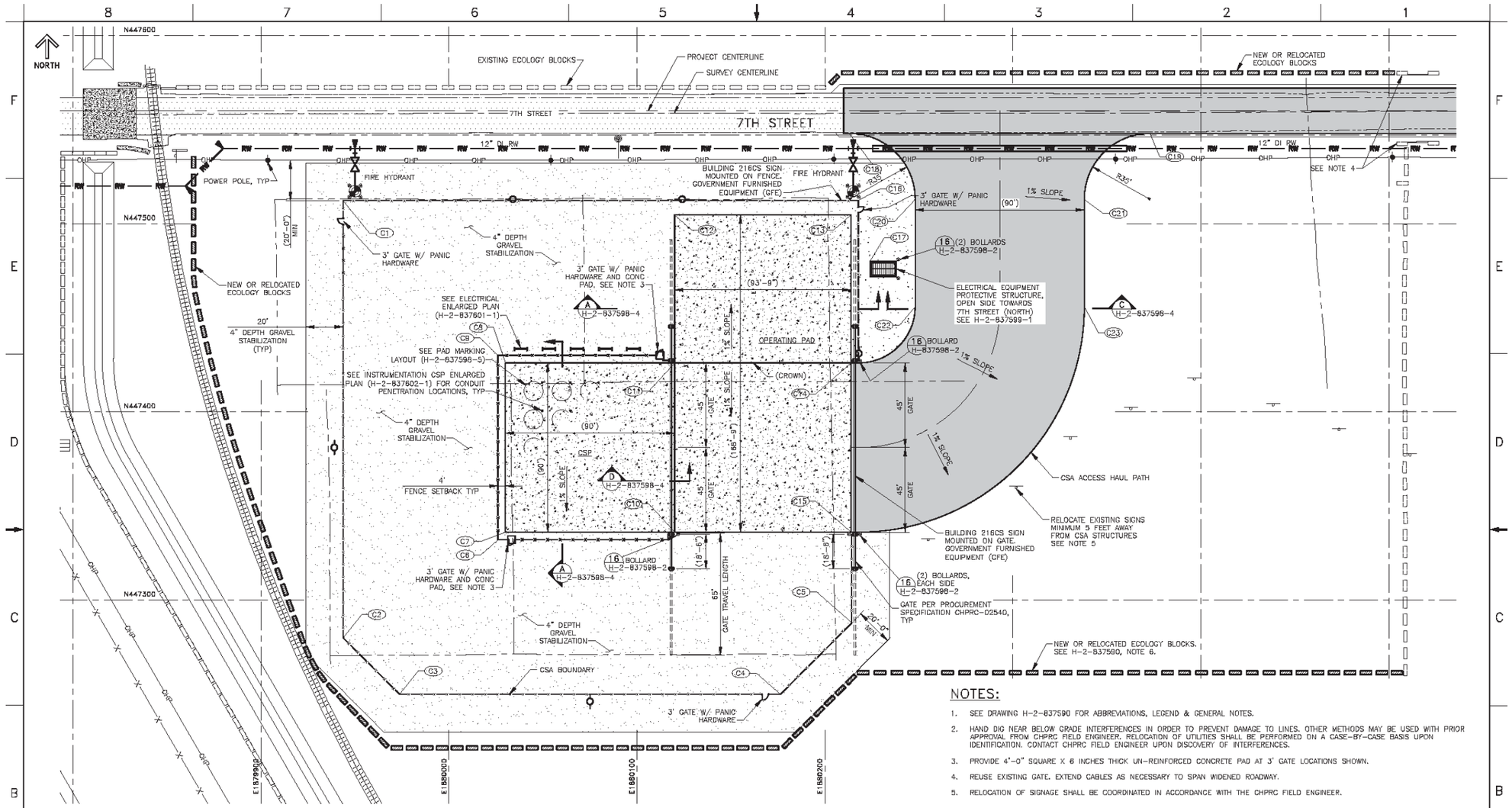

NOTES:

1. SEE DRAWING H-2-837590 FOR ABBREVIATIONS, LEGEND & GENERAL NOTES.
2. HAND DIG NEAR BELOW GRADE INTERFERENCES IN ORDER TO PREVENT DAMAGE TO LINES. OTHER METHODS MAY BE USED WITH PRIOR APPROVAL FROM CHPRC FIELD ENGINEER. RELOCATION OF UTILITIES SHALL BE PERFORMED ON A CASE-BY-CASE BASIS UPON IDENTIFICATION. CONTACT CHPRC FIELD ENGINEER UPON DISCOVERY OF INTERFERENCES.
3. PROVIDE 4'-0" SQUARE X 6 INCHES THICK UN-REINFORCED CONCRETE PAD AT 3' GATE LOCATIONS SHOWN.
4. REUSE EXISTING GATE. EXTEND CABLES AS NECESSARY TO SPAN WIDENED ROADWAY.
5. RELOCATION OF SIGNAGE SHALL BE COORDINATED IN ACCORDANCE WITH THE CHPRC FIELD ENGINEER.

KEYED NOTES:

C1	N.447512.25, E.1879843.75	CSA BOUNDARY FENCE CORNER
C2	N.447279.75, E.1879843.75	CSA BOUNDARY FENCE CORNER
C3	N.447249.75, E.1879873.75	CSA BOUNDARY FENCE CORNER
C4	N.447249.75, E.1880176.25	CSA BOUNDARY FENCE CORNER
C5	N.447287.75, E.1880214.25	CSA BOUNDARY FENCE CORNER
C6	N.447332.00, E.1880026.00	CSP FENCE CORNER
C7	N.447336.00, E.1880030.00	CSP PAD CORNER
C8	N.447426.00, E.1880030.00	CSP PAD CORNER
C9	N.447430.00, E.1880026.00	CSP FENCE CORNER
C10	N.447336.00, E.1880120.00	CSP PAD CORNER
C11	N.447426.00, E.1880120.00	CSP PAD CORNER
C12	N.447504.75, E.1880120.00	OPERATING PAD CORNER
C13	N.447504.75, E.1880213.75	OPERATING PAD CORNER
C14	N.447426.00, E.1880213.75	CSA ACCESS HAUL PATH CORNER
C15	N.447336.00, E.1880213.75	OPERATING PAD CORNER
C16	N.447512.25, E.1880217.75	CSA BOUNDARY FENCE CORNER
C17	N.447480.00, E.1880224.00	ELECTRICAL EQUIPMENT PROTECTIVE STRUCTURE NW CORNER
C18	N.447548.00, E.1880213.00	CSA ACCESS HAUL PATH POINT OF TANGENT AT 7TH STREET
C19	N.447548.00, E.1880373.00	CSA ACCESS HAUL PATH POINT OF TANGENT AT 7TH STREET
C20	N.447513.00, E.1880248.00	CSA ACCESS HAUL PATH POINT OF CURVE
C21	N.447513.00, E.1880338.00	CSA ACCESS HAUL PATH POINT OF CURVE
C22	N.447456.00, E.1880248.00	CSA ACCESS HAUL PATH POINT OF TANGENT
C23	N.447456.00, E.1880338.00	CSA ACCESS HAUL PATH POINT OF TANGENT

CSA ENLARGED PLAN

SCALE: 1"=20'

0 10 20 40 80
SCALE IN FEET

DWG NUMBER	TITLE
DRAWING TRACEABILITY LIST	

REF NUMBER	TITLE
REFERENCES	
NEXT USED ON END ITEM	

REV CODE	DESCRIPTION
F	RELEASED PER DCN-W135-CSA-001
REVISIONS	

BLDG. NO. 216CS

INDEX NO. 0110

CAUTION
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	NAME	DATE	SIGNATURE
DRAWN	EPCULBERTSON		
ENGINEERING DIRECTOR	JL DEVINE		
PROJECT ENGINEER	JR MARTIN		
DESIGN AGENCY	G MARTINEZ-CISNEROS		

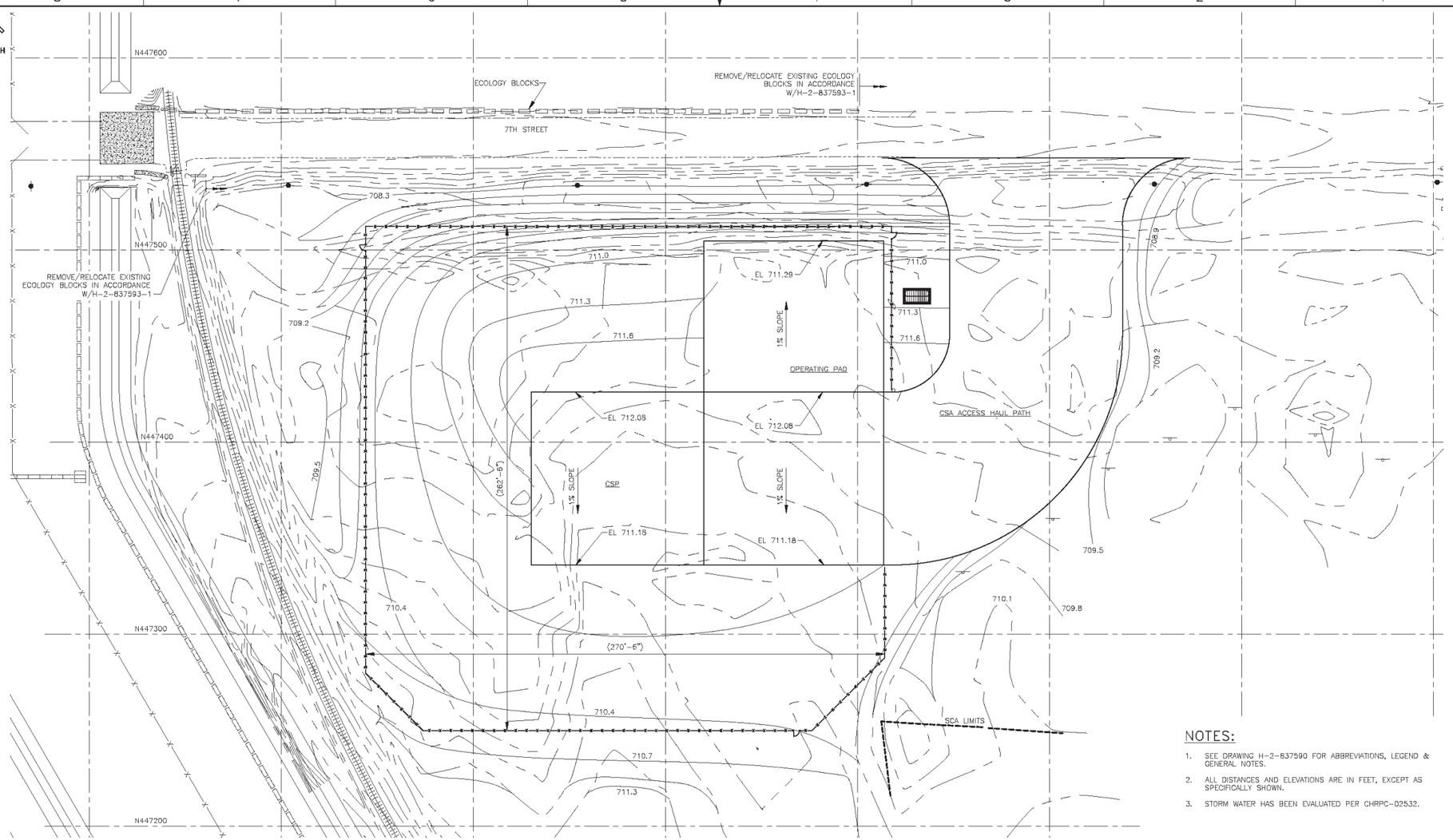
U.S. DEPARTMENT OF ENERGY
Richland Operations Office

CAPSULE STORAGE AREA
CIVIL
ENLARGED PLAN

SIZE F | DRAWING NUMBER H-2-837593 | SHEET 1 | REV 0

SCALE SHOWN

PLOT ID



NOTES:

1. SEE DRAWING H-2-837590 FOR ABBREVIATIONS, LEGEND & GENERAL NOTES.
2. ALL DISTANCES AND ELEVATIONS ARE IN FEET, EXCEPT AS SPECIFICALLY SHOWN.
3. STORM WATER HAS BEEN EVALUATED PER CHRPC-02532.

CSA SITE GRADING PLAN

SCALE: 1"=20'

0 10 20 40 80
SCALE IN FEET

DWG NUMBER	TITLE	REF NUMBER	TITLE
DRAWING TRACEABILITY LIST		REFERENCES	
		NEXT USED ON END ITEM	

REV SYM	DESCRIPTION
F	RELEASED PER DCN-W135-CSA-001
REVISIONS	

BLDG. NO. 216CS

INDEX NO. 0111

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	M. DEVINE		
DESIGN CHK'D			
	JR MARTIN		
DESIGN AUTHORITY	G MARTINEZ-CISNEROS		

U.S. DEPARTMENT OF ENERGY
Richland Operations Office

CAPSULE STORAGE AREA
CIVIL
GRADING PLAN

SIZE F | DRAWING NUMBER H-2-837592 | SHEET 1 | REV 0

CHKD SCALE SHOWN

PLOT ID

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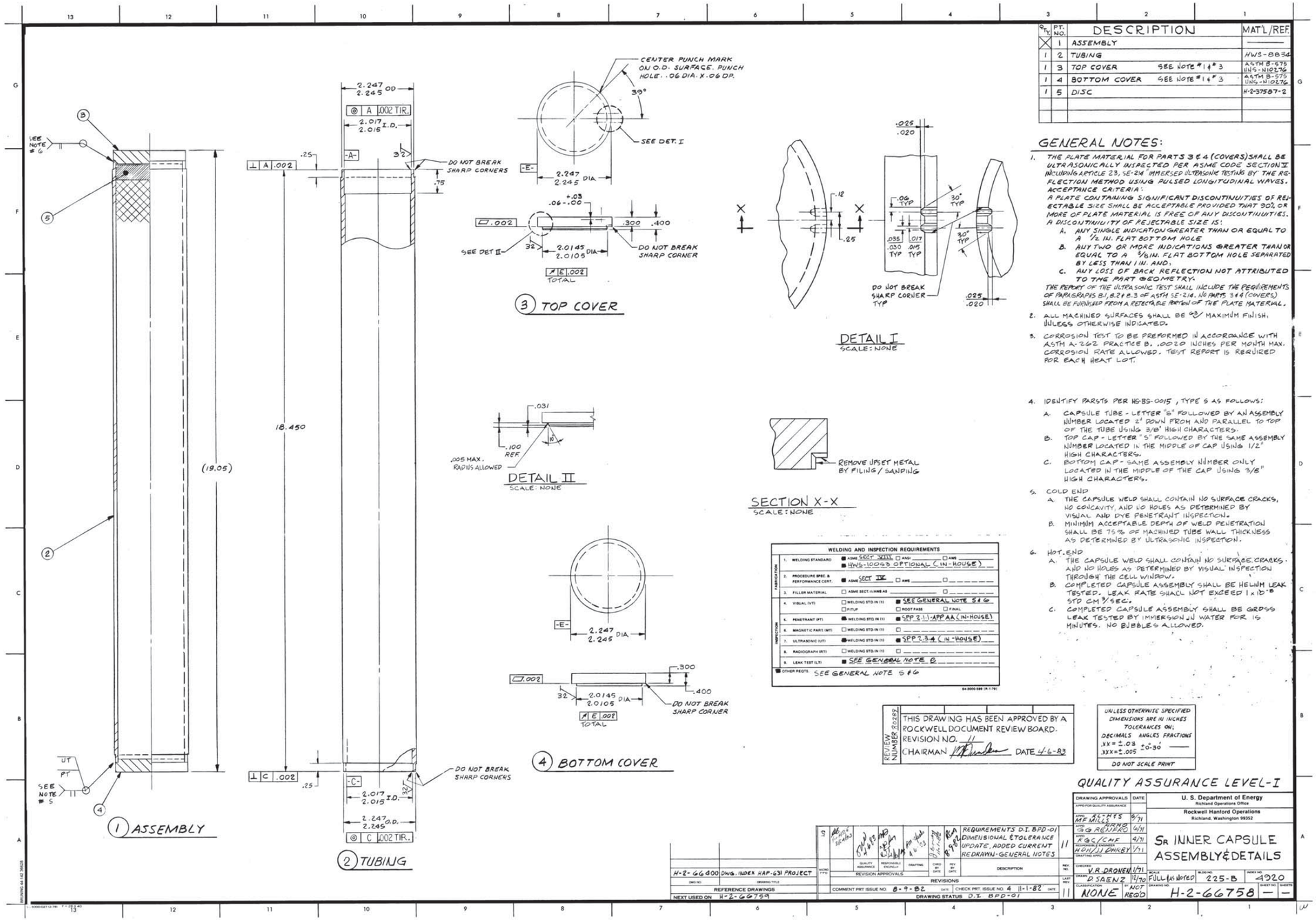


QTY	PT. NO.	DESCRIPTION		MAT'L/REF.
	1	ASSEMBLY		
1	2	TUBING		HWS-8834
1	3	TOP COVER	SEE NOTE # 1 & # 3	ASTM B-575 UNS-N10276
1	4	BOTTOM COVER	SEE NOTE # 1 & # 3	ASTM B-575 UNS-N10276
1	5	DISC		H-2-37587-2

GENERAL NOTES:

1. THE PLATE MATERIAL FOR PARTS 3 & 4 (COVERS) SHALL BE ULTRASONICALLY INSPECTED PER ASME CODE SECTION II INCLUDING ARTICLE 23, SE-214 IMMERSED ULTRASONIC TESTING BY THE REFLECTION METHOD USING PULSED LONGITUDINAL WAVES.
   ACCEPTANCE CRITERIA:
   A PLATE CONTAINING SIGNIFICANT DISCONTINUITIES OF REJECTABLE SIZE SHALL BE ACCEPTABLE PROVIDED THAT 90% OR MORE OF PLATE MATERIAL IS FREE OF ANY DISCONTINUITIES.
   A DISCONTINUITY OF REJECTABLE SIZE IS:
   A. ANY SINGLE INDICATION GREATER THAN OR EQUAL TO A 1/2 IN. FLAT BOTTOM HOLE
   B. ANY TWO OR MORE INDICATIONS GREATER THAN OR EQUAL TO A 3/8 IN. FLAT BOTTOM HOLE SEPARATED BY LESS THAN 1 IN. AND:
   C. ANY LOSS OF BACK REFLECTION NOT ATTRIBUTED TO THE PART GEOMETRY.
   THE REPORT OF THE ULTRASONIC TEST SHALL INCLUDE THE REQUIREMENTS OF PARAGRAPHS 8.1, 8.2 & 8.3 OF ASTM SE-214. NO PARTS 3 & 4 (COVERS) SHALL BE FURNISHED FROM A REJECTABLE PORTION OF THE PLATE MATERIAL.
2. ALL MACHINED SURFACES SHALL BE 63 MAXIMUM FINISH, UNLESS OTHERWISE INDICATED.
3. CORROSION TEST TO BE PREFORMED IN ACCORDANCE WITH ASTM A-262 PRACTICE B. .0020 INCHES PER MONTH MAX. CORROSION RATE ALLOWED. TEST REPORT IS REQUIRED FOR EACH HEAT LOT.
4. IDENTIFY PARTS PER HS-BS-0015, TYPE 5 AS FOLLOWS:
   A. CAPSULE TUBE - LETTER "6" FOLLOWED BY AN ASSEMBLY NUMBER LOCATED 2" DOWN FROM AND PARALLEL TO TOP OF THE TUBE USING 3/8" HIGH CHARACTERS.
   B. TOP CAP - LETTER "5" FOLLOWED BY THE SAME ASSEMBLY NUMBER LOCATED IN THE MIDDLE OF CAP USING 1/2" HIGH CHARACTERS.
   C. BOTTOM CAP - SAME ASSEMBLY NUMBER ONLY LOCATED IN THE MIDDLE OF THE CAP USING 3/8" HIGH CHARACTERS.
5. COLD END
   A. THE CAPSULE WELD SHALL CONTAIN NO SURFACE CRACKS, NO CONCAVITY, AND NO HOLES AS DETERMINED BY VISUAL AND DYE PENETRANT INSPECTION.
   B. MINIMUM ACCEPTABLE DEPTH OF WELD PENETRATION SHALL BE 75% OF MACHINED TUBE WALL THICKNESS AS DETERMINED BY ULTRASONIC INSPECTION.
6. HOT END
   A. THE CAPSULE WELD SHALL CONTAIN NO SURFACE CRACKS AND NO HOLES AS DETERMINED BY VISUAL INSPECTION THROUGH THE CELL WINDOW.
   B. COMPLETED CAPSULE ASSEMBLY SHALL BE HELIUM LEAK TESTED. LEAK RATE SHALL NOT EXCEED 1×10^{-8} STD CM³/SEC.
   C. COMPLETED CAPSULE ASSEMBLY SHALL BE GROSS LEAK TESTED BY IMMERSION IN WATER FOR 15 MINUTES. NO BUBBLES ALLOWED.

WELDING AND INSPECTION REQUIREMENTS

FABRICATION	1. WELDING STANDARD	■ ASME SECT. VIII ☐ AWS ☐ AWS ■ HWS-10063 OPTIONAL (IN-HOUSE)	
	2. PROCEDURE SPEC. & PERFORMANCE CERT.	■ ASME SECT IX ☐ AWS	☐
	3. FILLER MATERIAL	☐ ASME SECT. II AWS AS	☐
INSPECTION	4. VISUAL (VT)	☐ WELDING STD IN (1) ☐ FIT-UP	■ SEE GENERAL NOTE 5 & 6 ☐ ROOT PASS ☐ FINAL
	5. PENETRANT (PT)	■ WELDING STD IN (1)	■ SPP 2.1.1-APP AA (IN-HOUSE)
	6. MAGNETIC PARTS (MT)	☐ WELDING STD IN (1)	☐
	7. ULTRASONIC (UT)	■ WELDING STD IN (1)	■ SPP 2.3.4 (IN-HOUSE)
	8. RADIOGRAPH (RT)	☐ WELDING STD IN (1)	☐
	9. LEAK TEST (LT)	■ SEE GENERAL NOTE 8	
■ OTHER REQTS.	SEE GENERAL NOTE 5 & 6		

64-3000-588 (R-1-78)

REVIEW NUMBER 32282

THIS DRAWING HAS BEEN APPROVED BY A ROCKWELL DOCUMENT REVIEW BOARD.
REVISION NO. 11
CHAIRMAN [signature] DATE 4-6-83

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON:
DECIMALS .XX = ±.03 .XXX = ±.005
ANGLES ±0°30'
FRACTIONS ——
DO NOT SCALE PRINT

QUALITY ASSURANCE LEVEL-I

DRAWING APPROVALS	DATE
APPD FOR QUALITY ASSURANCE	
APPD MF MILLS	6/71
APPD GG RENFRO	6/71
APPD RGC/CHE (RESPONSIBLE ENGINEER)	4/71
APPD HDH/JJ DHIRBY (DRAFTING AREA)	1/71
CHECKED V.R. DRONEN	1/71
DRAWN D SAENZ	1/70
CLASSIFICATION NONE	SECURITY NOT REQ'D

U. S. Department of Energy
Richland Operations Office
Rockwell Hanford Operations
Richland, Washington 99352

SR INNER CAPSULE ASSEMBLY & DETAILS

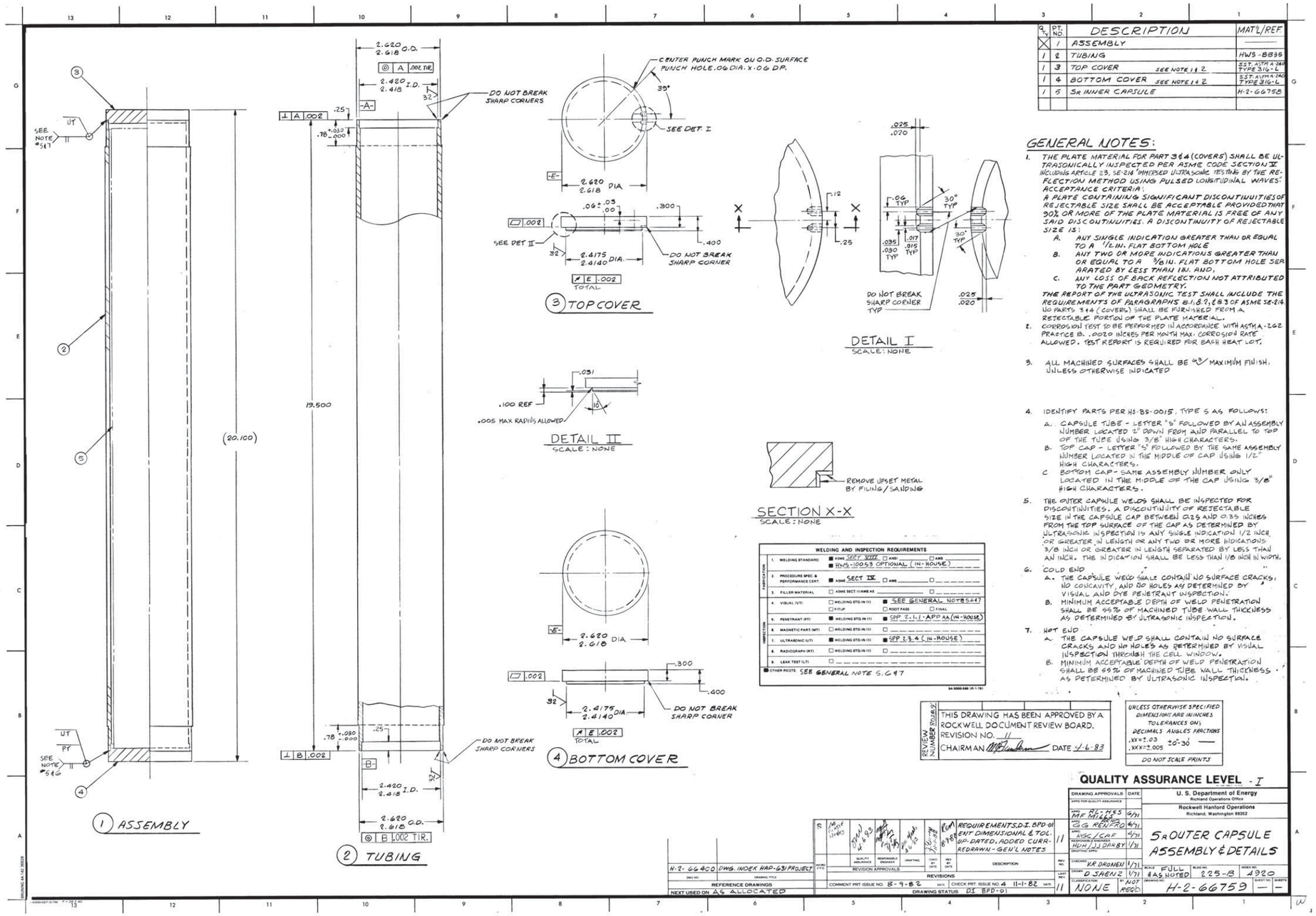
SCALE: FULL (AS NOTED) | BLDG NO. 225-B | INDEX NO. 4920
DRAWING NO. H-2-66758 | SHEET NO. — | SHEETS —

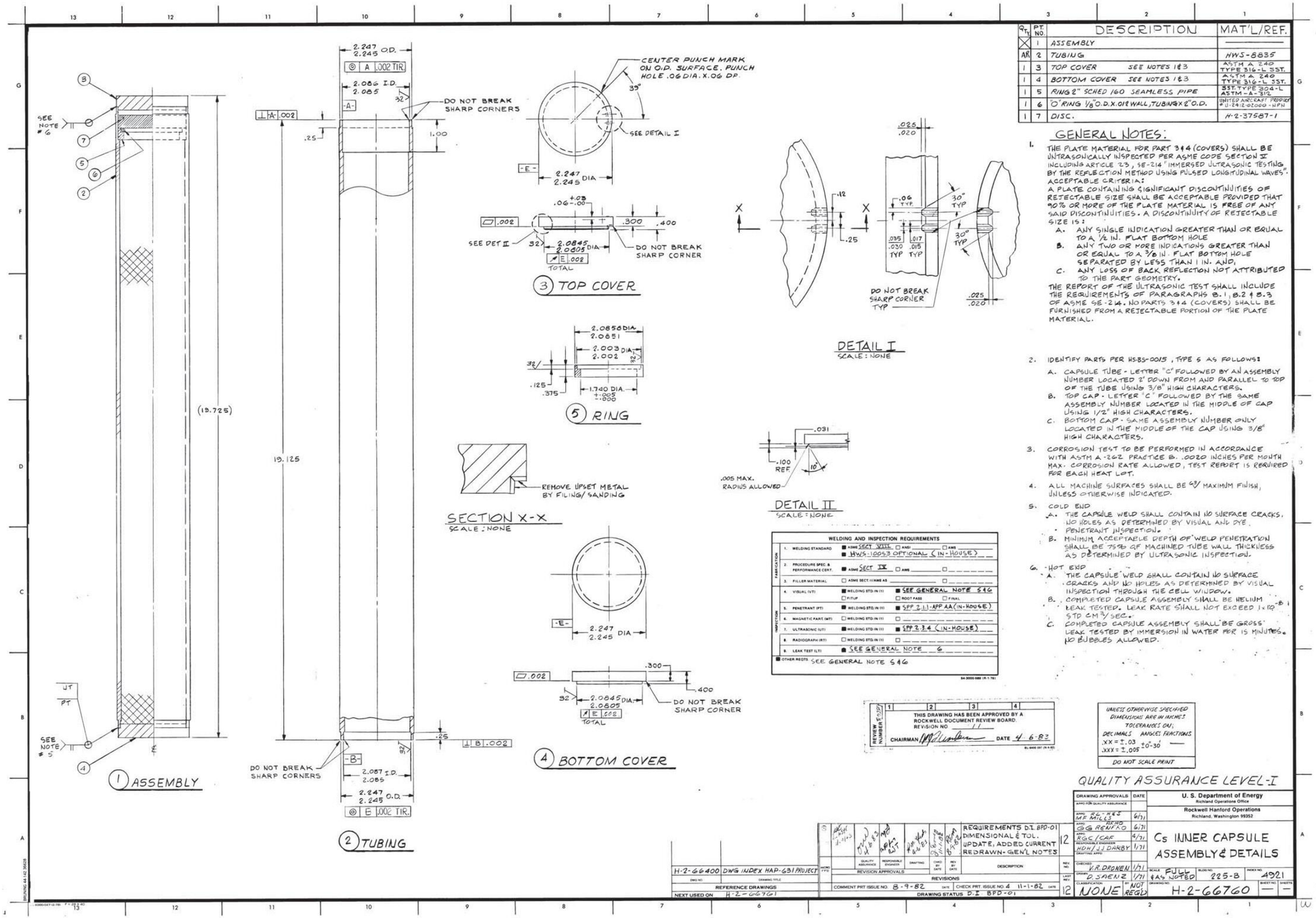
REV. NO.	REVISION APPROVALS	DESCRIPTION
11		REQUIREMENTS D.I. BPD-01 & DIMENSIONAL & TOLERANCE UPDATE, ADDED CURRENT REDRAWN-GENERAL NOTES

REVISIONS
COMMENT PRT. ISSUE NO. 8-9-82 DATE
CHECK PRT. ISSUE NO. 4 11-1-82 DATE
DRAWING STATUS D.I. BPD-01

REFERENCE DRAWINGS
H-2-66400 DWG. INDEX HAP-631 PROJECT
NEXT USED ON H-2-66759

1


1 ASSEMBLY
2 TUBING
3 TOP COVER
4 BOTTOM COVER
DETAIL I
SCALE: NONE
DETAIL II
SCALE: NONE
SECTION X-X
SCALE: NONE
DO NOT BREAK SHARP CORNERS
CENTER PUNCH MARK ON O.D. SURFACE PUNCH HOLE .06 DIA. x .06 DP.
SEE DET. I
SEE DET II
REMOVE UPSET METAL BY FILING/SANDING
.100 REF
.005 MAX RADIUS ALLOWED
19.500
(20.100)
2.620 / 2.618 O.D.
2.420 / 2.418 I.D.
2.620 / 2.618 DIA
2.4175 / 2.4140 DIA.
.300
.400
.78 +.030 -.000
.25
32
.002 TIR
TOTAL
SEE NOTE #5 & 7
UT
PT
DO NOT BREAK SHARP CORNER TYP
30° TYP
.06 TYP
.035 .030 TYP
.017 .015 TYP
.025 .020
WELDING AND INSPECTION REQUIREMENTS
1. WELDING STANDARD — ASME SECT VIII; HWS-10053 OPTIONAL (IN-HOUSE)
2. PROCEDURE SPEC. & PERFORMANCE CERT. — ASME SECT IX
3. FILLER MATERIAL — ASME SECT II; AWS A5
4. VISUAL (VT) — SEE GENERAL NOTES 4 & 7
5. PENETRANT (PT) — SPP 2.1.1-APP AA (IN-HOUSE)
6. MAGNETIC PART. (MT)
7. ULTRASONIC (UT) — SPP 2.3.4 (IN-HOUSE)
8. RADIOGRAPH (RT)
9. LEAK TEST (LT)
OTHER REQTS: SEE GENERAL NOTE 5, & 7
GENERAL NOTES:
1. THE PLATE MATERIAL FOR PART 3 & 4 (COVERS) SHALL BE ULTRASONICALLY INSPECTED PER ASME CODE SECTION V INCLUDING ARTICLE 23, SE-214 "IMMERSED ULTRASONIC TESTING BY THE REFLECTION METHOD USING PULSED LONGITUDINAL WAVES". ACCEPTANCE CRITERIA:
A PLATE CONTAINING SIGNIFICANT DISCONTINUITIES OF REJECTABLE SIZE SHALL BE ACCEPTABLE PROVIDED THAT 90% OR MORE OF THE PLATE MATERIAL IS FREE OF ANY SAID DISCONTINUITIES. A DISCONTINUITY OF REJECTABLE SIZE IS:
A. ANY SINGLE INDICATION GREATER THAN OR EQUAL TO A 1/2 IN. FLAT BOTTOM HOLE
B. ANY TWO OR MORE INDICATIONS GREATER THAN OR EQUAL TO A 3/8 IN. FLAT BOTTOM HOLE SEPARATED BY LESS THAN 1 IN. AND,
C. ANY LOSS OF BACK REFLECTION NOT ATTRIBUTED TO THE PART GEOMETRY.
THE REPORT OF THE ULTRASONIC TEST SHALL INCLUDE THE REQUIREMENTS OF PARAGRAPHS 8.1, 8.2, & 8.3 OF ASME SE-214. NO PARTS 3 & 4 (COVERS) SHALL BE FURNISHED FROM A REJECTABLE PORTION OF THE PLATE MATERIAL.
2. CORROSION TEST TO BE PERFORMED IN ACCORDANCE WITH ASTM A-262 PRACTICE B. .0020 INCHES PER MONTH MAX. CORROSION RATE ALLOWED. TEST REPORT IS REQUIRED FOR EACH HEAT LOT.
3. ALL MACHINED SURFACES SHALL BE 63 MAXIMUM FINISH, UNLESS OTHERWISE INDICATED
4. IDENTIFY PARTS PER HS-BS-0015, TYPE S AS FOLLOWS:
A. CAPSULE TUBE - LETTER "S" FOLLOWED BY AN ASSEMBLY NUMBER LOCATED 2" DOWN FROM AND PARALLEL TO TOP OF THE TUBE USING 3/8" HIGH CHARACTERS.
B. TOP CAP - LETTER "S" FOLLOWED BY THE SAME ASSEMBLY NUMBER LOCATED IN THE MIDDLE OF CAP USING 1/2" HIGH CHARACTERS.
C. BOTTOM CAP - SAME ASSEMBLY NUMBER ONLY LOCATED IN THE MIDDLE OF THE CAP USING 3/8" HIGH CHARACTERS.
5. THE OUTER CAPSULE WELDS SHALL BE INSPECTED FOR DISCONTINUITIES. A DISCONTINUITY OF REJECTABLE SIZE IN THE CAPSULE CAP BETWEEN 0.25 AND 0.35 INCHES FROM THE TOP SURFACE OF THE CAP AS DETERMINED BY ULTRASONIC INSPECTION IS ANY SINGLE INDICATION 1/2 INCH OR GREATER IN LENGTH OR ANY TWO OR MORE INDICATIONS 3/8 INCH OR GREATER IN LENGTH SEPARATED BY LESS THAN AN INCH. THE INDICATION SHALL BE LESS THAN 1/8 INCH IN WIDTH.
6. COLD END
A. THE CAPSULE WELD SHALL CONTAIN NO SURFACE CRACKS, NO CONCAVITY, AND NO HOLES AS DETERMINED BY VISUAL AND DYE PENETRANT INSPECTION.
B. MINIMUM ACCEPTABLE DEPTH OF WELD PENETRATION SHALL BE 65% OF MACHINED TUBE WALL THICKNESS AS DETERMINED BY ULTRASONIC INSPECTION.
7. HOT END
A. THE CAPSULE WELD SHALL CONTAIN NO SURFACE CRACKS AND NO HOLES AS DETERMINED BY VISUAL INSPECTION THROUGH THE CELL WINDOW.
B. MINIMUM ACCEPTABLE DEPTH OF WELD PENETRATION SHALL BE 65% OF MACHINED TUBE WALL THICKNESS AS DETERMINED BY ULTRASONIC INSPECTION.
THIS DRAWING HAS BEEN APPROVED BY A ROCKWELL DOCUMENT REVIEW BOARD.
REVISION NO. 11
CHAIRMAN
DATE 4-6-83
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON:
DECIMALS ANGLES FRACTIONS
.XX ± .03 ±0°30'
.XXX ± .005
DO NOT SCALE PRINTS
QUALITY ASSURANCE LEVEL - I
DRAWING APPROVALS
U. S. Department of Energy
Richland Operations Office
Rockwell Hanford Operations
Richland, Washington 99352
5R OUTER CAPSULE ASSEMBLY & DETAILS
REQUIREMENTS S.D.I. BPD-01 ENT DIMENSIONAL & TOL. UP-DATED, ADDED CURR-REDRAWN - GEN'L NOTES
REVISIONS
REFERENCE DRAWINGS
NEXT USED ON AS ALLOCATED
DRAWING STATUS DI BPD-01
H-2-66759



QTY	PT. NO.	DESCRIPTION	MAT'L/REF.
X	1	ASSEMBLY	—
AR	2	TUBING	HWS-8835
1	3	TOP COVER SEE NOTES 1&3	ASTM A 240 TYPE 316-L SST.
1	4	BOTTOM COVER SEE NOTES 1&3	ASTM A 240 TYPE 316-L SST.
1	5	RING 2" SCHED 160 SEAMLESS PIPE	SST. TYPE 304-L ASTM-A-312
1	6	O RING 1/8" O.D. X .012 WALL, TUBING X 2" O.D.	UNITED AIRCRAFT PRODUCT # U-2412-012000-NPN
1	7	DISC.	H-2-37587-1

GENERAL NOTES:

1. THE PLATE MATERIAL FOR PART 3 & 4 (COVERS) SHALL BE ULTRASONICALLY INSPECTED PER ASME CODE SECTION V INCLUDING ARTICLE 23, SE-214 "IMMERSED ULTRASONIC TESTING BY THE REFLECTION METHOD USING PULSED LONGITUDINAL WAVES". ACCEPTABLE CRITERIA:
   A PLATE CONTAINING SIGNIFICANT DISCONTINUITIES OF REJECTABLE SIZE SHALL BE ACCEPTABLE PROVIDED THAT 90% OR MORE OF THE PLATE MATERIAL IS FREE OF ANY SAID DISCONTINUITIES. A DISCONTINUITY OF REJECTABLE SIZE IS:
   A. ANY SINGLE INDICATION GREATER THAN OR EQUAL TO A 1/2 IN. FLAT BOTTOM HOLE
   B. ANY TWO OR MORE INDICATIONS GREATER THAN OR EQUAL TO A 3/8 IN. FLAT BOTTOM HOLE SEPARATED BY LESS THAN 1 IN. AND,
   C. ANY LOSS OF BACK REFLECTION NOT ATTRIBUTED TO THE PART GEOMETRY.
   THE REPORT OF THE ULTRASONIC TEST SHALL INCLUDE THE REQUIREMENTS OF PARAGRAPHS 8.1, 8.2 & 8.3 OF ASME SE-214. NO PARTS 3 & 4 (COVERS) SHALL BE FURNISHED FROM A REJECTABLE PORTION OF THE PLATE MATERIAL.
2. IDENTIFY PARTS PER HS-BS-0015, TYPE 5 AS FOLLOWS:
   A. CAPSULE TUBE - LETTER "C" FOLLOWED BY AN ASSEMBLY NUMBER LOCATED 2" DOWN FROM AND PARALLEL TO TOP OF THE TUBE USING 3/8" HIGH CHARACTERS.
   B. TOP CAP - LETTER "C" FOLLOWED BY THE SAME ASSEMBLY NUMBER LOCATED IN THE MIDDLE OF CAP USING 1/2" HIGH CHARACTERS.
   C. BOTTOM CAP - SAME ASSEMBLY NUMBER ONLY LOCATED IN THE MIDDLE OF THE CAP USING 3/8" HIGH CHARACTERS.
3. CORROSION TEST TO BE PERFORMED IN ACCORDANCE WITH ASTM A-262 PRACTICE B. .0020 INCHES PER MONTH MAX. CORROSION RATE ALLOWED, TEST REPORT IS REQUIRED FOR EACH HEAT LOT.
4. ALL MACHINE SURFACES SHALL BE 63 MAXIMUM FINISH, UNLESS OTHERWISE INDICATED.
5. COLD END
   A. THE CAPSULE WELD SHALL CONTAIN NO SURFACE CRACKS, NO HOLES AS DETERMINED BY VISUAL AND DYE PENETRANT INSPECTION.
   B. MINIMUM ACCEPTABLE DEPTH OF WELD PENETRATION SHALL BE 75% OF MACHINED TUBE WALL THICKNESS AS DETERMINED BY ULTRASONIC INSPECTION.
6. HOT END
   A. THE CAPSULE WELD SHALL CONTAIN NO SURFACE CRACKS AND NO HOLES AS DETERMINED BY VISUAL INSPECTION THROUGH THE CELL WINDOW.
   B. COMPLETED CAPSULE ASSEMBLY SHALL BE HELIUM LEAK TESTED. LEAK RATE SHALL NOT EXCEED 1×10^{-8} STD CM³/SEC.
   C. COMPLETED CAPSULE ASSEMBLY SHALL BE GROSS LEAK TESTED BY IMMERSION IN WATER FOR 15 MINUTES. NO BUBBLES ALLOWED.

WELDING AND INSPECTION REQUIREMENTS

FABRICATION	1. WELDING STANDARD	■ ASME SECT VIII ☐ ANSI ☐ AWS; ■ HWS-10053 OPTIONAL (IN-HOUSE)	
	2. PROCEDURE SPEC & PERFORMANCE CERT.	■ ASME SECT IX ☐ AWS	
	3. FILLER MATERIAL	☐ ASME SECT II/AWS A5	
INSPECTION	4. VISUAL (VT)	■ WELDING STD IN (1) ☐ FITUP; ■ SEE GENERAL NOTE 5 & 6 ☐ ROOT PASS ☐ FINAL	
	5. PENETRANT (PT)	■ WELDING STD IN (1)	■ SPP 2.1.1-APP AA (IN-HOUSE)
	6. MAGNETIC PART. (MT)	☐ WELDING STD IN (1)	
	7. ULTRASONIC (UT)	■ WELDING STD IN (1)	■ SPP 2.3.4 (IN-HOUSE)
	8. RADIOGRAPH (RT)	☐ WELDING STD IN (1)	
	9. LEAK TEST (LT)	■ SEE GENERAL NOTE 6	

■ OTHER REQTS: SEE GENERAL NOTE 5 & 6

REVIEW NUMBER 1 2 3 4
THIS DRAWING HAS BEEN APPROVED BY A ROCKWELL DOCUMENT REVIEW BOARD.
REVISION NO. / /
CHAIRMAN DATE 4-6-83

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON:
DECIMALS ANGLES FRACTIONS
.XX = ±.03 ±0°-30' —
.XXX = ±.005
DO NOT SCALE PRINT

QUALITY ASSURANCE LEVEL-I

DRAWING APPROVALS	DATE
APPD FOR QUALITY ASSURANCE	
APPD R.C. HAYS / M.R. MILLS	6/71
APPD R.E. RENKO / G.G. RENKO	6/71
APPD R.G. CLAR / RESPONSIBLE ENGINEER	4/71
DRAFTING APPD H.D.N. / J.J. DARBY	1/71
CHECKED V.R. DRONEN	1/71
DRAWN D. SAENZ	1/71
CLASSIFICATION NONE	1st NOT REQ'D

U. S. Department of Energy
Richland Operations Office
Rockwell Hanford Operations
Richland, Washington 99352

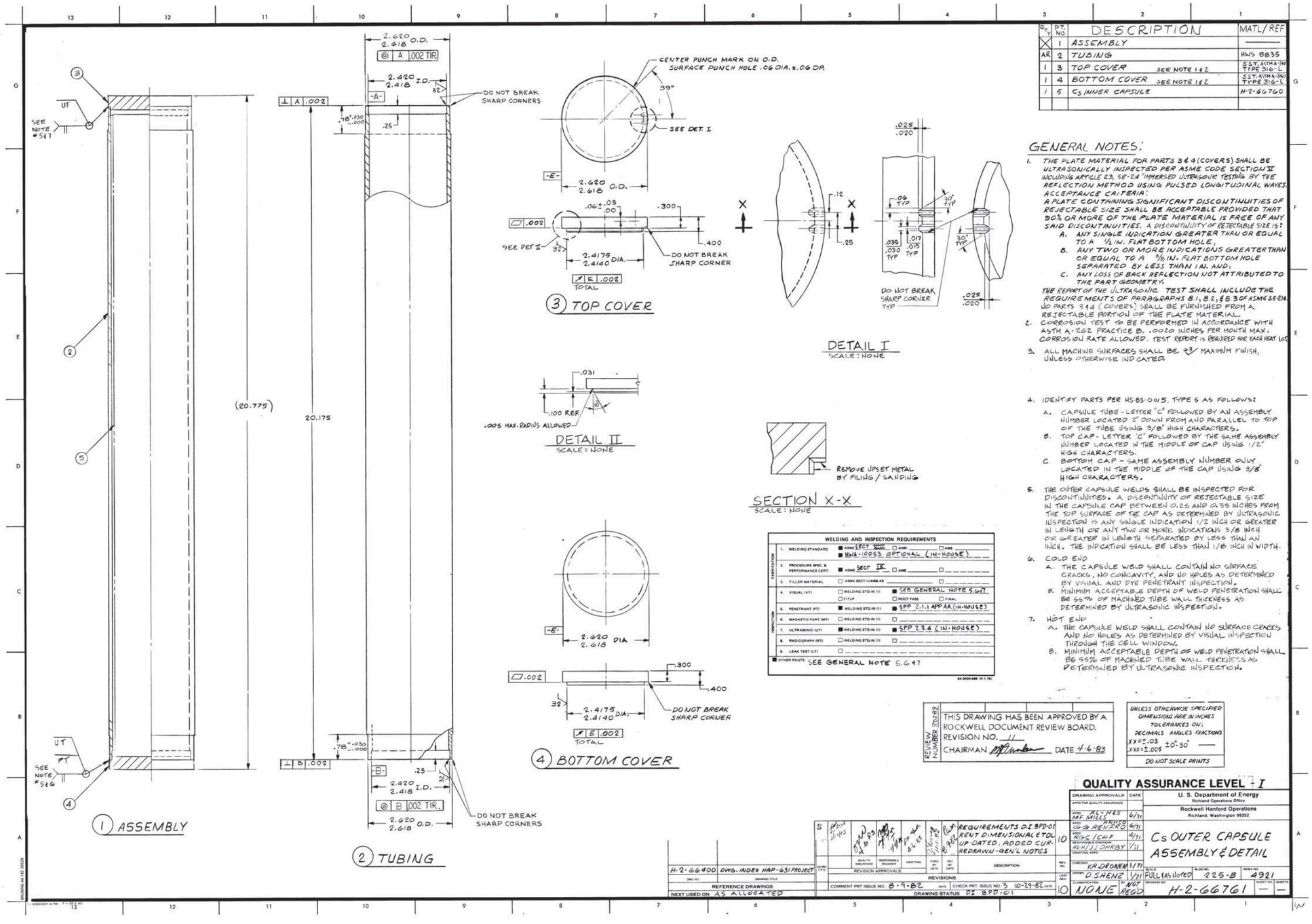
Cs INNER CAPSULE ASSEMBLY & DETAILS

SCALE FULL & AS NOTED | BLDG NO. 225-B | INDEX NO. 4921
DRAWING NO. H-2-66760 | SHEET NO. — | SHEETS —

REV. NO.	DESCRIPTION
12	REQUIREMENTS D.I. BPD-01 DIMENSIONAL & TOL. UPDATE, ADDED CURRENT REDRAWN-GEN'L NOTES

REVISION APPROVALS — REVISIONS
COMMENT PRT ISSUE NO. B-9-82 DATE — CHECK PRT. ISSUE NO. 4 11-1-82 DATE
DRAWING STATUS D.I. BPD-01

REFERENCE DRAWINGS
DWG NO. H-2-66400 DRAWING TITLE DWG INDEX HAP-631 PROJECT
NEXT USED ON H-2-66760

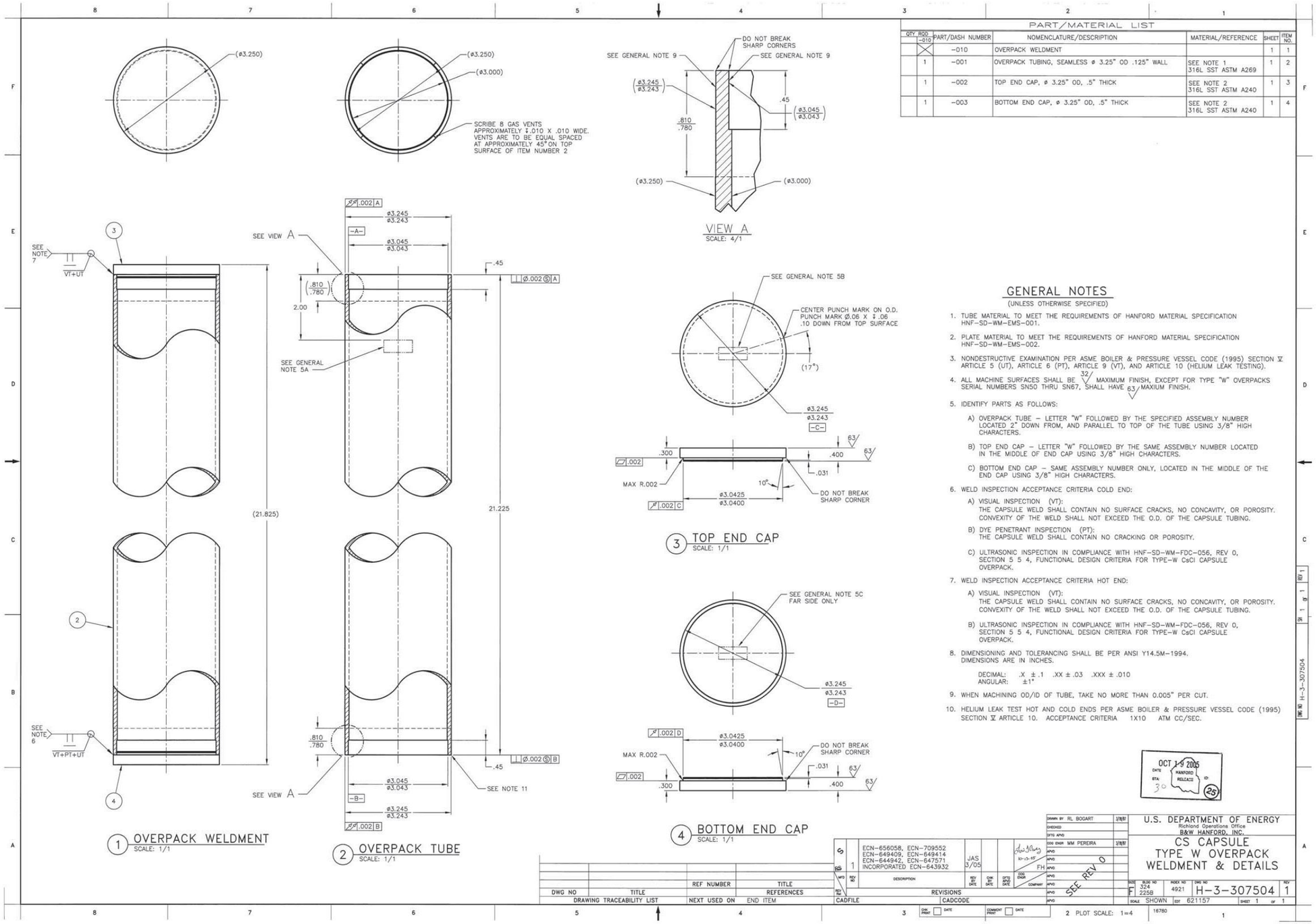


QTY	PT. NO	DESCRIPTION	MATL/REF
X	1	ASSEMBLY	—
AR	2	TUBING	HWS 8835
1	3	TOP COVER SEE NOTE 1 & 2	S.S.T. ASTM A-240 TYPE 316-L
1	4	BOTTOM COVER SEE NOTE 1 & 2	S.S.T. ASTM A-240 TYPE 316-L
1	5	Cs INNER CAPSULE	H-2-66760

GENERAL NOTES:

1. THE PLATE MATERIAL FOR PARTS 3 & 4 (COVERS) SHALL BE ULTRASONICALLY INSPECTED PER ASME CODE SECTION V INCLUDING ARTICLE 23, SE-214 "IMMERSED ULTRASONIC TESTING BY THE REFLECTION METHOD USING PULSED LONGITUDINAL WAVES. ACCEPTANCE CRITERIA:
   A PLATE CONTAINING SIGNIFICANT DISCONTINUITIES OF REJECTABLE SIZE SHALL BE ACCEPTABLE PROVIDED THAT 90% OR MORE OF THE PLATE MATERIAL IS FREE OF ANY SAID DISCONTINUITIES. A DISCONTINUITY OF REJECTABLE SIZE IS:
   A. ANY SINGLE INDICATION GREATER THAN OR EQUAL TO A 1/2 IN. FLAT BOTTOM HOLE,
   B. ANY TWO OR MORE INDICATIONS GREATER THAN OR EQUAL TO A 3/8 IN. FLAT BOTTOM HOLE SEPARATED BY LESS THAN 1 IN. AND,
   C. ANY LOSS OF BACK REFLECTION NOT ATTRIBUTED TO THE PART GEOMETRY.
   THE REPORT OF THE ULTRASONIC TEST SHALL INCLUDE THE REQUIREMENTS OF PARAGRAPHS 8.1, 8.2 & 8.3 OF ASME SE-214. NO PARTS 3 & 4 (COVERS) SHALL BE FURNISHED FROM A REJECTABLE PORTION OF THE PLATE MATERIAL.
2. CORROSION TEST TO BE PERFORMED IN ACCORDANCE WITH ASTM A-262 PRACTICE B. .0020 INCHES PER MONTH MAX. CORROSION RATE ALLOWED. TEST REPORT IS REQUIRED FOR EACH HEAT LOT.
3. ALL MACHINE SURFACES SHALL BE 63 MAXIMUM FINISH, UNLESS OTHERWISE INDICATED.
4. IDENTIFY PARTS PER HS-B3-0015, TYPE 5 AS FOLLOWS:
   A. CAPSULE TUBE - LETTER "C" FOLLOWED BY AN ASSEMBLY NUMBER LOCATED 2" DOWN FROM AND PARALLEL TO TOP OF THE TUBE USING 3/8" HIGH CHARACTERS.
   B. TOP CAP - LETTER "C" FOLLOWED BY THE SAME ASSEMBLY NUMBER LOCATED IN THE MIDDLE OF CAP USING 1/2" HIGH CHARACTERS.
   C. BOTTOM CAP - SAME ASSEMBLY NUMBER ONLY LOCATED IN THE MIDDLE OF THE CAP USING 3/8" HIGH CHARACTERS.
5. THE OUTER CAPSULE WELDS SHALL BE INSPECTED FOR DISCONTINUITIES. A DISCONTINUITY OF REJECTABLE SIZE IN THE CAPSULE CAP BETWEEN 0.25 AND 0.39 INCHES FROM THE TOP SURFACE OF THE CAP AS DETERMINED BY ULTRASONIC INSPECTION IS ANY SINGLE INDICATION 1/2 INCH OR GREATER IN LENGTH OR ANY TWO OR MORE INDICATIONS 3/8 INCH OR GREATER IN LENGTH SEPARATED BY LESS THAN AN INCH. THE INDICATION SHALL BE LESS THAN 1/8 INCH IN WIDTH.
6. COLD END
   A. THE CAPSULE WELD SHALL CONTAIN NO SURFACE CRACKS, NO CONCAVITY, AND NO HOLES AS DETERMINED BY VISUAL AND DYE PENETRANT INSPECTION.
   B. MINIMUM ACCEPTABLE DEPTH OF WELD PENETRATION SHALL BE 65% OF MACHINED TUBE WALL THICKNESS AS DETERMINED BY ULTRASONIC INSPECTION.
7. HOT END
   A. THE CAPSULE WELD SHALL CONTAIN NO SURFACE CRACKS AND NO HOLES AS DETERMINED BY VISUAL INSPECTION THROUGH THE CELL WINDOW.
   B. MINIMUM ACCEPTABLE DEPTH OF WELD PENETRATION SHALL BE 65% OF MACHINED TUBE WALL THICKNESS AS DETERMINED BY ULTRASONIC INSPECTION.

1


PART/MATERIAL LIST
QTY REQ -010 | PART/DASH NUMBER | NOMENCLATURE/DESCRIPTION | MATERIAL/REFERENCE | SHEET | ITEM NO.
-010 OVERPACK WELDMENT 1 1
1 -001 OVERPACK TUBING, SEAMLESS ø 3.25" OD .125" WALL SEE NOTE 1 316L SST ASTM A269 1 2
1 -002 TOP END CAP, ø 3.25" OD, .5" THICK SEE NOTE 2 316L SST ASTM A240 1 3
1 -003 BOTTOM END CAP, ø 3.25" OD, .5" THICK SEE NOTE 2 316L SST ASTM A240 1 4
GENERAL NOTES
(UNLESS OTHERWISE SPECIFIED)
1. TUBE MATERIAL TO MEET THE REQUIREMENTS OF HANFORD MATERIAL SPECIFICATION HNF-SD-WM-EMS-001.
2. PLATE MATERIAL TO MEET THE REQUIREMENTS OF HANFORD MATERIAL SPECIFICATION HNF-SD-WM-EMS-002.
3. NONDESTRUCTIVE EXAMINATION PER ASME BOILER & PRESSURE VESSEL CODE (1995) SECTION V ARTICLE 5 (UT), ARTICLE 6 (PT), ARTICLE 9 (VT), AND ARTICLE 10 (HELIUM LEAK TESTING).
4. ALL MACHINE SURFACES SHALL BE 32 MAXIMUM FINISH, EXCEPT FOR TYPE "W" OVERPACKS SERIAL NUMBERS SN50 THRU SN67, SHALL HAVE 63 MAXIUM FINISH.
5. IDENTIFY PARTS AS FOLLOWS:
A) OVERPACK TUBE – LETTER "W" FOLLOWED BY THE SPECIFIED ASSEMBLY NUMBER LOCATED 2" DOWN FROM, AND PARALLEL TO TOP OF THE TUBE USING 3/8" HIGH CHARACTERS.
B) TOP END CAP – LETTER "W" FOLLOWED BY THE SAME ASSEMBLY NUMBER LOCATED IN THE MIDDLE OF END CAP USING 3/8" HIGH CHARACTERS.
C) BOTTOM END CAP – SAME ASSEMBLY NUMBER ONLY, LOCATED IN THE MIDDLE OF THE END CAP USING 3/8" HIGH CHARACTERS.
6. WELD INSPECTION ACCEPTANCE CRITERIA COLD END:
A) VISUAL INSPECTION (VT): THE CAPSULE WELD SHALL CONTAIN NO SURFACE CRACKS, NO CONCAVITY, OR POROSITY. CONVEXITY OF THE WELD SHALL NOT EXCEED THE O.D. OF THE CAPSULE TUBING.
B) DYE PENETRANT INSPECTION (PT): THE CAPSULE WELD SHALL CONTAIN NO CRACKING OR POROSITY.
C) ULTRASONIC INSPECTION IN COMPLIANCE WITH HNF-SD-WM-FDC-056, REV 0, SECTION 5 5 4, FUNCTIONAL DESIGN CRITERIA FOR TYPE-W CsCl CAPSULE OVERPACK.
7. WELD INSPECTION ACCEPTANCE CRITERIA HOT END:
A) VISUAL INSPECTION (VT): THE CAPSULE WELD SHALL CONTAIN NO SURFACE CRACKS, NO CONCAVITY, OR POROSITY. CONVEXITY OF THE WELD SHALL NOT EXCEED THE O.D. OF THE CAPSULE TUBING.
B) ULTRASONIC INSPECTION IN COMPLIANCE WITH HNF-SD-WM-FDC-056, REV 0, SECTION 5 5 4, FUNCTIONAL DESIGN CRITERIA FOR TYPE-W CsCl CAPSULE OVERPACK.
8. DIMENSIONING AND TOLERANCING SHALL BE PER ANSI Y14.5M-1994. DIMENSIONS ARE IN INCHES.
DECIMAL: .X ± .1 .XX ± .03 .XXX ± .010
ANGULAR: ±1°
9. WHEN MACHINING OD/ID OF TUBE, TAKE NO MORE THAN 0.005" PER CUT.
10. HELIUM LEAK TEST HOT AND COLD ENDS PER ASME BOILER & PRESSURE VESSEL CODE (1995) SECTION V ARTICLE 10. ACCEPTANCE CRITERIA 1X10 ATM CC/SEC.
1 OVERPACK WELDMENT SCALE: 1/1
2 OVERPACK TUBE SCALE: 1/1
3 TOP END CAP SCALE: 1/1
4 BOTTOM END CAP SCALE: 1/1
VIEW A SCALE: 4/1
SEE GENERAL NOTE 9
DO NOT BREAK SHARP CORNERS
SCRIBE 8 GAS VENTS APPROXIMATELY ↧.010 X .010 WIDE. VENTS ARE TO BE EQUAL SPACED AT APPROXIMATELY 45° ON TOP SURFACE OF ITEM NUMBER 2
SEE GENERAL NOTE 5A
SEE GENERAL NOTE 5B
CENTER PUNCH MARK ON O.D. PUNCH MARK Ø.06 X ↧.06 .10 DOWN FROM TOP SURFACE
SEE GENERAL NOTE 5C FAR SIDE ONLY
SEE NOTE 11
VT+UT
VT+PT+UT
MAX R.002
OCT 19 2005
U.S. DEPARTMENT OF ENERGY
Richland Operations Office
B&W HANFORD, INC.
CS CAPSULE
TYPE W OVERPACK
WELDMENT & DETAILS
H-3-307504
ECN-656058, ECN-709552
ECN-649409, ECN-649414
ECN-644942, ECN-647571
INCORPORATED ECN-643932
DRAWING TRACEABILITY LIST
REVISIONS
CADFILE
CADCODE
PLOT SCALE: 1=4

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CAPSULE INTERIM STORAGE UNIT
ADDENDUM E
SECURITY

CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have its own change control log with a modification history table. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Modification History Table

Modification Date	Modification Number

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ADDENDUM E
SECURITY

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ADDENDUM E
SECURITY

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E.1.2.2 Warning Signs 5

FIGURE

Figure E-1 Capsule Storage Area Warning Signs (Month Unknown, 2017) 6

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E.1 Security

This addendum discusses the security requirements relative to the Capsule Interim Storage (CIS) Operating Unit Group (OUG) and complies with the security requirements set forth in WAC 173-303-310, Dangerous Waste Regulations, *Security*.

CIS, located within the western portion of the 200 East Area of the Hanford Facility, consists of the operating Capsule Storage Area (CSA) Dangerous Waste Management Unit (DWMU) (Figure E-1).

CIS operations provide for continued safe storage and maintenance of the 1,936 capsules containing cesium and strontium radioactive mixed waste. The double-encapsulated cesium and strontium salts are stored in a Cask Storage System on the CSA storage pad. CIS storage operations are designed to protect human health and the environment from the encapsulated mixed waste.

E.1.1 Hanford Site Security

The Hanford Site is a controlled-access area. Permit Attachment 3, *Security*, of the WA7890008967, Hanford Facility Resource Conservation and Recovery Act Permit, describes the multi-tiered site-wide security system and how it applies to the requirements for signs [WAC 173-303-310(2)(a)], 24-hours surveillance [WAC 173-303-310(2)(b)], and artificial and natural barriers [WAC 173-303-310(2)(c)].

E.1.2 Capsule Interim Storage Security Provisions

CIS complies with access control and warning sign requirements pursuant to WAC 173-303-310(1) and (2).

E.1.2.1 Access Control

Unknowing entry and the possibility for unauthorized entry of persons or livestock onto the active portion of CIS are minimized through implementation and maintenance of security fencing. Access to the CSA DWMU is controlled by a 2.4 m (8 ft) tall chain-link fence encircling the CIS perimeter with access provided through vehicle and personnel gates. A second 2.4 m (8 ft) tall chain-link fence encircles the portion of the DWMU that contains the waste storage configuration. The CIS gates are under surveillance by authorized personnel when work activities are occurring in the area. All gates remain closed and locked when not in use. Access is controlled and accessible to authorized personnel only (WAC 173-303-310(2)(c)). Keys to access gates are controlled by Project Operations dispatch personnel, and accessible only by authorized personnel.

Visitors to CIS must adhere to all personal protection requirements, and are subject to escorting protocols. Personnel training requirements for security protocol for those individuals whose assigned work tasks directly relate to CIS mixed waste management activities are found in CIS Addendum G, *Personnel Training*.

E.1.2.2 Warning Signs

Warning signs stating “Danger-Unauthorized Personnel Keep Out” are posted at each gate entrance. Signs identical to those affixed at gate entrances are posted along the outer fence line at distances not to exceed 76 m (250 ft) between signs. Figure E-1 identifies the minimum number of signs posted along each segment of fence.

Permittees must maintain the warning signage at points described in this Addendum and ensure that signs are written in English, legible from a distance of at least 7.6 m (25 ft) or more, and visible from all angles of approach (WAC 173-303-310(2)(a)).

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Note: Minimum number of signs required per boundary segment at distances not to exceed 76 m (250 ft) between signs. Signs will be posted on gates.

Figure E-1 Capsule Storage Area Warning Signs (Month Unknown, 2017)

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CAPSULE INTERIM STORAGE UNIT
ADDENDUM F
PREPAREDNESS AND PREVENTION

CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have its own change control log with a modification history table. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Modification History Table

Modification Date	Modification Number

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ADDENDUM F
PREPAREDNESS AND PREVENTION

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ADDENDUM F
PREPAREDNESS AND PREVENTION

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F.1 Preparedness and Prevention

This addendum addresses the preparedness and prevention measures in effect at the Capsule Interim Storage (CIS) Operating Unit Group and, furthermore, complies with the requirements set forth in Washington Administrative Code (WAC) 173-303-340, Dangerous Waste Regulations, *Preparedness and prevention*; WAC 173-303-806(4)(a)(viii), *Final facility permits*; and WAC 173-303-395(4), *Other general requirements*.

CIS operations provide for continued safe storage and maintenance of the 1,936 capsules containing cesium and strontium mixed waste. The double-encapsulated cesium and strontium salts are stored in a Cask Storage System (CSS) on the Capsule Storage Area (CSA) Dangerous Waste Management Unit (DWMU) storage pad. CIS storage operations are designed to protect human health and the environment from the encapsulated mixed waste.

F.2 Preparedness and Prevention Requirements

The purposes of preparedness and prevention are to minimize the damage caused by a fire, natural disaster or explosion, and help avoid or mitigate any unplanned releases of dangerous waste constituents to the air, soil, surface water, or groundwater. The following subsections describe preparedness and prevention measures at CIS, which help avoid or mitigate such situations.

The following equipment is available for use, in accordance with the requirements of WAC 173-303-340(1). All communications, alarms, and notifications are tested and maintained to ensure proper operation in time of emergency, in accordance with Addendum I, *Inspection Plan*.

F.2.1 Internal Communication

The CSA DWMU will not be a normally occupied area and does not require a telephone system. Personnel at CIS will use hand-held two-way radios as a portable communication device (WAC 173-303-340(1)(b) and (2)).

Whenever casks are being handled at CIS, all personnel involved must have immediate access to a hand-held two-way radio capable of directing emergency communication with another employee. The communication device described in this section meets the internal communication requirements of WAC 173-303-340(1)(a) and (2)(a).

Emergency notifications are conveyed through the use of hand-held two-way radios and site-wide alerts. Sirens broadcast the Hanford Site Emergency Alerting System in case of emergency (DOE/RL-94-02, *Hanford Emergency Management Plan*, Section 5.2.5).

F.2.2 External Communications

As required by WAC 173-303-340(1)(b), the communications equipment described in Section F2.1 must have the capability for contacting the Hanford Patrol Operations Center and Hanford Fire Department to request the assistance of local emergency response organizations. Hand-held radios can be used to notify dispatch personnel to request emergency assistance. The Hanford Patrol Operations Center Point of Contact can be contacted for 24-hour emergency communications and for information relays by dispatch personnel.

State and local response organizations are contacted through the Hanford Patrol Operations Center. Onsite responders are notified and dispatched through the Hanford Patrol Operations Center.

In the instance that just one employee is at CIS during operations, the individual must have immediate access to a hand-held two-way radio capable of summoning external emergency assistance [WAC 173-303-340(2)(b)].

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F.2.3 Emergency Equipment and Water for Fire Control

CIS stores double-walled capsules containing mixed waste that are further protected from external conditions by a CSS. The capsules are stored inside a sealed container, which is designed to contain the hazardous waste under accident condition. The CSSs contain no liquid waste and remain stationary due to the CSS configuration. Therefore, emergency equipment, such as spill control and decontamination equipment are not maintained at the CIS. In the unlikely event of an unplanned release, Addendum J, *Contingency Plan*, will be implemented.

National Fire Protection Association compliant fire hydrants, providing water at adequate volume and pressure, are located within accessible distances from the CSA. When needed, the Hanford Fire Department will use these hydrants to supply fire control equipment and water for fire suppression. The Hanford Fire Department can also respond to fire related emergencies at the CSA with pump engines capable of providing water at adequate volume and pressure for fire suppression.

CIS does not produce products for use, have any production processes, or receive waste from offsite facilities. For further details on CIS and storage operation, refer to CIS Addendum C, *Process Information*.

F.3 Preventive Procedures, Structures, and Equipment

The following sections describe preventive procedures, structures, and equipment in effect at CIS.

F.3.1 Aisle Spacing Requirements

The CSS has an internal support structure used to confine the capsules and prevent releases of hazardous waste (see CIS Addendum C for further details on the CSS design and capsule storage configuration). As described in Addendum C, the CSA design and CSS storage configuration maintains aisle space between casks to allow the unobstructed movement of personnel and emergency equipment to any area of the CSA in the event of an emergency, thereby meeting the requirements of WAC 173-303-340(3).

F.3.2 Loading and Unloading Operations

To minimize potential for accidental release of dangerous waste during loading and unloading activities, CIS personnel shall implement the following preventive measures, as addressed in Addendum C:

- The casks are handled by equipment appropriate for loading and transport operations.
- Management approval must be obtained prior to conducting cask transport operations.
- Pathways for loading and unloading operations must remain clear of obstructions.
- Transport vehicles are positioned in a manner that provides an unobstructed workspace to move the casks.

F.3.3 Prevention of Run On, Runoff, and Contamination to Water Supplies

Run on is prevented through engineered controls. As described in CIS Addendum C, the mixed waste capsules are stored in a CSS. The CSS protects the waste from contact with accumulated liquids. The casks are elevated on the concrete pad. The concrete storage pad is also sloped to prevent precipitation accumulation, thus preventing run on from entering the casks. Run on is not considered a relevant factor in evaluating the protectiveness of mixed waste storage activities at CIS. Because no precipitation can enter the cask to contact the mixed waste contents, no runoff can occur.

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F.3.4 Equipment and Power Failure

F.3.4.1 Equipment Failure

The CSS has been designed to minimize the possibility of equipment failure. As described in Addendum C, the capsules are sealed within universal capsule sleeves (UCS), which are within a sealed transportable storage canister (TSC). In the event of a capsule failure, the UCS and TSC are fabricated from 316L corrosion resistant stainless steel that are sealed to contain any releases. The system is designed with a passive cooling system to eliminate concerns related to cooling equipment failure. The inlet air vents contain screens to prevent foreign material from entering the cask and interfering with the passive air cooling system.

F.3.4.2 Power Failure

CIS is designed for safe operation during power outages. A temporary loss of electrical power does not affect the safe storage of the dangerous waste and would not result in a release of mixed waste, therefore, it would not constitute an emergency. In the event of a loss of electrical power, the temperature monitoring system would not be operational. However, actions would be taken to restore the loss of power and provide alternate monitoring of the casks to ensure air flow. A visual inspection would be conducted in place of remote temperature monitoring.

F.3.5 Personal Protection Equipment

CIS minimizes personnel exposure to occupational injury and dangerous waste by ensuring the use of adequate personal protective equipment (PPE) during normal operations and emergencies. All personnel are required to wear PPE specified by work authorization documentation, and in accordance with training, posted requirements, and administrative instruction. PPE requirements will vary depending on the form, content, and waste handling activities. When possible, engineering and/or administrative controls are first implemented to minimize the possibility of exposure.

F.4 Prevention of Reaction of Ignitable, Reactive, and Incompatible Waste

CIS does not and will not store ignitable waste, reactive waste, or waste found incompatible with the mixed waste capsules.

F.5 Arrangements with Local Authorities

Written emergency assistance agreements exist with local authorities that include arrangements to familiarize and furnish local hospitals, police departments, fire departments, and city and county emergency response teams with Hanford Facility information [WAC 173-303-340(4)(a) through (c)], as described in DOE/RL-94-02. The response agreements designate primary emergency authority (WAC 173-303-340(4)(d)). If state or local authorities decline to enter into a response agreement or familiarization arrangement with the Hanford Facility, the Permittees will record the refusal in the Hanford Facility Operating Record, as required by WA7890008967, Hanford Facility Resource Conservation and Recovery Act Permit, Condition II.I.1.g (WAC 173-303-340(5)).

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CAPSULE INTERIM STORAGE UNIT
ADDENDUM G
PERSONNEL TRAINING

CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have its own change control log with a modification history table. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Modification History Table

Modification Date	Modification Number

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ADDENDUM G
PERSONNEL TRAINING

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G.1 Introduction

This addendum discusses personnel training requirements based on WAC 173-303, *Dangerous Waste Regulations*, and WA7890008967, Hanford Facility Resource Conservation and Recovery Act Permit (hereinafter called Hanford Facility RCRA Permit) for the Capsule Interim Storage (CIS) Operating Unit Group (OUG).

Permittees will comply with the training outlined in Tables G-1 and G-2, which provide the training requirements for Hanford Facility personnel associated with dangerous and/or mixed waste management activities at CIS.

G.1.1 Introductory and Continuing Training Program

The dangerous waste training program consists of introductory and continuing training that are designed to prepare personnel to manage and maintain the CIS facility in a safe, effective, and environmentally sound manner. In addition to preparing personnel to manage and maintain the CIS facility under normal conditions, the training program ensures that personnel are prepared to respond in a prompt and effective manner should abnormal or emergency conditions occur. Emergency response training is consistent with the description of actions contained in Addendum J, *Contingency Plan*.

The introductory and continuing training programs contain the following objectives:

- Teach Hanford Facility personnel to perform their duties in a way that ensures compliance with WAC 173-303.
- Teach Hanford Facility personnel dangerous waste management activities (including implementation of the contingency plan) relevant to the job titles/positions in which they are employed.
- Ensure Hanford Facility personnel can respond effectively to emergencies.

The introductory and continuing training programs meet the requirements of WAC 173-303-330, *Personnel training*, through general Hanford Facility training, Contingency Plan training, Emergency Coordinator training, and Operations training as outlined in this section.

G.1.1.1 Introductory Training

Introductory training includes general Hanford Facility training and unit-group specific training. General Hanford Facility training is described below. Unit-group specific training is provided to CIS personnel allowing those personnel to work unescorted, and in some cases is required for escorted access. Personnel cannot perform a task for which they are not properly trained, except to gain required experience while under the direct supervision of a supervisor or coworker who is properly trained, as described in Section G.2.1. Personnel must be trained within six months after their employment at or assignment to the Hanford Facility, or to a new job title/position at the Hanford Facility, whichever is later.

General Hanford Facility training: Hanford Facility personnel will receive general Hanford Facility training described in Hanford Facility RCRA Permit Attachment 5, *Hanford Facility Personnel Training Program*, within six months of hire. This training provides an orientation on dangerous waste management activities conducted at the Hanford Facility and includes the following:

- Description of emergency signals and appropriate personnel response.
- Identification of contacts for information regarding dangerous waste management activities.
- Introduction to waste minimization concepts.
- Identification of contact(s) for emergencies involving dangerous waste.
- Familiarization with the applicable portions of the Hanford Facility RCRA Permit Attachment 4, *Hanford Emergency Management Plan* (DOE/RL-94-02).

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The Permittees will provide the necessary training to non-CIS personnel or visitors as appropriate for the locations and activities undertaken. Non-CIS personnel or visitors include individuals not permanently assigned exclusively to the CIS facility and who do not have dangerous waste management responsibilities or supervision of such activities. These individuals include but are not limited to administrative personnel, regulatory oversight, transient sampling personnel not permanently assigned to the CIS facility, and personnel utilized for temporary assignments.

Contingency Plan training: CIS personnel receive training on applicable portions of DOE/RL-94-02 in the general CIS training. To ensure effective emergency response, personnel receive training on the content of the actions described in Addendum J as well.

Emergency Coordinator training: CIS personnel facilitating emergency coordinator duties, WAC 173-303-360, *Emergencies*, such as the Building Emergency Director (BED)/Building Warden (BW) within the Hanford Incident Command System (ICS), receive training on implementing Addendum J and ICS BED/BW responsibilities. These personnel must also become thoroughly familiar with applicable contingency plan documentation, operations, activities, location and properties of all waste handled, location of all records, and the unit/building layout.

Emergency Coordinator training consists of the BED/BW training courses required for facility BEDs/BWs described in Table G-1.

Operations training: Dangerous waste management operations training (e.g., container management training, shippers training) will be determined on a unit-by-unit basis and shall consider the type of activities performed at the OUG (e.g., surveillance). Training provided for CIS operations is identified in Table G-1. Operations training consists of the following subjects:

- Container management.
- Waste Handling.
- Container labeling.
- Position specific training as detailed in Table G-1.

G.1.1.2 Continuing Training

In accordance with the requirements for WAC 173-303-330(1)(b), *Personnel Training*, dangerous waste workers participate in an annual review of training, including general Hanford Facility training and unit-group specific training. The frequencies for individual training courses is described below.

General Hanford Facility training: Annual refresher training is provided for general Hanford Facility training. Refer to description in Section G.1.1.

Contingency Plan training: Annual refresher training is provided for contingency plan training. Refer to description above in Section G.1.1.

Emergency Coordinator training: Annual refresher training is provided for emergency coordinator training including the BED/BW training course (Table G-1). Refer to description above in Section G.1.1.

Operations training: Refresher training occurs on many frequencies (i.e., annual, every other year, and every 3 years) for operations training. When justified, some training will not contain a refresher course and will be identified as a one-time only training course. Table G-1 specify the frequency for each training course.

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G.2 Description of Training Program

The dangerous waste training program is overseen by a training manager who is knowledgeable in dangerous waste management procedures and is otherwise qualified to design a dangerous waste training program by a combination of education and relevant experience. These qualifications are listed in Table G-2 as required by WAC 173-303-330(2)(a).

Training elements of WAC 173-303-330(1)(e) applicable to the CIS operations include the following:

- Procedures for using, inspecting, repairing, and replacing monitoring equipment.
- Communications or alarm systems.
- Response to fires or explosions.

Proper design of the training program ensures CIS personnel responsible for facilitating these elements are compliant with WAC 173-303 requirements. Actual job tasks, referred to as duties, include the above-referenced elements and are used to determine training requirements. As such, CIS personnel receive training pertinent to the duties they perform. CIS duties are outlined in Table G-2. Table G-1 contain specific information regarding the training requirements for CIS personnel.

G.2.1 Qualification of Staff (Including On-the-Job Training)

Training consists of a combination of self-study, classroom instruction, computer-based training, and on-the-job training (OJT) through the use of a qualification card.

A qualification card is the formal mechanism used to document the specialized training and performance requirements of a specific job/task (e.g. waste management, waste shipping, etc.). Qualification cards list the specific courses, required reading, and OJT activities that must be completed in order for personnel to perform the job task independently. OJT activities involve qualified personnel demonstrating a specific task, allowing the trainee to practice the task under supervision of the qualified OJT instructor.

The trainee's knowledge and skills are then evaluated against established standards. This can include written and/or oral examinations, evaluations, and reviews to ensure that they are adequately trained commensurate to their job title(s)/position(s). Results of examinations, evaluations, and reviews are documented. Completed checklists, examinations and evaluations are placed in each individual's training record.

These qualification cards are generally required to be completed within 6 months, as a means to record that personnel who perform dangerous waste activities have been provided training within 6 months of assignment. Qualification/proficiency training may, of necessity and in accordance with the provisions of collective bargaining agreements, take longer than 6 months to complete. In no case would unqualified personnel be allowed to complete specified tasks without direct oversight of certified personnel.

G.2.2 Review of the Training Program

Facility training provides for frequent, systematic review of the various components of the training program through multiple processes.

- All employees are required to complete Hanford General Employee Training (HGET) on an annual basis. This training is subject to biennial evaluation by HGET Approval Authorities who review, and revise HGET lessons when deemed necessary.
- The Permittee accounts for rule changes, facility changes, observed difficulties, and staff feedback to incorporate changes to training curricula, and/or frequency to address such new or changing circumstances.
- Another element of the training program is to ensure employees are assigned the correct training. To accomplish this, annual employee training plan reviews are conducted by assigned managers.

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- At the student level, the effectiveness of the training program is determined by reviewing student feedback (e.g. evaluation forms) and evaluating student performance (e.g. test scores). Any changes deemed necessary to the training, will be addressed with a revision and documented in the operating record.
- The training matrices (Table G-1) included in this addendum indicate regularly scheduled (required) refresher training frequencies of individual courses for the express purpose of ensuring a regimented review of course material at a topical level on a specified interval.

G.3 Description of Training Plan

The WAC 173-303-330 requirements for training are satisfied by this addendum. A description of how documentation meets the three items in WAC 173-303-330(2) is as follows:

WAC 173-303-330(2)(a): "… the job title, job description, and name of the employee filling each job. The job description must include requisite skills, education, other qualifications, and duties for each position."

Description: The specific personnel job title/position is correlated to the dangerous waste management duties. Dangerous waste management duties relating to WAC 173-303 are correlated to training courses to verify that training is properly assigned.

Only names of CIS personnel who carry out duties relating to unit-group dangerous waste management activities are maintained. A list of personnel assigned to CIS is available upon request.

A summary of requisite skills, education, and other qualifications for job title(s)/position(s) is summarized in Table G-2. Detailed information concerning job title, requisite skills, education, and other qualifications for personnel can be provided upon request.

WAC 173-303-330(2)(b): "A written description of the type and amount of both introductory and continuing training required for each position."

Description: In addition to the outline provided in Section G.1, training courses developed to comply with the introductory and continuing training programs are identified and described in Table G-1. Certain job titles/positions identified in Table G-1 may have some variability of task assignment/responsibility. Personnel assigned specific dangerous waste management duties within a job title/position are only required to take the necessary training specific to those duties. Training for assigned dangerous waste management duties are located in Table G-1.

Note that equivalent training can be used to meet the dangerous waste training requirements outlined in Table G-1 and G-2. Employees can substitute courses for the required training if the course is both similar in nature and quality and accomplishes the duties of the position to which he or she is assigned. Personnel must show by documentation or certification that an employee's training has resulted in training equivalency to the training required.

WAC 173-303-330(2)(c): "Records documenting that facility personnel have received and completed the training required by this section. The department may require, on a case-by-case basis, that training records include employee initials or signature to verify that training was received."

Description: As specified in Permit Condition II.C.1, the Permittees will maintain documentation in accordance with WAC 173-303-330(2) and (3) in the Hanford Facility Operating Record (CIS portion).

Note that training records are maintained in accordance with the requirements of the *Privacy Act of 1974*. Training records for personnel are available for inspection purposes through 59 FR 17091, which gives federal, state, and local government officers routine use access to training records where a regulatory program being implemented is applicable to a DOE or contractor program.

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Table G-1 Personnel Training

Course Number	Course Title/Description	Frequency	Job Title/Position						
			SOM	Waste Shipper[a]	Maintenance Crafts	NCO	TBD	ECO	BED/BW
General									
000001	Hanford General Employee Training (CBT) • Standard alarms, chemical spills, security, hazards, signs, escorts, badge requirements, and overall safety.	Annual	X	X	X	X	X	X	X
Facility Health & Safety									
TBD	Capsule Storage Area Orientation (CBT) • CSA facility overview, entry requirements, staging areas, and overall safety.	Initial	X	X[b]	X	X	X	X	X
03E179	Fuels Facility Emergency and Hazard Identification Checklist[c] (CBT) • Location/content of facility-specific hazards, hazard communication program, facility response actions, and waste management practices.	Annual	X	X[b]	X[b]	X	X	X	X
Waste Management									
035100	Container Waste Management (Classroom) • Waste minimization and pollution prevention, waste designation categories, recordkeeping, and container management.	Initial	X		X[e]	X			
035110	Container Waste Management Refresher[d] (CBT) • Waste minimization and pollution prevention, waste designation categories, recordkeeping, and container management.	Annual	X			X			
02006G	Waste Management Awareness (Classroom) • Introductory waste management topics, waste minimization, modifications, spills, and recordkeeping.	Initial			X[e]				

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Table G-1 Personnel Training

Course Number	Course Title/Description	Frequency	Job Title/Position						
			SOM	Waste Shipper[a]	Maintenance Crafts	NCO	TBD	ECO	BED/BW
Waste Services									
020159	Advanced Hazardous Waste Shipper Certification Training (Classroom) • Shipping techniques on hazardous waste labels, containers, packing, and manifesting.	Initial		X					
020078	Advanced Mixed Waste Shipper Certification Training[d] (Classroom) • Shipping techniques on hazardous waste labels, containers, packing, and manifesting.	Every 3 years		X					
Building Emergency									
037500	Building Warden Initial Training for Low-Hazards Facilities[f] • BW performance expectations and responsibilities as outlined in DOE/RL-94-02 for preparation, response, and recovery from emergency events at respective facility.	Initial							X
037525	Building Warden Refresher Training for Low-Hazards Facilities[d, f] • Refresher for BW performance expectations and responsibilities as outlined in DOE/RL-94-02.	Annual							X
02028B	Building Emergency Director Initial Training (Classroom)[f] • BED performance expectations and responsibilities as outlined in DOE/RL-94-02 for preparation, response, and recovery from emergency events at respective facility.	Initial							X
037515	Building Emergency Director Refresher Training[d] (CBT)[f] • Refresher for BED performance expectations and responsibilities as outlined in DOE/RL-94-02.	Annual							X

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Table G-1 Personnel Training

Course Number	Course Title/Description	Frequency	Job Title/Position						
			SOM	Waste Shipper[a]	Maintenance Crafts	NCO	TBD	ECO	BED/BW
TBD	Capsule Storage Area Building Emergency Director Qualification (XXX)[f] • Emergency response actions and responsibilities of the BED specific to the Capsule Storage Area.	Initial							X
Environmental									
600100	Environmental Compliance Officer – Core (OJT) • Knowledge of environmental regulations, permits, regulator inspections and notifications, recordkeeping, and pollution prevention practices.	Initial						X	
705610	Fuels Storage – Environmental Compliance Officer (OJT) • Facility specific environmental requirements and processes, including management of regulated waste and environmental impacts from operations.	Initial						X[g]	
Facility Operations									
TBD	Capsule Storage Area Nuclear Chemical Operator Initial Qualification Card (XXX) • Surveillance activities associated with the CSA and mandated by dangerous waste regulations.	Initial				X			
TBD	Capsule Storage Area Nuclear Chemical Operator Requalification[d] (XXX) • Surveillance activities associated with the CSA and mandated by dangerous waste regulations.	Every 2 years				X			

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Table G-1 Personnel Training

Course Number	Course Title/Description	Frequency	Job Title/Position						
			SOM	Waste Shipper[a]	Maintenance Crafts	NCO	TBD	ECO	BED/BW
Facility Management									
300226	Core Fundamentals for Shift Managers in Training (OJT) • Management of activities and tasks associated with emergency response, emergency or abnormal operations, inspections, and communications.	Initial	X						
TBD	Capsule Storage Area Shift Operations Manager (XXX) • Management of activities and tasks associated with emergency response, emergency or abnormal operations, inspections, and communications.	Initial	X						
TBD	Capsule Storage Area Shift Operations Manager Requalification[d] (XXX) • Management of activities and tasks associated with emergency response, emergency or abnormal operations, inspections, and communications.	Every 2 years	X						

a. Training is only required during the initial transfer of casks to the Capsule Storage Area (CSA) and the shipment of the casks to their final disposal location.

b. Personnel that do not have this training will be escorted.

c. Personnel may have training in course 03E179 or 03E079.

d. Refresher/requalification training is taken only after the initial training is completed.

e. Maintenance Crafts may take course 02006G or 035100. Course 02006G is an awareness level class that satisfies the requirements of the job duties. Course 035100 is an operational level class that satisfies and exceeds the requirements identified in course 02006G.

f. The Emergency Coordinator is defined as a Building Warden during pre-active life, and as a Building Emergency Director during active life.

g. Required training only for permanently assigned ECO.

BED = Building Emergency Director
BW = Building Warden
CBT = Computer Based Training
ECO = Environmental Compliance Officer
NCO = Nuclear Chemical Operator
OJT = On-the-Job Training
SOM = Shift Operations Manager
TBD = to be determined

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Table G-2 Capsule Storage Area Job Description

Job Title/Position	Job Description	
	Duties	**Requisite Skills, Education, Other Qualifications**
Shift Operations Manager (SOM)	• Report discovered spills and releases. • Evacuate or take cover in response to specific incidents. • Respond to and use communications or alarm systems. • Respond to fires or explosions. • Receive shipment of dangerous or mixed waste. • Ensure corrective actions are addressed for problems identified by inspections. • Dispatch personnel responsible for access control. • Prepare and submit environmental records.	Requisite skills Three years of nuclear facility experience, or education/experience equivalent Education High School Diploma or equivalent Other qualifications None
Waste Shippers	• Report discovered spills and releases. • Evacuate or take cover in response to specific incidents. • Prepare and certify waste shipment documentation for both onsite and offsite shipments of waste. • Prepare and submit environmental records.	Requisite skills None Education High school diploma Other qualifications None
Maintenance Crafts	• Report discovered spills and releases. • Evacuate or take cover in response to specific incidents. • Routine maintenance within the TSD facility. • Prepare environmental records.	Requisite skills One year maintenance related Education None Other qualifications None
Nuclear Chemical Operator (NCO)	• Report discovered spills and releases. • Evacuate or take cover in response to specific incidents. • Respond to and use communications or alarm systems. • Respond to fires or explosions. • Perform annual inspection of CSA (signs, exterior surfaces and surrounding area, cask labels). • Perform monthly inspection of CSA general area. • Prepare environmental records.	Requisite skills None Education High school diploma or equivalent Other qualification None
TBD	• Report discovered spills and releases. • Evacuate or take cover in response to specific incidents. • Respond to and use communications or alarm systems. • Respond to fires or explosions. • Perform inspections of temperature monitoring system. • Prepare environmental records.	TBD

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Table G-2 Capsule Storage Area Job Description

Job Title/Position	Job Description	
	Duties	**Requisite Skills, Education, Other Qualifications**
Environmental Compliance Officer (ECO)	• Report discovered spills and releases. • Evacuate or take cover in response to specific incidents. • Ensure operations are consistent with requirements contained in Dangerous Waste Regulations, WAC 173-303. • Prepare and submit environmental records.	Requisite skills Experience with environmental regulations Education Bachelor of Arts or Bachelor of Science degree in a technical discipline or an equivalent combination of education and experience. Other qualifications None
Building Emergency Director (BED)*	• Report discovered spills and releases. • Evacuate or take cover in response to specific incidents. • Respond to and use communications or alarm systems. • Provide direction during emergencies, evacuation or take cover. • Perform RCRA Emergency Coordinator duties as the Building Emergency Director in Hanford Incident Command System. • Prepare and submit environmental records.	Requisite skills Three years nuclear facility experience Education High school diploma or equivalent Other qualifications None
Building Warden (BW)*	• Report discovered spills and releases. • Evacuate or take cover in response to specific incidents. • Respond to and use communications or alarm systems. • Provide direction during emergencies, evacuation or take cover. • Perform RCRA Emergency Coordinator duties as the Building Warden in Hanford Incident Command System. • Prepare and submit environmental records.	Requisite skills None Education High school diploma or equivalent Other qualifications None
Training Manager	• Ensure the application of a graded, systematic approach to training program development and administration. • Ensure the training program will comply with WAC 173-303. • Approve training program content and provide final approval.	Requisite skills Four-years nuclear facility experience Education Bachelor of Science or Bachelor of Arts Other qualifications None

* The Emergency Coordinator is defined as a Building Warden during pre-active life, and as a Building Emergency Director during active life.

RCRA = *Resource Conservation and Recovery Act of 1976.*

TSD = treatment, storage, and disposal.

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CAPSULE INTERIM STORAGE UNIT
ADDENDUM H
CLOSURE PLAN

CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have its own change control log with a modification history table. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

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H.1 Introduction

This addendum discusses closure activities for the Capsule Interim Storage (CIS) Operating Unit Group (OUG) and, furthermore, complies with the closure requirements outlined in Washington Administrative Code (WAC) 173-303-610(2) through (6), Dangerous Waste Regulations, *Closure and post-closure*.

Amendments to this closure plan will be submitted as a permit modification in accordance with WAC 173-303-610(3)(b) and WAC 173-303-830, *Permit changes*, as applicable.

Any deviations from a treatment, storage, and/or disposal (TSD) unit closure plan required by unforeseen circumstances encountered during the closure activities, which do not impact the overall closure strategy, but provide equivalent results, shall be documented in the TSD unit-specific Operating Record. Documentation shall be made available to the Washington State Department of Ecology (Ecology) upon request, or during the course of an inspection in accordance with WA7890008967, Hanford Facility Resource Conservation and Recovery Act Permit (hereinafter referred to as the Hanford Facility RCRA Permit), Condition II.K.6.

H.1.1 Hanford Facility Contact Information

The Hanford Facility contact information is described in CIS Addendum A, *Part A Form*.

H.1.2 Hanford Facility Description

The Hanford Facility, located in southeastern Washington State, is owned and operated by the U.S. Department of Energy (DOE). Dangerous waste and mixed waste (i.e., waste containing both dangerous and radioactive components) are generated and managed at the Hanford Facility.

H.1.3 Capsule Interim Storage Operating Unit Group History, Function, Location, and Layout

The CIS OUG is in the western portion of the 200 East Area of the Hanford Facility. CIS was designed as part of the Management of Cesium and Strontium Capsules (W-135) Project for dry storage of the 1,936 cesium and strontium capsules previously stored at the Waste Encapsulation and Storage Facility, as described in Addendum C, *Process Information*. Refer to Addendum A, *Part A Form*, for waste quantity.

H.1.4 Products and Production Processes

The CIS OUG does not produce products nor have production processes.

H.1.5 Capsule Storage Area Dangerous Waste Management Unit

The CIS OUG consists of one operating miscellaneous Dangerous Waste Management Unit (DWMU): the Capsule Storage Area (CSA). Casks stored on the CSA concrete pad contain cesium chloride and strontium fluoride salts, which are contained within double-walled capsules and Type W overpacks arranged within a Cask Storage System (CSS). Each CSS contains up to 132 capsules arranged within redundant containment in the storage system. See Addendum C, Section C2.2 for additional information on the CSS. The cesium and strontium salts are known to have chemical impurities with associated dangerous waste codes (shown in parentheses) consisting of barium (D005), cadmium (D006), chromium (D007), lead (D008), and silver (D011). CIS Addendum A provides a comprehensive list of waste managed in accordance with *Resource Conservation and Recovery Act of 1976* (RCRA) regulations, including estimated annual quantities.

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H.1.5.1 Unit Description

The CSA is an uncovered concrete pad located within CIS in the western portion of the 200 East Area (Figure H-1). Refer to Addendum A for a topographic map of the area and the civil engineering plan of the site. The CSA measures approximately 27 m (90 ft) wide by 56.1 m (184 ft) long. A chain-link fence encircles a portion of the pad to control access to the waste configuration. See Addendum E, *Security* for further description on security requirements. The CSA is permitted for storage of concrete casks containing capsules of cesium and strontium salts.

Treatment of dangerous or mixed waste will not be conducted within the CSA DWMU.

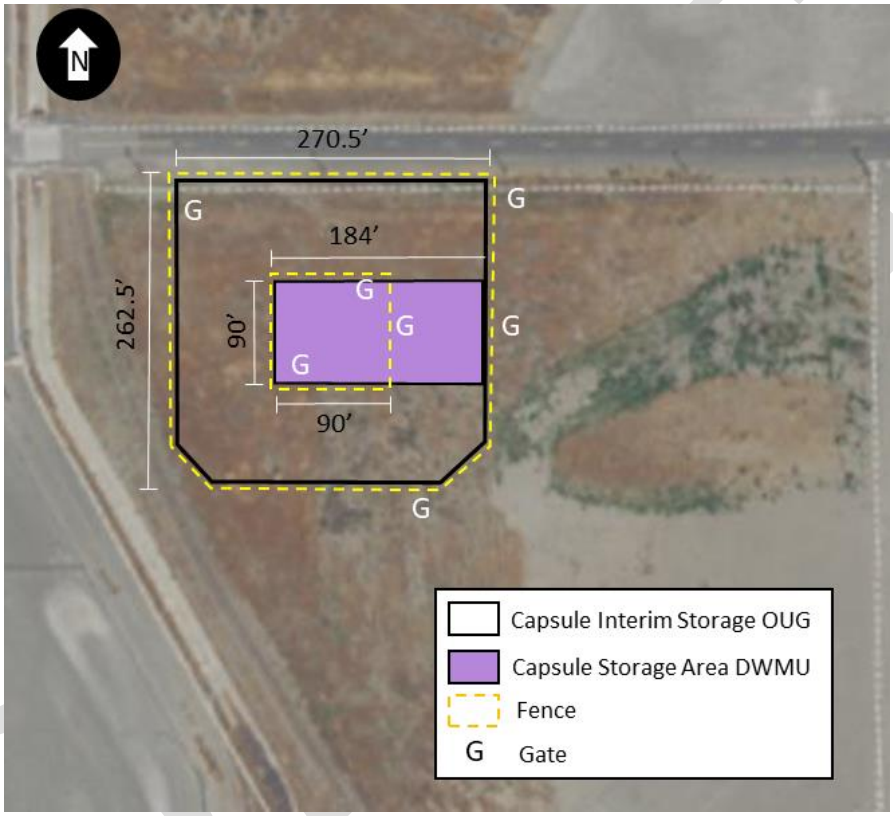

Figure H-1 Capsule Interim Storage Capsule Storage Area Dangerous Waste Management Unit Configuration

H.1.5.2 Maximum Waste Inventory

The CSA is permitted to store cesium chloride and strontium fluoride mixed waste. The maximum waste inventory is 1,936 L (511.4 gal) stored within CSSs, as described in CIS Addendum A.

H.2 Closure Performance Standard

This closure plan addresses the CSA DWMU concrete pad. The CSA will be closed in accordance with the general closure performance standards in WAC 173-303-610(2)(a), which requires closure of the facility in a manner that accomplishes the following objectives:

- Minimize the need for further maintenance.

- Control, minimize, or eliminate, to the extent necessary to protect human health and the environment (HHE), post-closure escape of dangerous waste, dangerous constituents, leachate, contaminated runoff, or dangerous waste decomposition products to the ground, surface water, groundwater, or atmosphere.
- Return the land to the appearance and use of surrounding land areas, to the degree possible, given the nature of the previous dangerous waste activity.

Furthermore, clean closure requires removal or decontamination of all dangerous waste; dangerous waste residues; and equipment, bases, liners, soils/subsoils, and other materials containing or contaminated with dangerous waste or dangerous waste residue in accordance with WAC 173-303-610(2)(b).

The CSA will be clean closed by removal of the CSA DWMU concrete pad to the performance standards identified in WAC 173-303-610 through the successful completion of the closure activities described in Section H.4.

H.3 Health and Safety Requirements

Due to the radioactive nature of mixed waste in storage, the Permittees must ensure that all closure activities do not pose a risk to HHE. Closure of the CSA will be performed in a manner to ensure the safety of personnel and the surrounding environment. Qualified personnel will be trained in and perform all necessary closure activities in compliance with the applicable safety and environmental procedures identified in CIS Addendum G, *Personnel Training*. All field operations will be performed in accordance with applicable health and safety requirements. Personnel will be equipped with appropriate personal protective equipment (PPE) for the closure activity being performed.

The Permittees have instituted training and qualification programs to meet training requirements imposed by regulations, DOE orders, and national standards such as those published by the American National Standards Institute/American Society of Mechanical Engineers. For example, the environmental, safety, and health training program provides workers with the knowledge and skills necessary to execute assigned duties safely. Attachment 5, *Hanford Facility Personnel Training Program*, to the Hanford Facility RCRA Permit describes specific training requirements for Hanford Facility personnel. The Permittees will comply with the training matrix detailed in CIS Addendum G, which provides training requirements for Hanford Facility personnel associated with the CSA DWMU.

Training records are maintained for each employee in an electronic database. The Permittees' training organization maintains the training records system.

During the closure period, to prevent threats to HHE, the CSA will be inspected in accordance with WAC 173-303-320, *General inspection*, requirements and CIS Addendum I, *Inspection Plan*.

H.4 Closure Activities

The CSA will be clean closed by removal of the concrete pad under Washington State's *Hazardous Waste Management* Act, Chapter 70.105 Revised Code of Washington, and implementing regulations of WAC 173-303. The term "clean closure" refers to performing closure activities that result in full removal of all dangerous wastes and full removal or decontamination of all structures and containment system components, equipment, debris, environmental media (i.e., soil and groundwater) materials affected by releases from the unit so as to satisfy the closure performance standards of WAC 173-303-610(2)(b)(i) and (ii). Clean closure determinations for the CSA will be based on successful completion of the closure activities outlined in this chapter.

The following closure activities, in sequential order, are required to achieve and verify clean closure of the CSA:

- Review cask storage, operating, and inspection records for documented spills or releases of mixed waste and subsequent cleanup actions.

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- Perform a visual inspection of the concrete pad to identify any mixed waste related staining, all cracks, holes, or other breaches in the concrete pad, through which dangerous waste might migrate.
- Remove and dispose of the concrete pad and inner fence.
- Transmit closure certification to Ecology.

H.4.1 Records Review and Visual Examination

CIS cask storage, operating, inspection, and spill records will be reviewed for documented spills or potential releases of mixed waste within the CSA, and subsequent cleanup actions.

A visual examination will then be performed to determine and document the presence of any mixed waste related staining, and all cracks, holes, or other breaches in the concrete pad, through which dangerous waste might migrate. A walkdown of the area will be performed and photographs taken for documentation. Locations and dimensions of any staining or breaches will also be documented. Collaborative results of the records review and visual examination will be used to determine if mixed waste or dangerous waste constituents could have been released to the environment. If contaminated environmental media (soil) is identified, the Permittees will work with Ecology to develop a sampling and analysis plan that meets the closure performance standards set forth in WAC 173-303-610.

H.4.2 Demolition

Once all the steps identified in Section H.4.1 have been completed, demolition of the DWMU concrete pad can be initiated. Demolition of the pad will include the following primary activities, described in the sub-sections below:

- Location of utilities.
- Mobilization of equipment.
- Removal and disposal of the concrete pad and inner chain-link fence.

H.4.2.1 Location of Utilities

Prior to demolition, any in-use utilities will be located and marked to ensure that there are no disruptions to the surrounding activities.

H.4.2.2 Equipment Mobilization

The resources, equipment, and materials necessary to perform demolition will be staged in designated laydown areas.

H.4.2.3 Demolition Activities for the CSA

Demolition of the CSA will be accomplished primarily by using shearing and rubblizing. Demolition of the DWMU will require the use of heavy equipment (e.g., excavator with various attachments) to remove and demolish the fencing and concrete. Standard industry or conventional demolition practices may be used (e.g., hydraulic shears with steel shear jaws, concrete pulverizer jaws or breaker jaws).

Selection of demolition methods will be based on the structural elements to be demolished, location, and integrity of the structure. Water may be used to control dust generated from demolition activities. The fire hydrants may be used to supply water for dust control during rubblization of the concrete pad. The amount of water used will be minimized to prevent ponding and runoff.

H.4.3 Identifying and Managing Waste Generated During Closure Activities

Closure activities for the CSA will result in generation of debris in the generation of one known waste stream (debris from demolition) requiring management and disposal. Waste generated during closure activities will be managed as a newly generated waste stream in accordance with WAC 173-303-610(5).

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Waste generated during the closure period must be properly disposed. The newly generated waste must be handled in accordance with all applicable requirements of WAC 173-303-170, *Requirements for generators of dangerous waste*, through WAC 173-303-230, *Special conditions*.

Management and disposal of waste generated during closure will be documented and included as part of the clean closure certification documentation (Section H.6).

H.4.3.1 Debris from Demolition

Debris generated from demolition will be packaged at the CSA and transported to an appropriate waste disposal facility. Debris includes, but is not limited to, the following:

- Concrete and associated rubblized debris.
- Fencing materials.
- Miscellaneous (e.g., rubber, glass, paper, PPE, cloth, plastic, and metal).
- Equipment and construction materials.

The preferred management of debris resulting from demolition of the pad is in bulk form. Bulk waste will be designated and placed into bulk containers, such as roll-off boxes, for disposal. These bulk containers will be stored in a suitable area in proximity to the DWMU or, if debris designates as dangerous waste, it may be accumulated for up to 90 days in accordance with WAC 173-303-200, *Conditions for exemption for a large quantity generator that accumulates dangerous waste*. Bulk containers of waste will be covered when waste is not being added or removed. Lightweight material (e.g., plastic and paper) will be bagged, if appropriate, prior to placement in the bulk container, to eliminate the potential for materials blowing out of the bulk container.

Debris will be containerized and labeled for waste characterization. Waste subject to land disposal restriction (LDR) requirements of WAC 173-303-140, *Land disposal restrictions*, which includes by reference 40 Code of Federal Regulations (CFR) 268, *Land Disposal Restrictions*, will be characterized and designated at the CSA, as applicable, prior to being stored, treated, and/or disposed of in an approved facility.

H.4.4 Identifying and Managing Contaminated Environmental Media

A sampling and analysis plan will be developed upon identification of possible contaminated environmental media (Section H.4.1). Contaminated soil will be managed as a newly generated waste stream in accordance with WAC 173-303-610(5). Contaminated soil must be handled in accordance with all applicable requirements of WAC 173-303-170 through WAC 173-303-230. Contaminated soil will be containerized, labeled, and sampled for waste characterization. Soil accumulations will be placed in the U.S. Department of Transportation compliant containers and sent to an approved disposal facility or staged at less than 90-day accumulation areas in accordance with WAC 173-303-200 standards. Waste subject to LDR requirements of WAC 173-303-140, which includes by reference 40 CFR 268, will be characterized and designated at the CSA, as applicable, prior to being stored, treated and/or disposed of in an approved facility.

H.5 Role of the Independent Qualified Registered Professional Engineer

An Independent Qualified Registered Professional Engineer (IQRPE) will be retained to provide certification of closure, as required by WAC 173-303-610(6). The IQRPE will be responsible for observing field activities and reviewing documents associated with clean closure of the CSA. At minimum, the following activities will be performed by the IQRPE:

- Review of the CSA DWMU visual inspection.
- Review demolition activities.
- Review of newly generated waste management and disposition records.

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- Verify that closure activities were performed in accordance with this closure plan.

The IQRPE will record observations and reviews in the closure certification, which will then be provided to Ecology and maintained in the CIS portion of the Hanford Facility Operating Record.

H.6 Closure Certification

In accordance with WAC 173-303-610(6), within 60 days of completion of closure of the CSA, a certification that the DWMU has been closed in accordance with the specifications in this closure plan will be submitted to Ecology by registered mail. The certification will be signed by the owner or operator and an IQRPE.

Upon request by Ecology, in accordance with WAC 173-303-610(6), information will be submitted to support closure certification. This information could include the following:

- All field notes and photographs related to closure activities.
- Description and justification of any minor deviations from the approved closure plan and justification for these deviations.
- Documentation of the removal and final disposition of all dangerous and mixed wastes residues and any corresponding residues.
- Description of the DWMU area appearance at completion of closure.

H.7 Conditions that will be Achieved when Closure is Complete

Once the CSA concrete pad has been removed, no possible contaminated environmental media is identified, and it meets the closure performance standards, the CSA DWMU will be considered clean closed, at which point only bare soil will remain. A permit modification request will be submitted after clean closure has been confirmed by Ecology to remove the CSA DWMU from the Hanford Facility RCRA Permit.

H.8 Closure Schedule and Time Frame

Major Milestone M-092 addresses the disposition path for the cesium and strontium capsules, with a milestone due date of December 31, 2047 to complete the acquisition and modification of facilities necessary for the storage, treatment/processing, and disposal of the capsules. Currently, a viable disposal option for the capsules is not available. Milestone M-092-20 requires a disposition pathway evaluation every four years until such time that disposition is determined. Due to these circumstances, storage of the CSS at the CSA is expected to take place over an extended period, and meeting the 30-day requirement to begin closure activities after receiving the last known volume of waste, as required in WAC 173-303-610(4)(b), is not possible. Therefore, the Permittees request an extension to the start of closure. Approval of this closure plan will grant the Hanford Facility an extension to the start of closure, in accordance with WAC 173-303-610(3)(c), and a separate extension request will not be filed. In accordance with WAC 173-303-610(3)(c)(i), a notification of intent to close the CSA DWMU will be submitted to Ecology at least 45 days prior to the date on which closure is expected to begin.

In accordance with WAC 173-303-610(4)(b), closure activities will be completed no more than 180 days after the start of closure (Table H-1 and Figure H-2) for the CSA. Should unexpected circumstances arise and an extension to the 180-day closure period be deemed necessary, a permit modification will be submitted to Ecology for approval at least 30 days prior to the 180-day expiration date in accordance with WAC 173-303-610(4)(c) and WAC 173-303-830, Appendix I, Section D.1.b. The extension request would also demonstrate that all steps to prevent threats to HHE, including compliance with all applicable permit requirements, have been and will continue to be taken. In the event of a proposed change in facility design or operation or an unexpected event that affects the closure plan, a permit modification request to amend the closure plan will be submitted to Ecology per WAC 173-303-610(3)(b)(iii).

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Closure certification will be submitted to Ecology within 60 days following completion of closure activities at the CSA, as outlined in Section H.6.

H.9 Closure Costs

An annual report outlining updated projections of anticipated closure costs for the Hanford Facility treatment, storage and disposal units having final status is not required per Permit Condition II.H. The Hanford Facility is owned by DOE and operated by DOE and its contractors; therefore, in accordance with WAC 173-303-620(1)(c), provisions of WAC 173-303-620, *Financial requirements*, are not applicable to the Hanford Facility.

Table H-1 Capsule Storage Area Dangerous Waste Management Unit Closure Activity Description

Closure Activity Description		Expected Duration
Primary Activity	**Secondary Activity**	
Prior to Closure		
Submit Notification to Ecology of Intent to Close the CSA DWMU	In accordance with WAC 173-303-610(3)(c)(i), at least 45 days prior to the date on which closure is expected to begin.	--
Begin Closure of the CSA DWMU	Once all casks are removed from the CSA, closure of the CSA DWMU will commence.	Day 0
Closure Activities		
Records Review	Perform review of cask storage, inspection, and spill records.	70 Days (Day 70)
Visual Inspection of Concrete Pad	Inspect structural integrity for any mixed waste related staining, cracks, holes, or other breaches in the concrete pad.	20 Days (Day 90)
	Document visual inspection with photos, locations, and dimensions of staining and cracks (if any).	
Remove Concrete Pad and Fence	Remove concrete pad and fence with large equipment.	90 Days (Day 180)
	Containerize waste debris.	
	Dispose of debris in approved disposal facility.	
RCRA Closure Activities Complete		
Owner/Operators and IQRPE Submit Clean Closure Certification	In accordance with WAC 173-303-610(6), within 60 days of completion of closure of the DWMU; certification that the DWMU has been closed in accordance with the specifications in the approved closure plan (Section H.6 provides details on the clean closure certification).	60 Days (Day 240)

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Figure H-2 Capsule Storage Area Closure Schedule Activities

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H.10 References

40 CFR 268, *Land Disposal Restrictions*, Code of Federal Regulations. Available at: https://www.ecfr.gov/cgi-bin/text-idx?SID=8ed4dbc82239fd075f48a3f71ea03d9b&mc=true&node=pt40.29.268&rgn=div5.

M-92-17-01, 2017, Federal Facility Agreement and Consent Order Change Control Form, *Establish One Interim Milestone for the Management of Cesium and Strontium (Cs/Sr) Capsules*, Washington State Department of Ecology and U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0069392H.

Resource Conservation and Recovery Act of 1976, 42 USC 6901, et seq. Available at: https://elr.info/sites/default/files/docs/statutes/full/rcra.pdf.

WAC 173-303, *Dangerous Waste Regulations*, Washington Administrative Code, Olympia, Washington. Available at: http://apps.leg.wa.gov/WAC/default.aspx?cite=173-303.

WAC 173-303-140, *Land disposal restrictions*.

WAC 173-303-170, *Requirements for generators of dangerous waste*.

WAC 173-303-200, *Conditions for exemption for a large quantity generator that accumulates dangerous waste*.

WAC 173-303-230, *Special conditions*.

WAC 173-303-320, *General inspection*.

WAC 173-303-610, *Closure and post-closure*.

WAC 173-303-620, *Financial requirements*.

WAC 173-303-830, *Permit changes*.

WA7890008967, *Hanford Facility Resource Conservation and Recovery Act Permit, Dangerous Waste Portion for the Treatment, Storage, and Disposal of Dangerous Waste*, Revision 8C, as amended, Washington State Department of Ecology. Available at: https://fortress.wa.gov/ecy/nwp/permitting/hdwp/rev/8c/index.html.

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CAPSULE INTERIM STORAGE UNIT
ADDENDUM I
INSPECTION PLAN

CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have its own change control log with a modification history table. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Modification History Table

Modification Date	Modification Number

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ADDENDUM I
INSPECTION PLAN

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ADDENDUM I
INSPECTION PLAN

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I.1 Inspection Plan

In accordance with Washington Administrative Code (WAC) 173-303-806(4)(a)(v), Dangerous Waste Regulation, *Final facility permits*, WAC 173-303-320, *General inspection*, and WAC 173-303-340, *Preparedness and prevention*, this inspection plan is designed to prevent malfunctions, deterioration, operator errors, and discharges at the Capsule Interim Storage (CIS) Operating Unit Group which may cause or lead to the release of dangerous waste constituents to the environment or a threat to human health. This inspection plan is designed to provide early warning of the potential for such events to make timely corrections or take preventive actions.

I.1.1 General Inspection Requirements

Inspections within the schedule are performed by qualified personnel according to a frequency that has been developed through both regulatory requirements and operating experience (Table I-1). For frequencies that are not defined by specific regulatory requirements, a justification for the frequency will be documented and maintained in the Hanford Facility Operating Record (CIS portion) in accordance with WA7890008967, Hanford Facility Resource Conservation and Recovery Act Permit (hereinafter referred to as Hanford Facility RCRA Permit) Condition II.I. During an inspection, inspectors evaluate each inspection item against its associated acceptance criteria, defined in the schedule (Table I-1). The results of the inspections are documented in inspection logs that are dated and signed, handwritten or electronically, by the inspector, and retained in the Hanford Facility Operating Record (CIS portion) for at least 5 years.

This inspection plan addresses the following unit group specific items:

- General facility.
- Casks.

Management-level staff are responsible for implementation and training according to the inspection plan. These staff may include the Facility Director or Facility Manager personnel. All inspectors shall have the appropriate training as outlined in Addendum G, *Personnel Training*.

I.1.2 Inspection Log [WAC 173-303-320(2)(d)]

Inspections implemented through operating requirements will be documented on inspection checklists or log sheets in accordance with WAC 173-303-320(2)(d). Inspection checklists or log sheets will note the date and time of the inspection and the items that will be assessed during each inspection. Any problems or discrepancies identified during the inspection, and the date and nature of any repairs or remedial actions taken, are recorded on the inspection checklist or log sheet, reported to the operating organizations, and prioritized and addressed in a timely fashion, as described in Section I.1.3.

When the inspection is completed, the inspector's full name is printed and signed on the inspection checklist or log sheet. The schedule and inspection records will be maintained and stored in the Hanford Facility Operating Record (CIS portion) in accordance with the record retention requirements of WAC 173-303-320(2)(d) and WAC 173-303-380(1)(e), *Facility recordkeeping*. The schedule will be electronically available at building 212H.

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I.1.3 Remedy Schedule [WAC 173-303-320(3)]

Problems and unanticipated substandard conditions identified by the inspector are documented on the inspection log and reported to facility management for prioritization, and scheduling of remedial actions to prevent environmental or human health incidents. Problems identified during inspections are categorized into three general areas and addressed accordingly. The areas include imminent hazards to human health and the environment, problems that can be easily remedied with little or no planning, and maintenance items that require planning and coordination to correct:

- When an identified problem poses an imminent risk to human health or the environment, actions are taken immediately to mitigate the hazard and may include activation of the Building Emergency Plan for CIS (located in CIS Addendum J, *Contingency Plan*) and the Hanford Emergency Management Plan (located in Hanford Facility RCRA Permit Attachment 4, *Hanford Emergency Management Plan*), when contingency plan action levels are exceeded. Problems that warrant immediate action include active releases of mixed waste to the environment (i.e., cask leak).
- Problems identified during inspections that are easily corrected (e.g., no maintenance planning required), such as sign replacement, will be corrected within 24 hours or tracked until completion.
- Other problems that cannot be easily corrected are addressed on a prioritized schedule. Actions to assess and remedy such problems are assigned and a schedule for completion is determined.

Inspections are completed by using either inspection logs or through a job control database. Problems identified using an inspection log are noted on the inspection log and either corrected during the time of the inspection or tracked on each subsequent inspection log until corrected. Problems identified using the job control database are noted on the inspection form and either corrected during the time of the inspection or the problem is added to the job control database to be addressed according to a remedy schedule.

An overall schedule for remedying problems would include time to develop a maintenance instruction in conjunction with any schedule constraints, such as parts availability, fabrication, and environmental or facility access limitations. The time to develop a maintenance instruction depends on several factors including nuclear, radiological, and industrial safety hazards associated with the task; complexity of the task; human factors and performance considerations; skill of worker(s); and risk to the worker(s), public, or the environment.

The inspection problem resolution process may include preparing an inspection data sheet that identifies the criteria for the inspection; relaying identified problems onto an action tracking list; and developing maintenance instructions for problems based on the actions tracking list. The remedies for problems identified are developed using maintenance instructions and prioritized on a schedule as described previously. Problems pending resolution, and their associated tracking designation, will be noted until the remedy is complete.

Information from the inspection checklist or log sheet will be maintained in the Hanford Facility Operating Record (CIS portion) in accordance with the Hanford Facility RCRA Permit Condition II.I.

I.1.4 Summary and Frequency of Dangerous Waste Management Unit Items to be Inspected [WAC 173-303-320(2)(c)]

The capsules, which are stored within a CSS, contain no liquid waste, and remain stationary due to the CSS design configuration. Therefore, the Capsule Storage Area (CSA) Dangerous Waste Management Unit (DWMU) is not subject to spills and daily inspections per WAC 173-303-320(2)(c) are not required.

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Based on possible localized radiation fields at the CSA DWMU, physical access to the casks should be minimized. In-person weekly inspections (pursuant to WAC 173-303-630(6), *Use and management of containers*) of the casks would cause unnecessary risks to workers and contradict *Atomic Energy Act of 1954* radiation safety requirements. Therefore, remote inspection of the CSA DWMU will be accomplished through monitoring of the temperature monitoring equipment associated with the CSS passive ventilation system. Temperature monitoring will be performed on work days to determine if the CSS outlet air vent temperature is within an acceptable range; thus, verifying the cooling vents are clear of debris (e.g., soil, vegetation) and wildlife.

The items subject to inspection and their respective evaluation criteria are identified at Table I-1.

Table I-1 Capsule Interim Storage Inspection Schedule

Inspection Item/Area	Frequency	Types of Problems and Evaluation Criteria
General Facility		
Posted Warning Signs[a]	A	Problem: Dangerous waste warning signs missing, not in proper location, not visible, or not in good condition. Check condition of dangerous waste warning signs. Ensure signs are visible, in good condition, and verify the location of the signs.
Exterior Surfaces of the Casks and Storage Pad[a]	A	Problem: Cracks, gaps, or other degradation of the casks and concrete storage pad, which could compromise the integrity of the storage system. Evidence of spills or leaks. Check for deterioration, structural damage, and settlement. Visually inspect for any evidence of spills present on or near the casks.
General Area	M	Problem: Damage to fence and gates. Abnormal conditions within DWMU. Verify outer fence and gates are intact with no unexpected openings, and check for accumulated debris (e.g., tumbleweeds). Visually inspect the DWMU for abnormal conditions from all sides of the outer fence line.
Two-way Radios	M	Problem: Two-way radios not operational. Verify that equipment is operational by checking for power and function.
Casks		
Cooling Vents[b]	A	Problem: Debris and wildlife blocking the casks' cooling vents. Verify that cooling vents are clear of defects and obstructions.
Cask Labels	A	Problem: Labels not present, difficult to read, altered, or falling off. Ensure labels are intact. Assess legibility of labels, note any impediments to visibility and off-normal condition of labels. Ensure labels are visible and legible.

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Table I-1 Capsule Interim Storage Inspection Schedule

Inspection Item/Area	Frequency	Types of Problems and Evaluation Criteria
Temperature Monitoring System Annunciator	W	Problem: High temperature beacon not functional. Visually verify that high temperature beacon is functional.
Temperature Monitoring	D[d]	Problem: Equipment not operational. Temperature out of normal operating range. Verify that equipment is operational and within the acceptable range. **Cask Type** / **Temperature Difference[c]** Sr (14.6 kW) / 114°F Sr (17.6 kW) / 131°F Sr (22.3 kW) / 114°F Cs (3.52 kW) / 110°F Cs (15.6 kW) / 110°F

a. Inspection will continue during and through closure activities until final certification.

b. Due to localized radiation fields, physical inspections of cooling vents will be conducted on an annual basis. Temperature monitoring will occur daily and used as an indicator for the cooling vents.

c. Allowable temperature difference between the ambient temperature and the cask outlet temperature.

d. Inspections will be on scheduled work days excluding Hanford Facility closure days.

Note: Unless otherwise noted, inspection frequencies are defined by the following periodicities:

Daily (D) = Once per calendar day.

Weekly (W) = Once per calendar week with a period that runs from Sunday to Saturday.

Monthly (M) = Once per calendar month.

Annually (A) = At least once per 12-month period ±30 days from the time of the last annual inspection.

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HNF-IP-0263-CSA
Revision 0

BUILDING EMERGENCY PLAN FOR CAPSULE INTERIM STORAGE

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

CH2MHILL
Plateau Remediation Company

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Approved for Public Release;
Further Dissemination Unlimited

HNF-IP-0263-CSA
Revision 0

BUILDING EMERGENCY PLAN FOR CAPSULE INTERIM STORAGE

Document Type: PLAN Program/Project: W&FMP

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Date Published
July 2019

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

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By Lynn M. Ayers at 2:59 pm, Jul 11, 2019

Release Approval Date

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This plan covers the following buildings and structures: Capsule Interim Storage.

USQ #: N/A per Section 1.3 PRC-PRO-NS-062

Screened by: L I Covey 7-10-19

Brad Norman
Fuels Facilities Management

7/10/19
Date

David Watson
Environmental Compliance Officer

7-10-2019
Date

H. M. Hassell
CHPRC Emergency Management

7-10-2019
Date

This document will be reviewed at least annually and updated if necessary by Facility Management unless Hanford Facility RCRA Permit coordination requirements provide otherwise. The Building Emergency Director has the authority to carry out the provisions of this plan.

BUILDING EMERGENCY PLAN

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1.0 GENERAL INFORMATION

The Capsule Storage Area (CSA) **is located on the Hanford Site, a 560-square-mile (1,450-square kilometer) U.S. Department of Energy (DOE) Richland Operations Office (RL) site in southeastern Washington State. The** CSA **is located in the** center **portion of the** 200 East **Area near the** center **of the Hanford Site.**

This plan contains a description of facility-specific emergency planning and response, and is used in conjunction with portions of the DOE/RL-94-02, *Hanford Emergency Management Plan*, to meet contingency plan requirements of Washington Administrative Code (WAC) 173-303. Pursuant to WAC 173-303 Dangerous Waste Regulations, DOE-RL (as the owner or operator of the Hanford Facility) is required to have a "contingency plan" for use in emergencies or sudden or nonsudden releases that threaten human health and the environment. Additionally, WAC 173-303-201(9) (for dangerous waste generator locations) and WAC 173-303-350(2) (for treatment, storage, and disposal [TSD] facilities) allows the owner or operator to use documentation, other than a "contingency plan," so long as the other documentation incorporates dangerous waste management provisions sufficient to comply with the requirements of WAC 173-303-201, WAC 173-303-350, and WAC 173-303-360. This approach is used at Hanford. There is no specific document titled "Contingency Plan" for the Hanford Facility. Rather, specific portions of this plan combined with portions of contractor facility/activity-specific documentation (e.g., emergency plans/procedures) are maintained to meet the contingency plan requirements of WAC 173-303.

1.1 Facility Name

U.S. Department of Energy
Hanford Site
Capsule Interim Storage

1.2 Facility Location

Benton County, Washington within the 200 East **Area**.

Buildings/facilities covered by this plan are: Capsule Storage Area.

1.3 Owner

U.S. Department of Energy
Richland Operations Office
2420 Steven Center Plaza
Richland, Washington 99354

Manager

CH2M HILL Plateau Remediation Company
P.O. Box 1600
Richland, Washington 99352-1600

1.4 Description of the Facility and Operations

The CSA will be used to store cesium and strontium capsules inside dry storage casks. The capsules are currently located in the Waste Encapsulation and Storage Facility (WESF) pool cells.

The CSA will consist of a concrete pad, fencing, lighting, and road access to support interim storage of the capsules. The location of the facility will be in the 200 East Area to the west of WESF and east of the Canister Storage Building (CSB) (Figure 1). The CSA will be similar to spent fuel storage pads in use elsewhere and consist primarily of passive systems.

The dry storage portion of the Cask Storage System (CSS) will consist of a Vertical Concrete Cask (VCC) with a Transportable Storage Canister (TSC) and a TSC Basket inside. Universal Capsule Sleeves (UCSs) will contain the capsules and will be placed inside the TSC Basket.

Each UCS will hold up to six standard cesium or strontium capsules or two Type W capsules and will be sealed and leak tested. The UCS has a nominal diameter of 19.1 cm (7.5 in.) and a length of 1.2 m (49 in.). There are two UCS designs; a standard configuration that accommodates up to six cesium or strontium capsules and a Type W configuration that accommodates two Type W capsules. The standard configuration will hold six capsules and the Type W configuration will hold two capsules, each with capsules stacked two units high. The UCS includes a closure lid, which provides a lift feature for handling of the loaded UCS with the Dry Transfer System (DTS) grapple.

The TSC Basket is located inside the TSC and will house up to two UCSs inside each of 11 openings. The TSC Basket is robustly designed to provide structural and thermal performance tailored to the specific content geometry and heat load of the UCSs. Each of the TSC Basket 11 openings has a shield plug and closure lid. The TSC incorporates a duel-sealed closure lid design whose primary purpose is to provide confinement to the contents. The first lid incorporates a fitting to permit inerting the cavity with helium after loading. The second lid provides redundant closure for the canister.

Each CSS contains one TSC and is approximately 3.4 m (11 ft) tall and 30 m (10 ft) in diameter. The expected loaded weight of the CSS assembly is approximately 73,620 kg (162,300 lb.) The VCC concrete in the radial direction and the VCC steel lid in the axial direction provide the primary CSS shielding. The CSS also includes cooling channels to allow passive cooling of the capsules.

This plan addresses both the “active life”1 and the “pre-active life”2 for the CSA.

2.0 PURPOSE

This plan describes both the facility hazards and the basic responses to upset and/or emergency conditions within the CSA**. These events may include spills or releases caused by processing, fires and explosions, transportation activities, movement of materials, packaging, storage of hazardous materials, and natural and security contingencies. When used in conjunction with Permit Attachment 4, *Hanford Emergency Management Plan* (DOE/RL-94-02), this plan meets the requirements for contingency planning as required by WAC 173-303. Sections 1.0, 3.1, 4.0, 7.1,**

[1] “Active life” of a facility means the period from the initial receipt of dangerous waste at the facility until the department receives certification of final closure (WAC 173-303-040).

[2] “Pre-active life” is not defined in the regulation, but refers to the facility construction up to the start of active life.

7.1.1, 7.1.2, 7.2, 7.2.1, 7.2.2, 7.2.3, 7.2.4, 7.2.5, 7.2.5.1, 7.3 and subsections), 7.6, 8.2, 8.2.1, 8.2.2, 9.0, 9.1, 9.2, 9.3, 9.4, 9.5, 9.6, 11.0, 12.0 of this Building Emergency Plan (BEP) are enforceable sections meeting RCRA contingency planning requirements. Enforceable sections cannot be changed without coordinating the change with the Permit modification process. Attachment B of this BEP provides a crosswalk listing applicable WAC 173-303 requirements and how/where the requirements are met.

3.0 FACILITY/BUILDING EMERGENCY RESPONSE ORGANIZATION

The facility/building emergency response organization (ERO) includes the Building Emergency Director (BED)/Building Warden (BW), facility subject matter experts, and other operations personnel who are responsible for implementing emergency response actions at CSA.

The CSA BED/BW is an on-call position during normal working hours, back-shifts, weekends, and holidays, which is established to handle various emergencies. In any emergency that requires implementation of this emergency plan, the on-call BED/BW has the authority to commit the resources required to respond, including money, manpower, and/or equipment. For after-hours response, the Hanford Patrol Operations Center (POC)/Hanford Emergency Operations Center (EOC) Shift Office maintains a weekly on-call directory of the Hanford Site BEDs/BWs. When notified, the POC/EOC Shift Office will contact the on-call CSA BED/BW to respond to the scene in person, as necessary.

The CSB facility ERO is responsible for implementing emergency response actions at the CSA.

3.1 Building Emergency Director

Emergency response will be directed by the BED/BW until the IC arrives. The BED/BW, supported by facility/building ERO personnel, fulfills the role and meets the requirements of the "Emergency Coordinator" as defined in WAC 173-303-201 (for dangerous waste generator activities) and WAC 173-303-360 (for permitted TSD facilities). During events, CSA **personnel perform response duties under the direction of the BED/BW. The senior responding Hanford Fire Department official will be the IC. If the event is determined to primarily be a security event, the Hanford Fire Department and Hanford Patrol will operate under a unified command system with Hanford Patrol making decisions pertaining to security. These individuals have the authority to request and obtain any resources necessary for protecting people and the environment.**

The BED/BW becomes a member of the Incident Command Organization and functions under the direction of the IC. In this role, the BED/BW continues to manage and direct CSA **operations.**

The BED/BW is on the premises or is available through an "on-call" list 24 hours a day. **The on-call BED/BW's home telephone number is available from the POC in accordance with Permit Condition II.A.4.**

As necessary, the BED/BW will make the Operational Emergency categorization/classification decision and also determine if the event is subject to the requirements of WAC 173-303-201(14)(d) or WAC 173-303-360(2)(d) prior to responding to the scene.

3.2 Other Members

At a minimum, Facility Management appoints and ensures training is provided to individuals to perform as Personnel Accountability Aides and Staging Area Managers. The Personnel Accountability Aides are responsible for facilitating the implementation of protective actions (evacuation or take cover) and for facilitating the accountability of personnel after the protective actions have been implemented. Staging Area Managers are responsible for coordinating and conducting activities at the staging area. In addition, the BED/BW can identify additional support personnel (radiological control, maintenance, engineering, hazardous material coordinators, etc.) to be part of the facility/building ERO.

The BED/BW will notify other facility/building ERO to support the on-scene response. During upset conditions requiring the response from the facility/building ERO, Patrol Operations and the Hanford Emergency Operations Center Shift Office notify the on-call BED/BW.

The complete Facility/Building ERO listing of positions, names of ERO members, work locations, and telephone numbers for the CSA **is maintained in a separate location in a format determined appropriate by** CSA **management. Copies are distributed to appropriate** CSA **locations and maintained by** the Permittee**.**

4.0 IMPLEMENTATION OF THE PLAN

The BED/BW must assess each incident to determine the response necessary to protect the personnel, facility, and the environment. If assistance from the Hanford Patrol or the Hanford Fire Department is required, the Hanford Emergency Response Number (911 or 509-373-0911 if using a cell phone) must be used to contact the POC and request the desired assistance.

In accordance with WAC 173-303-201(14)(b) or WAC 173-303-360(2)(b), whenever there is a release, fire, or explosion, the BED/BW ensures that personnel identify the character, source, amount, and a real extent of any released materials. Identification can be made by activities that can include, but are not limited to, visual inspection of casks, **sampling activities in the field, reference to inventory records, or by consulting with facility personnel.**

Samples of materials involved in an emergency might be taken and analyzed as appropriate. These activities must be performed with a sense of immediacy and shall include available information.

The BED/BW shall use the following steps to determine if an emergency circumstance is subject to the contingency plan implementation and notification requirements of WAC 173-303-201 or WAC 173-303-350 and WAC 173-303-360:

1. **The event involved an unplanned spill, release, fire, or explosion.**

AND

2. a. **The unplanned spill or release involved a dangerous waste, or the material involved became a dangerous waste as a result of the event (e.g., product that is not recoverable for reuse without processing).**

OR

2. **b. The unplanned fire or explosion occurred at a facility or transportation activity subject to RCRA contingency planning requirements.**

AND

3. **A threat to human health or the environment exists.**

Additional guidance to assist the BED/BW in determining the applicability of the requirements is maintained in DOE-0223, *DOE-RL Emergency Plan Implementing Procedures* (RLEPs). This guidance is derived from Washington State Department of Ecology Dangerous Waste Permit application guidelines for implementation of the contingency plan and notifications to Washington State Department of Ecology (Ecology). Contractor environmental single points-of-contact are also available to assist the BED/BW in determining the applicability of requirements.

If assessment of an event does not allow a definitive determination of the threat to human health and the environment, then the BED/BW shall continue to implement the emergency procedures for the event, and through that process continue the assessment of the event.

If the BED/BW determines that the event response requires contingency plan implementation, the BED/BW must complete/verify notifications to management/environmental compliance **in accordance with WAC 173-303-201(14)(d) or WAC 173-303-360(2).**

The following information must be included in the assessment report:

- **The name and telephone number of reporter**
- **The name and address of facility**
- **The time and type of incident (e.g., release, fire)**
- **The name and quantity of material(s) involved, to the extent known**
- **The extent of injuries, if any**
- **The possible hazards to human health or the environment outside the facility**

5.0 FACILITY HAZARDS

Hazards at the CSA potentially include industrial hazards, hazardous materials, and physical hazards. During pre-active life, dangerous/mixed waste will not yet be managed at the TSD unit. Until active life begins, this plan would be limited to response to hazardous materials/waste incident associated with generator activities.

5.1 Hazardous Materials

Hazardous materials handled during pre-active life might include (but may not be limited to) the following: spray adhesive, sorbent, diesel fuel, hydraulic oil, propane, road salt, industrial cleaner and

degreaser, and unleaded gasoline. A total list of materials will not be available until CSA begins active life. The use, storage, and inventory of hazardous materials will be controlled. Hazardous material inventories and safety data sheets will be maintained electronically using current Hanford Site databases.

5.2 Industrial Hazards

Industrial hazards could include transportation incidents, moving equipment accidents, subsidence (cave-ins), and exposure to spilled hazardous materials (Section 5.1). Potential material handling mishaps are associated with cask movement.

5.3 Dangerous/Mixed Waste

The dangerous/mixed waste at the CSA will consist of CSSs containing cesium or strontium capsules. The CSSs are closed environments, and due to important design features incorporated into the CSS, are robust enough not to release dangerous/mixed waste material. The CSB will be responsible for the CSA.

5.4 Radioactive Materials

The radioactive material at the CSA consists of cesium or strontium capsules in the CSSs. There will be a maximum of 132 capsules in a CSS (up to 6 capsules per UCS, 2 UCSs per TSC Basket cell, and 11 cells per TSC Basket). A total of 1,936 capsules will be stored at the CSA and it is expected that approximately 25 CSSs will be used.

5.5 Criticality

Not Applicable.

6.0 POTENTIAL EMERGENCY CONDITIONS

Potential emergency conditions, under both WAC 173-303 and DOE requirements, fall into three basic categories: (1) operations (process upsets, fires, explosions, loss of utilities, spills, and releases); (2) natural phenomena (e.g., earthquakes); and (3) security contingencies (e.g., bomb threat, hostage situation). The following are conditions that may lead to an emergency at the CSA.

6.1 Facility Operations Emergencies

6.1.1 Loss of Utilities

A loss of utilities could include the loss of electricity. Electrical power is required for the CSA; however, loss of electricity does not constitute an emergency, but must be restored as soon as possible.

Loss of Water – Not Applicable.

Loss of Ventilation – Not Applicable.

Loss of Steam – Not Applicable.

Loss of Air – Not Applicable.

6.1.2 Major Process Disruption/Loss of Plant Control

Not applicable.

6.1.3 Pressure Release

Not applicable.

6.1.4 Fire and/or Explosion

Potential fire hazards include smoke inhalation, burns, damage to equipment and/or structures. Fires in the vicinity of the CSA could engulf one or more casks. Based on scenario results of a potential fire, the fire will not exceed the design of the containment barriers of the cask, and will not result in a release of mixed waste.

6.1.5 Hazardous Material Spill

Hazards associated with spills include potential exposure to radioactive, toxic, dangerous, and corrosive material, as well as environmental damage.

6.1.6 Dangerous/Mixed Waste Spill

A failed capsule could present a hazard to operations personnel; however, due to design features incorporated into the CSS, the design is robust enough not to release dangerous/mixed waste material.

6.1.7 Transportation and/or Packaging Incidents

The only shipments to the CSA will be from WESF.

6.1.8 Radioactive Material Release

Due to important design features identified for the CSS, there will be very little to no potential for radioactive material to be released from the CSA. However, work activities having a potential for the spread of radioactive contamination are monitored for radiological conditions during the performance of the work. Responses to a release of radiological materials are performed in accordance with working level procedures.

6.1.9 Criticality

Not applicable.

6.2 Natural Phenomena

Natural phenomena are discussed in the following sections.

6.2.1 Seismic Event

Depending on the magnitude of the event, severe structural damage can occur resulting in serious injuries or fatalities and the release of hazardous materials to the environment. Damaged electrical circuits and wiring could result in the initiation of fires.

6.2.2 Volcanic Eruption/Ash Fall

Though not expected to cause structural damage, the ash resulting from a volcanic eruption could cause shorts in electrical equipment and plug the passive ventilation system.

6.2.3 High Winds/Tornadoes

While highly unlikely, high winds or tornadoes could cause structural damage to systems containing hazardous materials resulting in a release of the materials to the environment.

6.2.4 Flood

Not applicable.

6.2.5 Range Fire

The hazards associated with a range fire are the same as those associated with a fire/explosion (Section 6.1.4) plus potential site access restrictions and travel hazards such as poor visibility.

6.2.6 Aircraft Crash

In addition to the potential for serious injuries or fatalities, an aircraft crash could result in the direct release of hazardous materials to the environment or cause a fire.

6.3 Security Contingencies

Security contingencies are discussed in the following sections.

6.3.1 Bomb Threat/Explosive Device

A bomb threat may be received by anyone who answers the telephone or receives mail. In the event of a bomb threat, CSA personnel will evacuate the area. If an explosive device detonates, the effects could result in the direct release of hazardous materials to the environment.

6.3.2 Hostage Situation/Armed Intruder

A hostage situation or the entry of an armed hostile intruder(s) can pose an emergency if either of these conditions has the potential to adversely affect facility operations.

6.3.3 Suspicious Object

If a suspicious object is discovered, the CSA personnel will evacuate the area.

6.4 Unexpected/Unidentified Odors

Unexpected or unidentified odors have the potential to cause health effects and could be indicative of other events.

7.0 INCIDENT RESPONSE

The initial response to any emergency is to immediately protect the health and safety of persons in the affected area. Identification of released material is essential to determine appropriate protective actions. Containment, treatment, and disposal assessment are secondary responses.

The following sections describe the process for implementing basic protective actions as well as descriptions of response actions for the events listed in Section 6.0 of this plan. In addition, a section addressing prevention of secondary release, fires, or explosions is provided. Attachment A provides a list of applicable procedures.

7.1 Protective Action Responses

Protective action responses are discussed in the following sections. The steps identified in the following description of actions do not have to be performed in sequence because of the unanticipated sequence of incident events.

In addition to the facility protective actions described below, the BED/BW also reviews the sitewide and CSA **emergency response procedure(s) for categorization and/or classification of the event and if necessary, initiates area protective actions and Hanford Site ERO activation. Operational Emergency categorization and/or classification is reported to the Hanford Emergency Operations Center (EOC), triggering notification to offsite officials that includes planned recommendations for protective actions if needed. Hanford EOC staff are responsible to coordinate protective action recommendations with offsite officials.**

7.1.1 Evacuation Plan

- Halt any maintenance or work and place equipment and structures in a safe condition. Use emergency shutdown procedures for rapid evacuation, as applicable.

- Use whatever means are available (portable radios, bullhorns, runners, etc.) to pass the evacuation information to personnel.

- Evacuate personnel to the staging area (Figure 1) and group personnel as follows: PPE clothing-clad personnel, persons with keys to immediately available government or personal vehicles, and all others. Assist personnel with special needs.

- Conduct personnel accountability. If unable to account for personnel, report personnel accountability results to the BED/BW.

- Inform IC of any potentially affected personnel (i.e., injured, contaminated, exposed) once the IC arrives at the ICP.

- Relay pertinent evacuation information (routes, destination, etc.) to drivers.
- Dispatch vehicles as soon as the vehicles are loaded, providing safe routes of travel (Figure 2).
- Report status to the Hanford EOC, request additional transportation if required, and report if any personnel remain who are performing shutdown duties.

7.1.2 Take Cover

When the Take Cover Alarm (wavering siren) is activated, personnel shall take cover in the nearest building or trailer. The BED/BW shall notify the POC upon activation of the emergency siren system.

The following actions should be taken or considered in a Take Cover:

- Shut doors and windows and wait for further instructions.
- Secure ventilation and unnecessary electronic or electrical equipment, if possible.
- Follow normal exit procedures from radiological areas (in preparation for a possible evacuation).
- Potentially exposed personnel should be reported to the BED/BW to ensure they receive appropriate follow-up evaluation.

7.2 Response to Facility Operations Emergencies

Depending on the severity of the event, the BED/BW reviews the sitewide and CSA emergency response procedure(s) and, as required, categorizes and/or classifies the event. If necessary, the BED/BW initiates area protective actions and Hanford Site ERO activation. Attachment A provides a list of procedures.

The steps identified in the following description of actions do not have to be performed in sequence because of the unanticipated sequence of incident events.

7.2.1 Loss of Utilities

A case-by-case evaluation is required for each event to determine loss of utility impacts. When a BED/BW determines a loss of utility impact, actions are taken to ensure dangerous and/or mixed waste is being properly managed, to the extent possible given event circumstances. As necessary, the BED/BW will stop operations and take appropriate actions until the utility is restored.

A loss of utilities could include the loss of electricity.

Electrical power is required for the CSA; however, loss of electricity does not constitute an emergency, but must be restored as soon as possible.

Loss of Water – Not Applicable.

Loss of Ventilation – Not Applicable.

Loss of Steam – Not Applicable.

Loss of Air – Not Applicable.

7.2.2 Major Process Disruption/Loss of Plant Control

Not applicable.

7.2.3 Pressure Release

Not applicable.

7.2.4 Fire and/or Explosion

In the event of a fire, the discoverer calls 911 (509-373-0911 if using a cell phone) or verifies that 911 has been called.

- Unless otherwise instructed, personnel shall evacuate the area by the nearest safe exit and proceed to the designated staging area for accountability.
- ONLY if time permits, personnel should shut down equipment and secure waste, as applicable.
- The BED/BW establishes the initial command post, obtains all necessary information pertaining to the incident and sends a representative to meet the Hanford Fire Department.
- The BED/BW provides a formal turnover to the IC when the IC arrives at the initial command post.
- The BED/BW informs the Hanford Site ERO as to the extent of the emergency (including estimates of dangerous waste and mixed waste quantities released to the environment).
- If operations are stopped in response to the fire, the BED/BW ensures that systems are monitored for temperature.
- Hanford Fire Department firefighters extinguish the fire as necessary.

7.2.5 Hazardous Material, Dangerous, and/or Mixed Waste Spill

Spills can result from many sources including process leaks, container spills or leaks, damaged packages or shipments, or personnel error. Spills of mixed waste are complicated by the need to deal with the extra hazards posed by the presence of radioactive materials.

The discoverer notifies the BED/BW and initiates SWIM response:

- **<u>S</u>tops work.**
- **<u>W</u>arns others in the vicinity.**

- **Isolates the area.**

- **Minimizes exposure to the hazards.**

- The BED/BW determines if emergency conditions exist requiring response from the Hanford Fire Department based on classification of the spill and injured personnel, and evaluates the need to perform additional protective actions.

- If the Hanford Fire Department resources are not needed, the spill is mitigated with resources identified in Section 9.0 of this plan and proper notifications are made.

- If the Hanford Fire Department resources are needed, the BED/BW calls 911 (509-373-0911 if using a cell phone).

- The BED/BW sends a representative to meet the Hanford Fire Department.

- The BED/BW provides a formal turnover to the IC when the IC arrives at the ICP.

- The BED/BW informs the Hanford Site ERO as to the extent of the emergency (including estimates of dangerous waste and mixed waste quantities released to the environment).

- If operations are stopped in response to the spill, the BED/BW ensures that systems are monitored for leaks, pressure buildup, gas generation, and ruptures if applicable.

- Hanford Fire Department stabilizes the spill.

7.2.5.1 Damaged or Unacceptable Shipments

During the course of receiving dangerous and/or mixed waste at CSA**, an unanticipated event could be discovered resulting in a conformance issue concerning the waste. Damaged or unacceptable shipments resulting from onsite transfers are not subject to WAC 173-303-370; however, conformance issues must be resolved in order to maintain proper records.**

Regardless of whether the waste is received as an off-site shipment or onsite transfer, the following actions are taken:

- **Operations management is notified of the damaged or unacceptable waste to be received.**

- **If the conformance issue results in a spill or release, actions described in Section 7.2.5 are taken.**

- **The generating organization is notified of the conformance issue.**

- **An operations representative, in conjunction with the generating organization, determines the course of action to resolve the conformance issue.**

7.2.6 Radioactive Material Release

Section 7.2.5 addresses the actions for a radiological material release.

7.2.7 Criticality

Not applicable.

7.3 Response to Natural Phenomena

The steps identified in the following description of actions do not have to be performed in sequence because of the unanticipated sequence of incident events.

7.3.1 Seismic Event

The Hanford Site ERO's primary role in a seismic event is coordinating the initial response to injuries, fires, fire hazards, and acting to contain or control radioactive, and/or hazardous material releases.

Individuals should remain calm and stay away from windows, steam lines, and hazardous material storage locations. Once the shaking has subsided, individuals should evacuate carefully and assist personnel needing help. The location of any trapped individuals should be reported to the BED/BW or is reported to 911 (509-373-0911 if using a cell phone).

The BED/BW takes whatever actions are necessary to minimize damage and personnel injuries. Responsibilities include the following:

- Coordinating searches for personnel and potential hazardous conditions (e.g., fires, spills).
- Conducting accountability.
- Securing utilities and facility operations.
- Arranging rescue efforts and notifying 911 (509-373-0911 if using a cell phone) for assistance.
- Determining if hazardous materials were released.
- Determining current local meteorological conditions.
- Warning other facilities and implementing protective actions if release of hazardous materials poses an immediate danger.
- Providing personnel and resource assistance to other facilities, if required and possible.

7.3.2 Volcanic Eruption/Ashfall

In the event of ash-fall, the BED will coordinate efforts to remove accumulating ash around intake vents.

If other emergency conditions arise as a result of the ashfall (e.g., fires due to electrical shorts), response is as described in other sections of this plan.

7.3.3 High Winds/Tornadoes

Upon notification of impending high winds, the BED/BW takes steps necessary to secure all outdoor waste and hazardous material containers and storage locations.

7.3.4 Flood

Not applicable.

7.3.5 Range Fire

Responses to range fires are handled by preventive measures (e.g., keeping hazardous material and waste accumulation areas free of combustible materials such as weeds and brush). If a range fire breaches the CSA boundary, the response is as described in Section 7.2.4.

7.3.6 Aircraft Crash

The response to an aircraft crash is the same as for a fire and/or explosion (Section 7.2.4).

7.4 Security Contingencies

The steps identified in the following description of actions do not have to be performed in sequence because of the unanticipated sequence of incident events. Attachment A provides a list of procedures.

7.4.1 Bomb Threat/Explosive Device

7.4.1.1 Telephone Threat

Individuals receiving telephoned threats attempt to get as much information as possible from the caller (using the bomb threat checklist if available). Upon conclusion of the call, or during the call if possible, notify the BED/BW and Hanford Patrol by calling 911 (do not use wireless communications devices for reporting a bomb threat/explosive device unless beyond 30 m (100 ft) from the suspected object).

When notified, the BED/BW ensures the CSA protective actions have been taken and questions personnel at the staging area regarding any suspicious objects. When Hanford Patrol personnel arrive, follow their instructions.

7.4.1.2 Written Threat

Receivers of written threats handle the letter as little as possible. Notify the BED/BW and Hanford Patrol by calling 911 (do not use wireless communications devices for reporting a bomb threat/explosive device unless beyond 30 m (100 ft) from the suspected object). Depending on the content of the letter, the BED/BW might evacuate the affected locations. The letter is turned over to Hanford Patrol and their instructions are followed.

7.4.2 Hostage Situation/Armed Intruder

The discoverer of a hostage situation or armed intruder reports the incident to 911 (509-373-0911 if using a cell phone) and to the BED/BW if possible. Hanford Patrol will determine the remaining response actions.

7.4.3 Suspicious Object

The discoverer of a suspicious object reports this object to the BED/BW and to 911 (do not use wireless communications devices for reporting a bomb threat/explosive device unless beyond 30 m (100 ft) from the suspected object), if possible, and ensures that the object is not disturbed.

7.5 Response to Unexpected/Unidentified Odors

Unexpected and unidentified odors should be investigated by the facility or project safety and health personnel. If the odor can be traced to an identifiable source and controlled safely with local resources, it can be resolved at the facility level. Air monitoring may aid in identification of a source and help determine if the odor is indicative of a health threat or is merely a nuisance. If facility or project safety and health personnel concur that the odor may be indicative of a health threat and cannot be safely controlled with local resources or an odor is found to be the result of an action or condition that requires emergency response, the Hanford Fire Department would be notified and respond accordingly.

7.6 Prevention of Recurrence or Spread of Fires, Explosions, or Releases

The BED/BW, as part of the Incident Command Organization, takes the steps necessary to ensure that a secondary release, fire, or explosion does not occur. The BED/BW will take measures, where applicable, to stop processes and operations; collect and contain released wastes and remove or isolate containers. The BED/BW shall also monitor for leaks, pressure buildups, gas generation, or ruptures in valves, pipes or other equipment, whenever this is appropriate.

8.0 TERMINATION OF EVENT, INCIDENT RECOVERY, AND RESTART OF OPERATIONS

DOE/RL-94-02, Section 9.0, describes actions for event termination, incident recovery, restart of operations, and incompatible waste.

8.1 Termination of Event

For events where the Hanford EOC is activated, the Site Emergency Director has the authority to declare event termination. This decision is based on input from the BED/BW, IC, and other ERO members. For events where the Hanford EOC is not activated, the IC and staff will declare event termination.

8.2 Incident Recovery and Restart of Operations

Immediately after an emergency, the BED/BW must provide for treating, storing, or disposing of recovered waste, contaminated soil, or surface water, or any other material that results from a

release, fire, or explosion at CSA**. A recovery plan is developed when necessary in accordance with DOE/RL-94-02, Section 9.2.**
If this plan was implemented according to Section 4.0 of this plan, Ecology is notified that the CSA **is in compliance with cleanup activities, as described in DOE/RL-94-02, Section 5.1.2.2, before operations can resume.**

8.2.1 Incompatible Waste

After an event, the BED/BW or the onsite recovery organization ensures that no waste that might be incompatible with the released material is treated, stored, and/or disposed of until cleanup is completed. Clean-up actions are taken by CSA **personnel or other assigned personnel. DOE/RL-94-02, Section 9.2.3, describes actions to be taken.**

Waste from cleanup activities is designated and managed as newly generated waste. A field check for compatibility is performed before storage, as necessary. Incompatible wastes are not placed in the same container. Containers of waste are placed in approved storage areas appropriate for their compatibility class.

If incompatibility of waste was a factor in the incident, the BED/BW or the onsite recovery organization ensures that the cause is corrected.

8.2.2 Post Emergency Equipment Maintenance and Decontamination

All equipment used during an incident is decontaminated (if practicable) or disposed of as spill debris. Decontaminated equipment is checked for proper operation before storage for subsequent use. Consumable and disposed materials are restocked.

The BED/BW ensures that all equipment is cleaned and fit for its intended use before operations are resumed. Protective clothing is cleaned or disposed of, and restocked, etc.

9.0 EMERGENCY EQUIPMENT

Emergency resources and equipment for the CSA **are presented in this section. Emergency equipment must be tested and maintained to assure its proper operation in time of emergency.**

Sufficient space is maintained on the CSA pad to allow access of personnel and equipment responding to fires, spills, or other emergencies. Unobstructed fire lanes run from the main entrance to allow emergency vehicle access to the main entrance and the nearby fire hydrant. The interior space is designed to allow access by emergency response personnel while maintaining barriers to contain releases of gaseous or liquid waste and hazardous substances as defined in WAC 173-303-040 and WAC 173-303-201.

9.1 Fixed Emergency Equipment

Not applicable. There is no fixed emergency equipment.

9.2 Portable Emergency Equipment

Not Applicable. There is no portable emergency equipment.

9.3 Communications Equipment/Warning Systems

Whenever dangerous waste is being poured, mixed, spread, or otherwise handled, or if there is ever just a single employee on the premises while the facility is operating, the employee or employees involved must have immediate access to emergency communications **capable of summoning emergency assistance.**

COMMUNICATIONS EQUIPMENT		
TYPE	**LOCATION**	**CAPABILITY**
PAX System	North of CIS	Internal Communications
Temperature Monitoring System	Each individual Cask	Warning beacon to alert for a rise in temperature
Two way radios	Key Personnel	Internal Communications

NOTE: ***Sitewide communications and warning systems are identified in DOE/RL-94-02, Section 5.2.5.***

9.4 Personal Protective Equipment

PERSONAL PROTECTIVE EQUIPMENT		
TYPE	**LOCATION**	**CAPABILITY**
Protective Clothing	WESF	Personnel Contamination Protection
Respirators	WESF	Airborne Contamination Protection

9.5 Spill Control and Containment Supplies

Not applicable.

9.6 Incident Command Post

The IC determines the location of the ICP based on the event and may use the Hanford Fire Department Mobile Command Unit if necessary. 272HV is the primary location of the initial command post. Emergency resource materials are stored at various locations to support emergencies. Additional resources are available at other facilities.

10.0 COORDINATION AGREEMENTS

RL has established a number of coordination agreements or memoranda of understanding (MOU) with various agencies to ensure proper response resource availability for incidents involving the

Hanford Site. A description of the agreements is contained in DOE/RL-94-02, Section 3.0, Table 3-1.

11.0 REQUIRED REPORTS

Post incident written reports are required for certain incidents on the Hanford Site. The reports are described in DOE/RL-94-02, Section 5.1.2.2.

Facility management must note in the TSD-unit operating record, the time, date and details of any incident that requires implementation of the contingency plan (refer to Section 4.0 of this plan). Within 15 days after the incident, a written report must be submitted to Ecology. The report must include the elements specified in WAC 173-303-201(14)(k) or WAC 173-303-360(2)(k).

12.0 PLAN LOCATION AND AMENDMENTS

Copies of this plan are maintained at the following locations:

272HV is the initial command post and the Hanford Emergency Operations Center.

This plan will be reviewed and immediately amended as necessary, in accordance with DOE/RL-94-02, Section 14.3.1.1.

13.0 REFERENCES

DOE/RL-94-02, *Hanford Emergency Management Plan*.

Washington Administrative Code 173-303, *Washington State Dangerous Waste Regulations*, Washington State Department of Ecology, Olympia, Washington.

***Hanford Facility Resource Conservation and Recovery Act Permit for the Treatment, Storage, and Disposal of Dangerous Waste*, Permit Number WA7890008967, Washington State Department of Ecology, Olympia, Washington.**

ATTACHMENT A

Listing of Procedures

U.S. Department of Energy Richland Operations Office DOE-0223, *Emergency Plan Implementing Procedures*, RLEP 1.0, *Recognizing and Classifying Emergencies*, Appendix 1-X.X (*Facility Emergency Action Level Table). The EALs have not been created.*

U.S. Department of Energy Richland Operations Office DOE-0223, *Emergency Plan Implementing Procedures*, RLEP 1.1, *Hanford Incident Command System and Event Recognition and Classification.*

U.S. Department of Energy Richland Operations Office DOE-0223, *Emergency Plan Implementing Procedures*, RLEP 3.24, *Notification, Reporting, and Processing of Operations Information.*

U.S. Department of Energy Richland Operations Office DOE-0223, *Emergency Plan Implementing Procedures*, RLEP 3.4, *Emergency Termination, Reentry, and Recovery.*

Figure 1 – CSA Primary and Alternate Staging Area

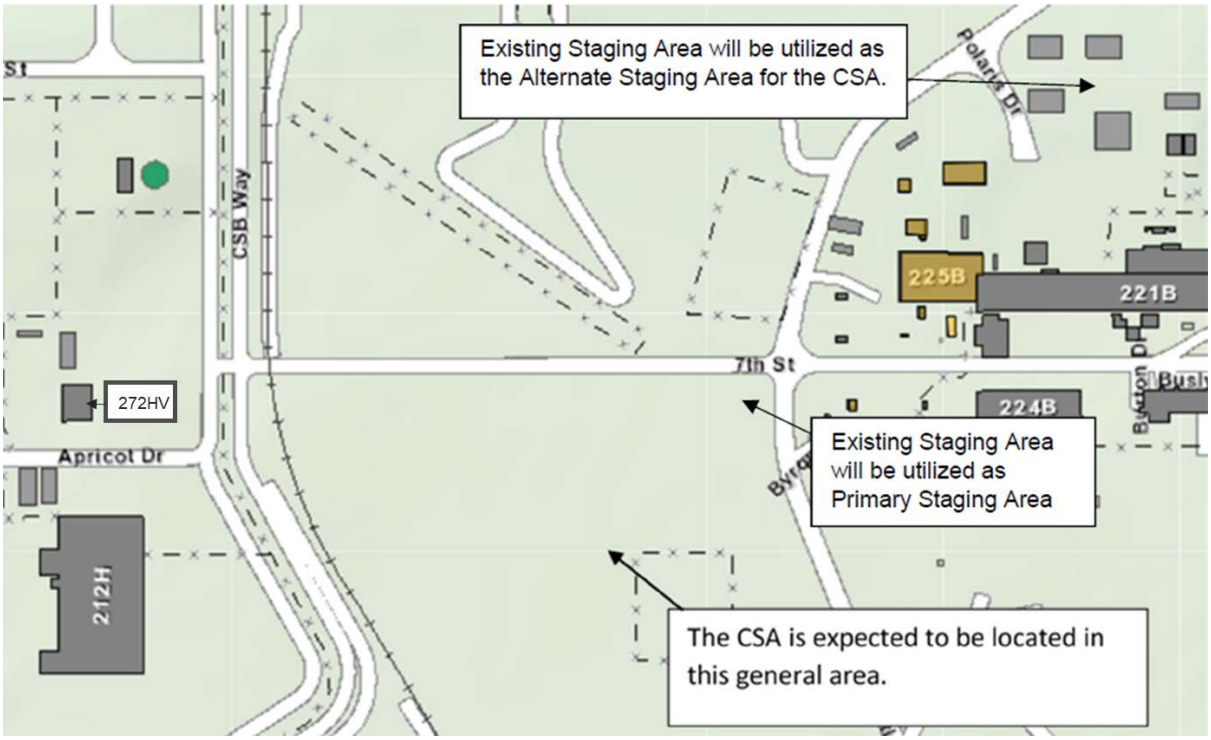
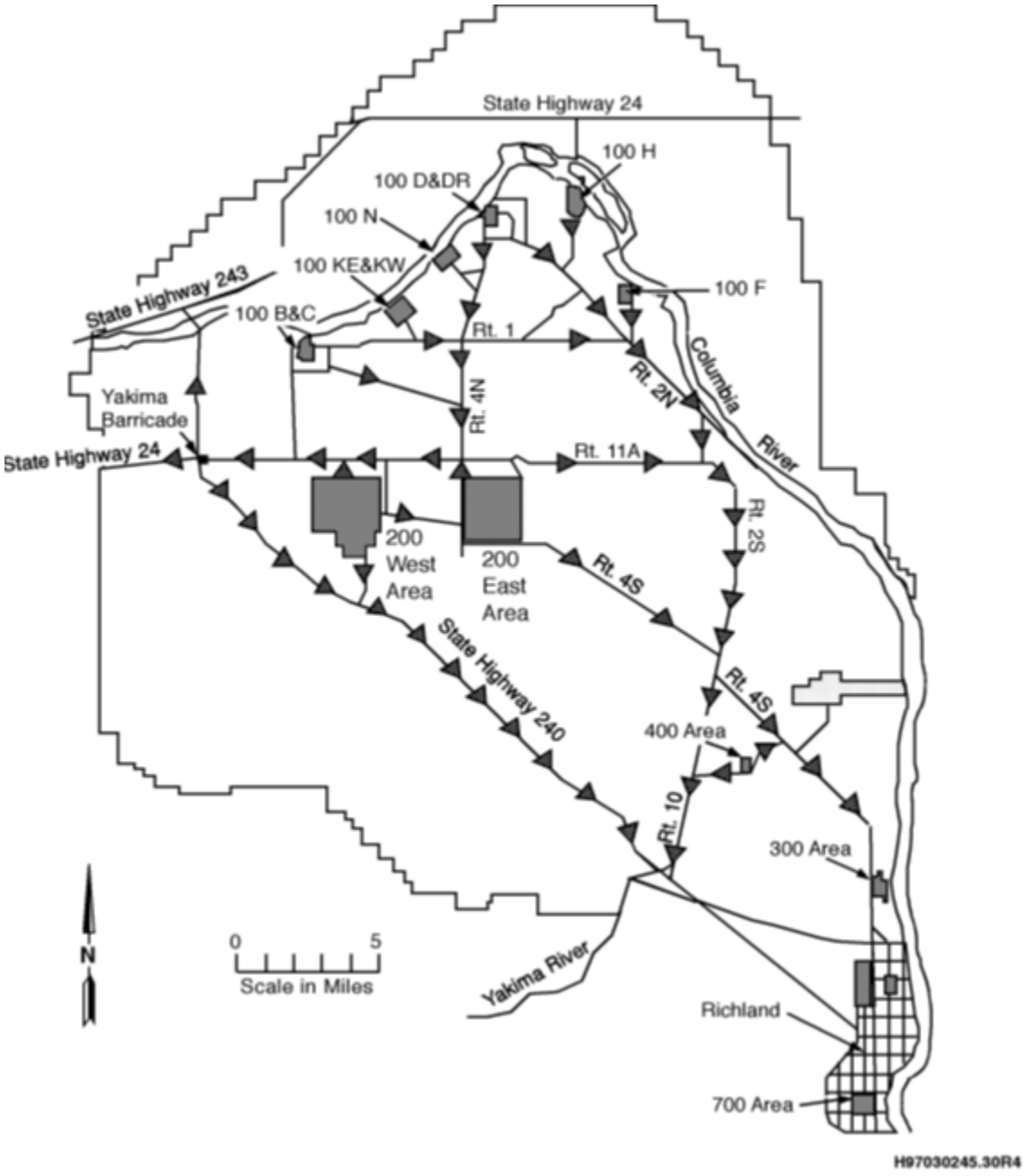


Figure 2 – Hanford Site Evacuation Map



ATTACHMENT B

RCRA APPLICABILITY MATRIX FOR THE TSD ACTIVITIES

REQUIREMENT SOURCE	REQUIREMENT DESCRIPTION	SITE LEVEL (How/Where Met)	UNIT LEVEL (How/Where Met)
WAC 173-303-340	Preparedness and prevention. Facilities must be designed, constructed, maintained, and operated to minimize the possibility of fire, explosion, or any unplanned sudden or nonsudden release of dangerous waste or dangerous waste constituents to air, soil, or surface or ground water, which could threaten the public health or the environment. This Section describes preparations and preventive measures, which help avoid or mitigate such situations.	Introductory statement of requirement – requirements are in sections below.	Introductory statement of requirement – requirements are in sections below.
WAC 173-303-340(1)	Required equipment. All facilities must be equipped with the following, unless it can be demonstrated to the department that none of the hazards posed by waste handled at the facility could require a particular kind of equipment specified below:	Introductory statement of requirement – requirements are in sections below.	Introductory statement of requirement – requirements are in sections below.
WAC 173-303-340(1)(a)	(a) An internal communications or alarm system capable of providing immediate emergency instruction to facility personnel;	DOE/RL-94-02, Section 5.2.5	*BEP Section 9.3*
WAC 173-303-340(1)(b)	(b) A device, such as a telephone or a hand-held, two-way radio, capable of summoning emergency assistance from local police departments, fire departments, or state or local emergency response teams;	DOE/RL-94-02, Section 5.2.12	*BEP Section 9.3* Units summon assistance by calling the Hanford Patrol emergency number. No offsite assistance is requested by the unit itself.
WAC 173-303-340(1)(c)	(c) Portable fire extinguishers, fire control equipment (including special extinguishing equipment, such as that using foam, inert gas, or dry chemicals), spill control equipment, and decontamination equipment; and	DOE/RL-94-02, Sections 11.2.2, 11.2.3, 11.2.4, 11.2.8 and Appendix C	*BEP Sections 9.1, 9.2, and 9.5*
WAC 173-303-340(1)(d)	(d) Water at adequate volume and pressure to supply water hose streams, foam producing equipment, automatic sprinklers, or water spray systems.	DOE/RL-94-02, Sections 11.2.2 and 11.2.8	*BEP Section 9.1*

REQUIREMENT SOURCE	REQUIREMENT DESCRIPTION	SITE LEVEL (How/Where Met)	UNIT LEVEL (How/Where Met)
WAC 173-303-340(1)(end)	All facility communications or alarm systems, fire protection equipment, spill control equipment, and decontamination equipment, where required, must be tested and maintained as necessary to assure its proper operation in time of emergency.	DOE/RL-94-02, Sections 11.2, 11.2.8, and 11.3	*BEP Section 9.0*
WAC 173-303-340(2)	Access to communications or alarms. Personnel must have immediate access to the signaling devices described in the situations below:	Introductory statement of requirement – requirements are in sections below.	Introductory statement of requirement – requirements are in sections below.
WAC 173-303-340(2)(a)	(a) Whenever dangerous waste is being poured, mixed, spread, or otherwise handled, all personnel involved must have immediate access to an internal alarm or emergency communication device, either directly or through visual or voice contact with another employee, unless such a device is not required in subsection (1) of this Section;	DOE/RL-94-02, Section 5.2.12	*BEP Section 9.3*
WAC 173-303-340(2)(b)	(b) If there is ever just one employee on the premises while the facility is operating, he must have immediate access to a device, such as a telephone or a hand-held, two-way radio, capable of summoning external emergency assistance, unless such a device is not required in subsection (1) of this Section.	DOE/RL-94-02, Section 5.2.12	*BEP Section 9.3*
WAC 173-303-340(3)	Aisle space. The owner or operator must maintain aisle space to allow the unobstructed movement of personnel. Fire protection equipment, spill control equipment, and decontamination equipment to any area of facility operation in an emergency, unless it can be demonstrated to the department that aisle space is not needed for any of these purposes.	Requirement is met at the unit level.	Parts III, V, and VI of the Hanford Facility Dangerous Waste Permit (WA7890008967) include description of how each unit meets this requirement. For 90-day areas, *BEP Section 9.0*

REQUIREMENT SOURCE	REQUIREMENT DESCRIPTION	SITE LEVEL (How/Where Met)	UNIT LEVEL (How/Where Met)
WAC 173-303-340(4)	Arrangements with local authorities. The owner or operator must attempt to make the following arrangements, as appropriate for the type of waste handled at his facility and the potential need for the services of these organizations, unless the hazards posed by wastes handled at the facility would not require these arrangements:	Introductory statement of requirement – requirements are in sections below.	Requirement is met at the site level.
WAC 173-303-340(4)(a)	(a) Arrangements to familiarize police, fire departments, and emergency response teams with the layout of the facility, properties of dangerous waste handled at the facility and associated hazards, places where facility personnel would normally be working, entrances to roads inside the facility, and possible evacuation routes;	The arrangements agreed to by local police, fire departments emergency response teams to coordinate emergency services are located in DOE/RL-94-02, Sections 3.4, 3.4.1.1, 3.4.1.2, 3.7, and Table 3-1.	Requirement is met at the site level.
WAC 173-303-340(4)(b)	(b) Arrangements to familiarize local hospitals with the properties of dangerous waste handled at the facility and the types of injuries or illnesses which could result from fires, explosions, or releases at the facility;	The arrangements agreed to by local hospitals to coordinate emergency services are located in DOE/RL-94-02, Sections 3.4.1.3, 3.7, and Table 3-1.	Requirement is met at the site level.
WAC 173-303-340(4)(c)	(c) Agreements with state emergency response teams, emergency response contractors, and equipment suppliers; and	The arrangements agreed to by state emergency response teams to coordinate emergency services are located in DOE/RL-94-02, Sections 3.3.1, 3.3.2, 3.7, and Table 3-1.	Requirement is met at the site level.
WAC 173-303-340(4)(d)	(d) Where more than one party might respond to an emergency, agreements designating primary emergency authority and agreements with any others to provide support to the primary emergency authority.	Discussed in the Tri-County Mutual Aid Agreement Memorandum of Understanding (MOU) and Mutual Law Enforcement Assistance MOUs. DOE/RL-94-02, Section 3.7, and Table 3-1.	Requirement is met at the site level.
WAC 173-303-340(5)	Where state or local authorities decline to enter into such agreements, the owner, or operator must document the refusal in the operating record.	If authorities decline, the documentation will be maintained in the Hanford Facility Operating Record.	Requirement is met at the site level.

REQUIREMENT SOURCE	REQUIREMENT DESCRIPTION	SITE LEVEL (How/Where Met)	UNIT LEVEL (How/Where Met)
WAC 173-303-350(1)	Purpose. The purpose of this Section and WAC 173-303-360 is to lessen the potential impact on the public health and the environment in the event of an emergency circumstance, including a fire, explosion, or unplanned sudden or nonsudden release of dangerous waste or dangerous waste constituents to air, soil, surface water, or ground water by a facility. A contingency plan must be developed to lessen the potential impacts of such emergency circumstances, and the plan must be implemented immediately in such emergency circumstances.	DOE/RL-94-02, Sections 1.1 and 1.2	*BEP Section 1.0.* Identified sections of the BEP/FRP are part of the contingency plan.
WAC 173-303-350(2)	(2) Contingency plan. Each owner or operator must have a contingency plan at his facility for use in emergencies or sudden or nonsudden releases which threaten human health and the environment. If the owner or operator has already prepared a spill prevention control and countermeasures (SPCC) plan in accordance with Part 112 of Title 40 C.F.R. or Part 1510 of chapter V, or some other emergency or contingency plan, they need only amend that plan to incorporate dangerous waste management provisions that are sufficient to comply with the requirements of this section and WAC 173-303-360. The owner or operator may develop one contingency plan that meets all regulatory requirements. Ecology recommends that the plan be based on the National Response Team's Integrated Contingency Plan Guidance ("One Plan") as found at www.nrt.org. When modifications are made to nondangerous waste (non-Hazardous Waste Management Act or nondangerous waste regulation) provisions in an integrated contingency plan, the changes do not trigger the need for a dangerous waste permit modification.	DOE/RL-94-02, Sections 1.1 and 1.2 Portions of the Hanford emergency response program are used to meet requirements of WAC 173-303-350 and -360 under the provision of -350(2).	*BEP Section 1.0* Identified sections of the BEP/FRP are part of the contingency plan.

REQUIREMENT SOURCE	REQUIREMENT DESCRIPTION	SITE LEVEL (How/Where Met)	UNIT LEVEL (How/Where Met)
WAC 173-303-350(3)(a)	The contingency plan must contain the following: (a) A description of the actions which facility personnel must take to comply with this Section and WAC 173-303-360;	DOE/RL-94-02, Section 1.3.4 provides an overview of how the Hanford Site responds to emergency events. More specific descriptions of actions to meet other requirements of this section and WAC 173-303-360 are identified in those sections of this matrix. The relationship of emergency procedures and description of actions is in footnote[3].	*BEP Section 7.1 and subsections and Sections 7.2, 7.2.1, 7.2.2, 7.2.3, 7.2.4, 7.2.5, 7.2.5.1, 7.3 and subsections*
WAC 173-303-350(3)(b)	The contingency plan must contain the following: (b) A description of the actions which will be taken in the event that a dangerous waste shipment, which is damaged or otherwise presents a hazard to the public health and the environment, arrives at the facility, and is not acceptable to the owner or operator, but cannot be transported, pursuant to the requirements of WAC 173-303-370(5), Manifest system, reasons for not accepting dangerous waste shipments;	Requirement is met at the unit level.	*BEP Section 7.2.5.1*

[3] Sitewide and facility/activity-specific emergency procedures are described and in some cases identified in this plan. The descriptions of actions in this plan are required to accurately describe the emergency procedures. Unless specifically incorporated into the RCRA Permit, these emergency procedures are not subject to permit modification requirements of permit condition 1.C.3 simply because they are described or referenced in this plan. If the emergency procedures change and the description is no longer accurate, the revision of the description is subject to permit modification requirements of permit condition 1.C.3.

REQUIREMENT SOURCE	REQUIREMENT DESCRIPTION	SITE LEVEL (How/Where Met)	UNIT LEVEL (How/Where Met)
WAC 173-303-350(3)(c)	The contingency plan must contain the following: (c) A description of the arrangements agreed to by local police departments, fire departments, hospitals, contractors, and state and local emergency response teams to coordinate emergency services as required in WAC 173-303-340(4);	The arrangements agreed to by state emergency response teams to coordinate emergency services are located in DOE/RL-94-02, Sections 3.2.3, 3.3.1, 3.3.2, 3.4, 3.4.1.1, 3.4.1.2, 3.4.1.3, 3.7, and Table 3-1.	Requirement is met at the site level.
WAC 173-303-350(3)(d)	The contingency plan must contain the following: (d) A current list of names, addresses, and phone numbers (office and home) of all persons qualified to act as the emergency coordinator required under WAC 173-303-360(1). Where more than one person is listed, one must be named as primary emergency coordinator, and others must be listed in the order in which they will assume responsibility as alternates. For new facilities only, this list may be provided to the department at the time of facility certification (as required by WAC 173-303-810(14)(a)(i)), rather than as part of the permit application;	DOE/RL-94-02, Sections 2.2 and 2.2.1.1 discuss personnel job titles, which will fill duties and responsibilities of the Emergency Coordinator, described in WAC 173-303-360. A list of current assigned or "on-call" BEDs/BWs is maintained at the Patrol Operations Center per II.A.4. A list of BEDs/BWs for each Hanford TSD unit group is maintained in Permit Attachment 4A. Changing BEDs/BWs on this list is a class 1 mod, self-implemented.	*BEP Section 3.1*
WAC 173-303-350(3)(e)	The contingency plan must contain the following: (e) A list of all emergency equipment at the facility (such as fire extinguishing systems, spill control equipment, communications and alarm systems, and decontamination equipment), where this equipment is required. This list must be kept up to date. In addition, the plan must include the location and a physical description of each item on the list, and a brief outline of its capabilities.	DOE/RL-94-02, Sections 11.2 and 11.2.8, and Appendix C	*BEP Sections 9.1, 9.2, 9.3, 9.4, 9.5, and 9.6*
WAC 173-303-350(3)(f)	The contingency plan must contain the following: (f) An evacuation plan for facility personnel where there is a possibility that evacuation could be necessary. This plan must describe the signal(s) to be used to begin evacuation, evacuation routes, and alternate evacuation routes.	DOE/RL-94-02, Figure 7-3, and Table 5-1	*BEP Section 7.1.1*

REQUIREMENT SOURCE	REQUIREMENT DESCRIPTION	SITE LEVEL (How/Where Met)	UNIT LEVEL (How/Where Met)
WAC 173-303-350(4)	Copies of contingency plan. A copy of the contingency plan and all revisions to the plan shall be:	Introductory statement of requirement – requirements are in sections below.	Introductory statement of requirement – requirements are in sections below.
WAC 173-303-350(4)(a)	(a) Maintained at the facility; and	DOE/RL-94-02, Section 14.3.7	*BEP Section 12.0*
WAC 173-303-350(4)(b)	(b) Submitted to all local police departments, fire departments, hospitals, and state and local emergency response teams that may be called upon to provide emergency services.	DOE/RL-94-02, Section 14.3.7	Requirement is met at the site level.
WAC 173-303-350(5)	Amendments. The owner or operator shall review and immediately amend the contingency plan, if necessary, whenever:	Introductory statement of requirement – requirements are in sections below.	Introductory statement of requirement – requirements are in sections below.
WAC 173-303-350(5)(a)	(a) Applicable regulations or the facility permit are revised;	DOE/RL-94-02, Section 14.3.1.1	*BEP Section 12.0*
WAC 173-303-350(5)(b)	(b) The plan fails in an emergency;	DOE/RL-94-02, Section 14.3.1.1	*BEP Section 12.0*
WAC 173-303-350(5)(c)	(c) The facility changes (in its design, construction, operation, maintenance, or other circumstances) in a way that materially increases the potential for fires, explosions, or releases of dangerous waste or dangerous waste constituents, or in a way that changes the response necessary in an emergency;	DOE/RL-94-02, Section 14.3.1.1	*BEP Section 12.0*
WAC 173-303-350(5)(d)	(d) The list of emergency coordinators changes; or	DOE/RL-94-02, Section 14.3.1.1	*BEP Section 12.0*
WAC 173-303-350(5)(e)	(e) The list of emergency equipment changes.	DOE/RL-94-02, Section 14.3.1.1	*BEP Section 12.0*
WAC 173-303-355(1)	Owners or operators must coordinate preparedness and prevention planning and contingency planning efforts, conducted under WAC 173-303-340 and -350 with local emergency planning committees established pursuant to Title III of the 1986 Superfund Amendments and Reauthorization Act.	DOE/RL-94-02, Sections 3.1, 3.1.1, and 3.4	Requirement is met at the site level.

REQUIREMENT SOURCE	REQUIREMENT DESCRIPTION	SITE LEVEL (How/Where Met)	UNIT LEVEL (How/Where Met)
WAC 173-303-355(2)	Appropriate and generally accepted computer models should be utilized to determine the impacts of a potential catastrophic air release due to fire, explosion, or other accidental releases of hazardous constituents. Evacuation plans prepared pursuant to WAC 173-303-350(3)(d) must include those effected persons and areas identified through these modeling efforts.	DOE/RL-94-02, Sections 2.2.2.2.4 and 1.3.3.2	Requirement is met at the site level.
WAC 173-303-360(1)	Emergency coordinator. At all times, there must be at least one employee either on the facility premises or on call with the responsibility for coordinating all emergency response measures. This emergency coordinator must be thoroughly familiar with all aspects of the facility's contingency plan, required by WAC 173-303-350(2), all operations and activities at the facility, the location and properties of all wastes handled, the location of all records within the facility, and the facility layout. In addition, this person must have the authority to commit the resources needed to carry out the contingency plan.	DOE/RL-94-02, Sections 2.2 and 2.2.1.1	*BEP Section 3.1* Permit Attachment 4A lists the BED/BW for each unit.
WAC 173-303-360(2)	Emergency procedures. The following procedures must be implemented in the event of an emergency.	Introductory statement of requirement – requirements are in sections below.	Introductory statement of requirement – requirements are in sections below.
WAC 173-303-360(2)(a)	(a) Whenever there is an imminent or actual emergency situation, the emergency coordinator (or his designee when the emergency coordinator is on call) must immediately:	Introductory statement of requirement – requirements are in sections below.	Introductory statement of requirement – requirements are in sections below.
WAC 173-303-360(2)(a)(i)	(i) Activate internal facility alarms or communication systems, where applicable, to notify all facility personnel; and	DOE/RL-94-02, Sections 2.2.1.1.2(b), 2.2.1.1.3(b), and 5.2.5	*BEP Sections 7.1* and subsections, and 7.2 and subsections
WAC 173-303-360(2)(a)(ii)	(ii) Notify appropriate state or local agencies with designated response roles if their help is needed.	DOE/RL-94-02, Sections 1.3.4, and 5.2.1 Units summon assistance by calling the Hanford Patrol emergency number. No offsite assistance is requested by the unit itself.	*BEP Section 4.0*

REQUIREMENT SOURCE	REQUIREMENT DESCRIPTION	SITE LEVEL (How/Where Met)	UNIT LEVEL (How/Where Met)
WAC 173-303-360(2)(b)	Emergency procedures. (b) Whenever there is a release, fire, or explosion, the emergency coordinator must immediately identify the character, exact source, amount, and areal extent of any released materials.	DOE/RL-94-02, Sections 2.2.1.1.2(f), 2.2.1.1.3(g), and 4.2	*BEP Section 4.0*
WAC 173-303-360(2)(c)	Emergency procedures. (c) Concurrently, the emergency coordinator shall assess possible hazards to human health and the environment (considering direct, indirect, immediate, and long-term effects) that may result from the release, fire, or explosion.	DOE/RL-94-02, Sections 4.2 and 2.2.2.2.4	*BEP Section 4.0*
WAC 173-303-360(2)(d)	Emergency procedures. (d) If the emergency coordinator determines that the facility has had a release, fire, or explosion which could threaten human health or the environment, he must report his findings as follows:	Introductory statement of requirement – requirements are in sections below.	Introductory statement of requirement – requirements are in sections below.
WAC 173-303-360(2)(d)(i)	(i) If his assessment indicates that evacuation of local areas may be advisable, he must immediately notify appropriate local authorities. He must be available to help appropriate officials decide whether local areas should be evacuated; and	DOE/RL-94-02, Sections 2.2.1.1.2(a) & (d), 2.2.1.1.3 (a) & (e), 5.1.1, 5.1.1.2, and 5.1.2.1	*BEP Section 7.1*
WAC 173-303-360(2)(d)(ii)	(ii) He must immediately notify the department and either the government official designated as the on-scene coordinator, or the National Response Center (using their 24-hour toll free number (800) 424-8802).	DOE/RL-94-02, Sections 2.2.1.1.2(a) & (d), 2.2.1.1.3 (a) & (e), 5.1.1, 5.1.1.2, 5.1.2.1, and 5.1.2.2	*BEP Section 4.0*
WAC 173-303-360(2)(e)	Emergency procedures. (e) His assessment report must include: (i) Name and telephone number of reporter; (ii) Name and address of facility; (iii) Time and type of incident (e.g., release, fire); (iv) Name and quantity of material(s) involved, to the extent known; (v) The extent of injuries, if any; and (vi) The possible hazards to human health or the environment outside the facility.	DOE/RL-94-02, Sections 2.2.1.1.2(d), 2.2.1.1.3(e), 5.1.1, 5.1.1.2, 5.1.2.1, and 5.1.2.2	*BEP Section 4.0*

REQUIREMENT SOURCE	REQUIREMENT DESCRIPTION	SITE LEVEL (How/Where Met)	UNIT LEVEL (How/Where Met)
WAC 173-303-360(2)(f)	Emergency procedures. (f) During an emergency, the emergency coordinator must take all reasonable measures necessary to ensure that fires, explosions, and releases do not occur, recur, or spread to other dangerous waste at the facility. These measures must include, where applicable, stopping processes and operations, collecting, and containing released waste, and removing or isolating containers.	DOE/RL-94-02, Sections 2.2.1.1, 2.2.1.1.2(f), and 2.2.1.1.3(g)	*BEP Section 7.6*
WAC 173-303-360(2)(g)	Emergency procedures. (g) If the facility stops operations in response to a fire, explosion, or release, the emergency coordinator must monitor for leaks, pressure buildup, gas generation, or ruptures in valves, pipes, or other equipment, wherever this is appropriate.	DOE/RL-94-02, Sections 2.2.1.1.2(f) and 2.2.1.1.3(g)	*BEP Sections 7.2.4 and 7.2.5*
WAC 173-303-360(2)(h)	Emergency procedures. (h) Immediately after an emergency, the emergency coordinator must provide for treating, storing, or disposing of recovered waste, contaminated soil or surface water, or any other material that results from a release, fire, or explosion at the facility.	DOE/RL-94-02, Section 9.2.3	*BEP Section 8.2*
WAC 173-303-360(2)(i)	Emergency procedures. (i) The emergency coordinator must ensure that, in the affected area(s) of the facility:	Introductory statement of requirement – requirements are in sections below.	Introductory statement of requirement – requirements are in sections below.
WAC 173-303-360(2)(i)(i)	(i) No waste that may be incompatible with the released material is treated, stored, or disposed of until cleanup procedures are completed; and	DOE/RL-94-02, Section 9.2.3	*BEP Section 8.2.1*
WAC 173-303-360(2)(i)(ii)	(ii) All emergency equipment listed in the contingency plan is cleaned and fit for its intended use before operations are resumed.	DOE/RL-94-02, Section 11.2	*BEP Section 8.2.2*
WAC 173-303-360(2)(j)	Emergency procedures. (j) The owner or operator must notify the department, and appropriate local authorities, that the facility is in compliance with (i) of this subsection before operations are resumed in the affected area(s) of the facility.	DOE/RL-94-02, Section 5.1.2.2	*BEP Section 8.2*

REQUIREMENT SOURCE	REQUIREMENT DESCRIPTION	SITE LEVEL (How/Where Met)	UNIT LEVEL (How/Where Met)
WAC 173-303-360(2)(k)	Emergency procedures. (k) The owner or operator must note in the operating record the time, date, and details of any incident that requires implementing the contingency plan. Within fifteen days after the incident, he must submit a written report on the incident to the department. The report must include: (i) Name, address, and telephone number of the owner or operator; (ii) Name, address, and telephone number of the facility; (iii) Date, time, and type of incident (e.g., fire, explosion); (iv) Name and quantity of material(s) involved; (v) The extent of injuries, if any; (vi) An assessment of actual or potential hazards to human health or the environment, where this is applicable; (vii) Estimated quantity and disposition of recovered material that resulted from the incident; (viii) Cause of incident; and (ix) Description of corrective action taken to prevent reoccurrence of the incident.	DOE/RL-94-02, Section 5.1.2.2	*BEP Section 11.0*

RCRA APPLICABILITY MATRIX FOR GENERATOR ACTIVITIES

REQUIREMENT SOURCE	REQUIREMENT DESCRIPTION	SITE LEVEL (How/Where Met)	UNIT LEVEL (How/Where Met)
WAC 173-303-201	Preparedness and prevention. Facilities must be designed, constructed, maintained, and operated to minimize the possibility of fire, explosion, or any unplanned sudden or nonsudden release of dangerous waste, hazardous substance or dangerous waste constituents to air, soil, or surface or groundwater, which could threaten the public health or the environment. This section describes preparations and preventive measures, which help avoid or mitigate such situations.	Introductory statement of requirement – requirements are in sections below.	Introductory statement of requirement – requirements are in sections below.
WAC 173-303-201(1)	Applicability. The regulations of this section apply to those areas of a large quantity generator's facility where dangerous waste is generated or accumulated on site.	Introductory statement of requirement – requirements are in sections below.	Introductory statement of requirement – requirements are in sections below.
WAC 173-303-201(3)	Required equipment. All areas deemed applicable by subsection (1) of this section must be equipped with the following, unless it can be demonstrated to the department that none of the hazards posed by waste handled at the facility could require a particular kind of equipment specified below. A large quantity generator may determine the most appropriate locations within its facility to locate equipment necessary to prepare for and respond to emergencies:	Introductory statement of requirement – requirements are in sections below.	Introductory statement of requirement – requirements are in sections below.
WAC 173-303-201(3)(a)	(a) An internal communications or alarm system capable of providing immediate emergency instruction (voice or signal) to facility personnel;	DOE/RL-94-02, Section 5.2.5	*BEP Section 9.3*
WAC 173-303-201(3)(b)	(b) A device, such as a telephone (immediately available at the scene of operations) or a hand-held, two-way radio, capable of summoning emergency assistance from local police departments, fire departments, or state or local emergency response teams;	DOE/RL-94-02, Section 5.2.12	*BEP Section 9.3* Units summon assistance by calling the Hanford Patrol emergency number. No offsite assistance is requested by the unit itself.
WAC 173-303-201(3)(c)	(c) Portable fire extinguishers, fire control equipment (including special extinguishing equipment, such as that using foam, inert gas, or dry chemicals), spill control equipment, and decontamination equipment; and	DOE/RL-94-02, Sections 11.2.2, 11.2.3, 11.2.4, 11.2.8 and Appendix C	*BEP Sections 9.1, 9.2, and 9.5*

REQUIREMENT SOURCE	REQUIREMENT DESCRIPTION	SITE LEVEL (How/Where Met)	UNIT LEVEL (How/Where Met)
WAC 173-303-201(3)(d)	(d) Water at adequate volume and pressure to supply water hose streams, foam producing equipment, automatic sprinklers, or water spray systems.	DOE/RL-94-02, Sections 11.2.2 and 11.2.8	*BEP Section 9.1*
WAC 173-303-201(4)	Testing and maintenance of equipment. All facility communications or alarm systems, fire protection equipment, spill control equipment, and decontamination equipment, where required, must be tested and maintained as necessary to assure its proper operation in time of emergency.	DOE/RL-94-02, Sections 11.2, 11.2.8, and 11.3	*BEP Section 8.0*
WAC 173-303-201(5)	Access to communications or alarms. Personnel must have immediate access to the signaling devices described in the situations below:	Introductory statement of requirement – requirements are in sections below.	Introductory statement of requirement – requirements are in sections below.
WAC 173-303-201(5)(a)	(a) Whenever dangerous waste is being poured, mixed, spread, or otherwise handled, all personnel involved must have immediate access (e.g., direct or unimpeded access) to an internal alarm or emergency communication device, either directly or through visual or voice contact with another employee, unless such a device is not required in subsection (3) of this section;	DOE/RL-94-02, Section 5.2.12	*BEP Section 8.3*
WAC 173-303-201(5)(b)	(b) If there is ever just one employee on the premises while the facility is operating, they must have immediate access (e.g., direct or unimpeded access) to a device, such as a telephone (immediately available at the scene of operation) or a hand-held, two-way radio, capable of summoning external emergency assistance, unless such a device is not required in subsection (3) of this Section.	DOE/RL-94-02, Section 5.2.12	*BEP Section 8.3*
WAC 173-303-201(6)	Aisle space. The generator must maintain aisle space to allow the unobstructed movement of personnel, fire protection equipment, spill control equipment, and decontamination equipment to any area of facility operation in an emergency, unless it can be demonstrated to the department that aisle space is not needed for any of these purposes.	Requirement is met at the unit level.	*BEP Section 9.0*

REQUIREMENT SOURCE	REQUIREMENT DESCRIPTION	SITE LEVEL (How/Where Met)	UNIT LEVEL (How/Where Met)
WAC 173-303-201(7)	Arrangements with local authorities. The large quantity generator must attempt to make the following arrangements, as appropriate for the type of waste handled at its facility and the potential need for the services of these organizations, unless the hazards posed by wastes handled at the facility would not require these arrangements:	Introductory statement of requirement – requirements are in sections below.	Introductory statement of requirement – requirements are in sections below.
WAC 173-303-201(7)(a)	(a) Arrangements to familiarize police, fire departments, and emergency response teams with the layout of the facility, properties of dangerous waste handled at the facility and associated hazards, places where facility personnel would normally be working, entrances to roads inside the facility, and possible evacuation routes;	The arrangements agreed to by local police, fire departments emergency response teams to coordinate emergency services are located in DOE/RL-94-02, Sections 3.4, 3.4.1.1, 3.4.1.2, 3.7, and Table 3-1.	Requirement is met at the site level.
WAC 173-303-201(7)(b)	(b) Arrangements to familiarize local hospitals with the properties of dangerous waste handled at the facility and the types of injuries or illnesses which could result from fires, explosions, or releases at the facility;	The arrangements agreed to by local hospitals to coordinate emergency services are located in DOE/RL-94-02, Sections 3.4.1.3, 3.7, and Table 3-1.	Requirement is met at the site level.
WAC 173-303-201(7)(c)	(c) Agreements with state emergency response teams, emergency response contractors, and equipment suppliers; and	The arrangements agreed to by state emergency response teams to coordinate emergency services are located in DOE/RL-94-02, Sections 3.3.1, 3.3.2, 3.7, and Table 3-1.	Requirement is met at the site level.
WAC 173-303-201(7)(d)	(d) Where more than one party might respond to an emergency, agreements designating primary emergency authority and agreements with any others to provide support to the primary emergency authority.	Discussed in the Tri-County Mutual Aid Agreement MOU and Mutual Law Enforcement Assistance MOUs. DOE/RL-94-02, Section 3.7 and Table 3-1	Requirement is met at the site level.
WAC 173-303-201(7)(e)	(e) Where state or local authorities decline to enter into such agreements, the owner~~,~~ or operator must document the refusal in the operating record; and~~.~~	If authorities decline, the documentation will be maintained in the Hanford Facility Operating Record.	Requirement is met at the site level.

REQUIREMENT SOURCE	REQUIREMENT DESCRIPTION	SITE LEVEL (How/Where Met)	UNIT LEVEL (How/Where Met)
WAC 173-303-201(7)(f)	(f) A facility possessing twenty-four-hour response capabilities may seek a waiver from the authority having jurisdiction (AHJ) over the fire code with the facility's locality as far as organization necessary to respond to an emergency, provided ~~that~~ the waiver is documented in the generator's operating record.		
WAC 173-303-201(8)	Contingency plan purpose and implementation.	Introductory statement of requirement – requirements are in sections below.	Introductory statement of requirement – requirements are in sections below.
WAC 173-303-201(8)(a)	(a) The large quantity generator must have a contingency plan for the facility. The purpose of a contingency plan and emergency procedures is to lessen the potential impact on the public health and the environment due to any emergency event such as, but not limited to, a fire, natural disaster, explosion, or unplanned sudden or nonsudden release of dangerous waste or dangerous waste constituents to air, soil, surface water, or groundwater.	DOE/RL-94-02, Sections 1.1 and 1.2	*BEP Section 1.0* Identified sections of the BEP are part of the contingency plan.
WAC 173-303-201(8)(b)	(b) A contingency plan must be developed to lessen the potential impacts of such emergency events, and the plan must be implemented immediately when such emergency events occur.	DOE/RL-94-02, Sections 1.1 and 1.2	*BEP Section 1.0* Identified sections of the BEP are part of the contingency plan.
WAC 173-303-201(9)	Contents of a contingency plan.	Introductory statement of requirement – requirements are in sections below.	Introductory statement of requirement – requirements are in sections below.
WAC 173-303-201(9)(a)	(a) Each large quantity generator must have a contingency plan at their facility for use in emergencies or sudden or nonsudden releases which threaten human health and the environment. If the generator has already prepared a spill prevention control and countermeasures (SPCC) plan in accordance with Part 112 of Title 40 C.F.R. or some other emergency or contingency plan, they need only amend that plan to incorporate dangerous waste management provisions that are sufficient to comply with the requirements of this section. The large quantity generator may develop one contingency plan that meets all regulatory requirements. Ecology recommends that the plan be based on the National Response Team's Integrated Contingency Plan Guidance ("One Plan").	DOE/RL-94-02, Sections 1.1 and 1.2 Portions of the Hanford emergency response program are used to meet requirements of WAC 173-303-201(8) through 201(14) under the provision of -201(9).	*BEP Section 1.0* Identified sections of the BEP are part of the contingency plan.

REQUIREMENT SOURCE	REQUIREMENT DESCRIPTION	SITE LEVEL (How/Where Met)	UNIT LEVEL (How/Where Met)
WAC 173-303-201(9)(b)	(b) The contingency plan must contain the following: (i) A description of the actions which facility personnel must take to comply with this section and WAC 173-303-145;	DOE/RL-94-02, Section 1.3.4 provides an overview of how the Hanford Site responds to emergency events. More specific descriptions of actions to meet other requirements of this section are identified in those sections of this matrix. Actions to comply with WAC 173-303-145 are addressed in DOE/RL-94-02, Section 5.1.2.	*BEP Section 7.1 (including subsections) and Sections 7.2, 7.2.1, 7.2.2, 7.2.3, 7.2.4, 7.2.5, 7.2.5.1*
WAC 173-303-201(9)(b)	The contingency plan must contain the following: (ii) A description of the actions which will be taken in the event that a dangerous waste shipment, which is damaged or otherwise presents a hazard to the public health and the environment, arrives at the facility, and is not acceptable to the large quantity generator, but cannot be transported, pursuant to the requirements of WAC 173-303-370(6), manifest system, reasons for not accepting dangerous waste shipments;	Requirement is met at the unit level.	*BEP Section 7.2.5.1*
WAC 173-303-201(9)(b)	The contingency plan must contain the following: (iii) A description of the arrangements agreed to by local police departments, fire departments, hospitals, contractors, and state and local emergency response teams to coordinate emergency services as required in subsection (7) of this section;	The arrangements agreed to by state emergency response teams to coordinate emergency services are located in DOE/RL-94-02, Sections 3.2.3, 3.3.1, 3.3.2, 3.4, 3.4.1.1, 3.4.1.2, 3.4.1.3, 3.7, and Table 3-1.	Requirement is met at the site level.

REQUIREMENT SOURCE	REQUIREMENT DESCRIPTION	SITE LEVEL (How/Where Met)	UNIT LEVEL (How/Where Met)
WAC 173-303-201(9)(b)	The contingency plan must contain the following: (iv) A current list of names, addresses, and telephone numbers of all persons qualified to act as the emergency coordinator required in this section and this list must be kept up to date. Where more than one person is listed, one must be named as primary emergency coordinator, and others must be listed in the order in which they will assume responsibility as alternates. In situations where the large quantity generator facility has an emergency coordinator continuously on duty because it operates a twenty-four hours per day, every day of the year, the plan may list the staff position (e.g., operations manager, shift coordinator, shift operations supervisor) as well as an emergency telephone number that can be guaranteed to be answered at all times;	DOE/RL-94-02, Sections 2.2 and 2.2.1.1 discuss personnel job titles, which will fill duties and responsibilities of the Emergency Coordinator, described in WAC 173-303-360. A list of current assigned or "on-call" BEDs/BWs is maintained at the Patrol Operations Center per II.A.4. A list of BEDs/BWs for each Hanford TSD unit group is maintained in Permit Attachment 4A. Changing BEDs/BWs on this list is a class 1 mod, self-implemented.	*BEP Section 3.1* The list of BEDs/BWs for CAAs and SAAs is maintained and collocated with the BEP.
WAC 173-303-201(9)(b)	The contingency plan must contain the following: (v) A list of all emergency equipment at the facility (such as fire extinguishing systems, spill control equipment, communications and alarm systems, and decontamination equipment), where this equipment is required. This list must be kept up to date. In addition, the plan must include the location and a physical description of each item on the list, and a brief outline of its capabilities.	DOE/RL-94-02, Sections 11.2 and 11.2.8, and Appendix C	*BEP Sections 9.1, 9.2, 9.3, 9.4, and 9.5*
WAC 173-303-201(9)(b)	The contingency plan must contain the following: (vi) An evacuation plan for facility personnel where there is a possibility that evacuation could be necessary. This plan must describe the signal(s) to be used to begin evacuation, evacuation routes, and alternate evacuation routes (in cases where the primary routes could be blocked by releases of materials or fires).	DOE/RL-94-02, Figure 7-3 and Table 5-1	*BEP Section 7.1.1*
WAC 173-303-201(10)	Copies of contingency plan. A copy of the contingency plan and all revisions to the plan shall be:	Introductory statement of requirement – requirements are in sections below.	Introductory statement of requirement – requirements are in sections below.
WAC 173-303-201(10)(a)	(a) Maintained at the large quantity generator's facility; and	DOE/RL-94-02, Section 14.3.7	*BEP Section 12.0*
WAC 173-303-201(10)(b)	(b) Submitted by the large quantity generator to all local police departments, fire departments, hospitals, and state and local emergency response teams that may be called upon to provide emergency services.	DOE/RL-94-02, Section 14.3.7	Not applicable at the unit level. DOE is responsible for offering documents to offsite entities.

REQUIREMENT SOURCE	REQUIREMENT DESCRIPTION	SITE LEVEL (How/Where Met)	UNIT LEVEL (How/Where Met)
WAC 173-303-201(12)	Amendments. The large quantity generator must review and immediately amend the contingency plan, if necessary, whenever:	Introductory statement of requirement – requirements are in sections below.	Introductory statement of requirement – requirements are in sections below.
WAC 173-303-201(12)(a)	(a) Applicable regulations or the facility permit are revised;	DOE/RL-94-02, Section 14.3.1.1	*BEP Section 12.0*
WAC 173-303-201(12)(b)	(b) The plan fails in an emergency;	DOE/RL-94-02, Section 14.3.1.1	*BEP Section 12.0*
WAC 173-303-201(12)(c)	(c) The generator's facility changes (in its design, construction, operation, maintenance, or other circumstances) in a way that materially increases the potential for fires, explosions, or releases of dangerous waste or dangerous waste constituents, or in a way that changes the response necessary in an emergency;	DOE/RL-94-02, Section 14.3.1.1	*BEP Section 12.0*
WAC 173-303-201(12)(d)	(d) The list of emergency coordinators changes; or	DOE/RL-94-02, Section 14.3.1.1	*BEP Section 12.0*
WAC 173-303-201(12)(e)	(e) The list of emergency equipment changes.	DOE/RL-94-02, Section 14.3.1.1	*BEP Section 12.0*
WAC 173-303-201(13)	Emergency coordinator. At all times, there must be at least one employee either on the facility premises or on call (that is, available to responds to an emergency by reaching the facility within a short period of time) with the responsibility for coordinating all emergency response measures. This emergency coordinator must be thoroughly familiar with all aspects of the facility's contingency plan, required by subsection (14) of this section.	DOE/RL-94-02, Sections 2.2 and 2.2.1.1	*BEP Section 3.1* Permit Attachment 4A lists the BED/BW for each unit.
WAC 173-303-201(14)	Emergency procedures. The following procedures must be implemented in the event of an emergency.	Introductory statement of requirement – requirements are in sections below.	Introductory statement of requirement – requirements are in sections below.
WAC 173-303-201(14)(a)	(a) Whenever there is an imminent or actual emergency situation, the emergency coordinator (or his designee when the emergency coordinator is on call) must immediately:	Introductory statement of requirement – requirements are in sections below.	Introductory statement of requirement – requirements are in sections below.
WAC 173-303-201(14)(a)(i)	(i) Activate internal facility alarms or communication systems, where applicable, to notify all facility personnel; and	DOE/RL-94-02, Sections 2.2.1.1.2(b), 2.2.1.1.3(b), and 5.2.5	*BEP Section 7.1 and subsections and 7.2 subsections*

REQUIREMENT SOURCE	REQUIREMENT DESCRIPTION	SITE LEVEL (How/Where Met)	UNIT LEVEL (How/Where Met)
WAC 173-303-201(14)(a)(ii)	(ii) Notify appropriate state or local agencies with designated response roles if their help is needed.	DOE/RL-94-02, Sections 1.3.4 and 5.2.1 Units summon assistance by calling the Hanford Patrol emergency number. No offsite assistance is requested by the unit itself.	*BEP Section 4.0*
WAC 173-303-201(14)(b)	Emergency procedures. (b) Whenever there is a release, fire, or explosion, the emergency coordinator must immediately identify the character, exact source, amount, and areal extent of any released materials.	DOE/RL-94-02, Sections 2.2.1.1.2(f), 2.2.1.1.3(g), and 4.2	*BEP Section 4.0*
WAC 173-303-201(14)(c)	Emergency procedures. (c) Concurrently, the emergency coordinator shall assess possible hazards to human health and the environment (considering direct, indirect, immediate, and long-term effects) that may result from the release, fire, or explosion.	DOE/RL-94-02, Sections 4.2 and 2.2.2.2.4	*BEP Section 4.0*
WAC 173-303-201(14)(d)	Emergency procedures. (d) If the emergency coordinator determines that the facility has had a release, fire, or explosion which could threaten human health or the environment, he must report his findings as follows:	Introductory statement of requirement – requirements are in sections below.	Introductory statement of requirement – requirements are in sections below.
WAC 173-303-201(14)(d)(i)	(i) If their assessment indicates that evacuation of local areas may be advisable, they must immediately notify appropriate local authorities. They must be available to help appropriate officials decide whether local areas should be evacuated; and	DOE/RL-94-02, Sections 2.2.1.1.2(a) & (d), 2.2.1.1.3 (a) & (e), 5.1.1, 5.1.1.2, and 5.1.2.1	*BEP Section 7.1*
WAC 173-303-201(14)(d)(ii)	(ii) They must immediately notify the department and either the government official designated as the on-scene coordinator, or the National Response Center (using their 24-hour toll free number (800) 424-8802).	DOE/RL-94-02, Sections 2.2.1.1.2(a) & (d), 2.2.1.1.3 (a) & (e), 5.1.1, 5.1.1.2, 5.1.2.1, and 5.1.2.2	*BEP Section 4.0*
WAC 173-303-201(14)(e)	Emergency procedures. (e) His assessment report must include: (i) Name and telephone number of reporter; (ii) Name and address of facility; (iii) Time and type of incident (e.g., release, fire); (iv) Name and quantity of material(s) involved, to the extent known; (v) The extent of injuries, if any; and (vi) The possible hazards to human health or the environment outside the facility.	DOE/RL-94-02, Sections 2.2.1.1.2(d), 2.2.1.1.3(e), 5.1.1, 5.1.1.2, 5.1.2.1, and 5.1.2.2	*BEP Section 4.0*

REQUIREMENT SOURCE	REQUIREMENT DESCRIPTION	SITE LEVEL (How/Where Met)	UNIT LEVEL (How/Where Met)
WAC 173-303-201(14)(f)	Emergency procedures. (f) During an emergency, the emergency coordinator must take all reasonable measures necessary to ensure that fires, explosions, and releases do not occur, recur, or spread to other dangerous waste at the facility. These measures must include, where applicable, stopping processes and operations, collecting, and containing released waste, and removing or isolating containers.	DOE/RL-94-02, Sections 2.2.1.1, 2.2.1.1.2(f), and 2.2.1.1.3(g)	*BEP Section 7.6*
WAC 173-303-201(14)(g)	Emergency procedures. (g) If the facility stops operations in response to a fire, explosion, or release, the emergency coordinator must monitor for leaks, pressure buildup, gas generation, or ruptures in valves, pipes, or other equipment, wherever this is appropriate.	DOE/RL-94-02, Sections 2.2.1.1.2(f) and 2.2.1.1.3(g).	*BEP Sections 7.2.4 and 7.2.5*
WAC 173-303-201(14)(h)	Emergency procedures. (h) Immediately after an emergency, the emergency coordinator must provide for treating, storing, or disposing of recovered waste, contaminated soil or surface water, or any other material that results from a release, fire, or explosion at the facility.	DOE/RL-94-02, Section 9.2.3	*BEP Section 8.2*
WAC 173-303-201(14)(i)	Emergency procedures. (i) The emergency coordinator must ensure that, in the affected area(s) of the facility:	Introductory statement of requirement – requirements are in sections below.	Introductory statement of requirement – requirements are in sections below.
WAC 173-303-201(14)(i)(i)	(i) No waste that may be incompatible with the released material is treated, stored, or disposed of until cleanup procedures are completed; and	DOE/RL-94-02, Section 9.2.3	*BEP Section 8.2.1*
WAC 173-303-201(14)(i)(ii)	(ii) All emergency equipment listed in the contingency plan is cleaned and fit for its intended use before operations are resumed.	DOE/RL-94-02, Section 11.2	*BEP Section 8.2.2*

REQUIREMENT SOURCE	REQUIREMENT DESCRIPTION	SITE LEVEL (How/Where Met)	UNIT LEVEL (How/Where Met)
WAC 173-303-201(14)(j)	Emergency procedures. (j) The large quantity generator must notify the department, and appropriate local authorities, that the facility is in compliance with (14)(i) of this section before operations are resumed in the affected area(s) of the facility.	DOE/RL-94-02, Section 5.1.2.2	*BEP Section 8.2*
WAC 173-303-201(14)(k)	Emergency procedures. (k) The large quantity generator must note in the operating record the time, date, and details of any incident that requires implementing the contingency plan. Within fifteen days after the incident, he must submit a written report on the incident to the department. The report must include: (i) Name, address, and telephone number of the owner or operator; (ii) Name, address, and telephone number of the facility; (iii) Date, time, and type of incident (e.g., fire, explosion); (iv) Name and quantity of material(s) involved; (v) The extent of injuries, if any; (vi) An assessment of actual or potential hazards to human health or the environment, where this is applicable; (vii) Estimated quantity and disposition of recovered material that resulted from the incident; (viii) Cause of incident; and (ix) Description of corrective action taken to prevent reoccurrence of the incident.	DOE/RL-94-02, Sections 5.1.2.1 and 5.1.2.2	*BEP Section 11.0*

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CHPRC-02538
Revision 0

Capsule Storage Area Final Design Report (Project W-135)

W-135 CAPSULE STORAGE AREA PROJECT

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

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Approved for Public Release;
Further Dissemination Unlimited

CHPRC-02538
Revision 0
EDC#: ECR-18-001278

Capsule Storage Area Final Design Report (Project W-135)

W-135 CAPSULE STORAGE AREA PROJECT

Project No: W-135 Document Type: RPT Program/Project: W&FMP

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Date Published
August 2018

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

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Aug 30, 2018
HANFORD RELEASE

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By Julia Raymer at 2:26 pm, Aug 30, 2018

Release Approval Date Release Stamp

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Printed in the United States of America

Total pages: 280

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List of Terms

Abbreviations, Initialisms, and Acronyms

ALARA	As Low As Reasonably Achievable
ASME	American Society of Mechanical Engineers
CDR	Conceptual Design Report
CE&I	Control, Electrical, and Instrumentation
CHPRC	CH2M HILL Plateau Remediation Company
CSA	Capsule Storage Area
CSB	Canister Storage Building
CSP	Capsule Storage Pad
CSS	Cask Storage System
DOE	U.S. Department of Energy
DOE-HQ	U.S. Department of Energy, Headquarters
DOE-RL	U.S. Department of Energy, Richland Operations Office
DSA	Documented Safety Analysis
EPRI	Electric Power Research Institute
FDC	Functional Design Criteria
FDR	Final Design Report
HLAN	Hanford Local Area Network
MCSC	Management of Cesium and Strontium Capsule
MSA	Mission Support Alliance
NAC	NAC International
NFPA	National Fire Protection Association
PAX	Public Address System
PDR	Preliminary Design Report
PDSA	Preliminary Documented Safety Analysis
QA	Quality Assurance
SDC	Seismic Design Category
SIL	Safety Integrity Analysis
SLF	Storage, Laydown, and Fabrication
SSC	Structure, System, and Component
TMS	Temperature Monitoring System
TSC	Transportable Storage Canister
VCC	Vertical Concrete Cask
VCT	Vertical Cask Transporter
WESF	Waste Encapsulation and Storage Facility
WIDS	Waste Information Data System

Units

ea.	each
ft	foot/feet
in.	inch(es)
kV	kilovolt
m	meters
mRem/hr	milirems per hour
V	volt(s)

1.0 INTRODUCTION

The Management of Cesium and Strontium Capsules (MCSCs) Project (W-135) will fill the capability gap for interim storage of cesium and strontium capsules currently stored underwater at the Waste Encapsulation and Storage Facility (WESF). The scope of Project W-135 is consistent with DOE/RL-2012-47, *Mission Need Statement for the Management of the Cesium and Strontium Capsules*.

The project will provide the capabilities necessary to transfer the capsules from the WESF pool cell to a Cask Storage System (CSS) which will be located in a new Capsule Storage Area (CSA). The CSS will safely and compliantly store the 1,936 capsules until a capsule disposal option is available in the future.

This report addresses the CSA portion of Project W-135, which consists of the following key elements:

- Design and construction of the CSA, including the Capsule Storage Pad (CSP) and other sub-systems to support interim storage of the capsules; and

- Design and construction of transfer roadway and haul path facility access improvements from the WESF to the CSA, as necessary to support transfer of the capsules utilizing the CSS-supplied Vertical Cask Transporter (VCT) and tug.

1.1 Background

From 1974 to 1985, cesium and strontium were removed from the nuclear waste at B-Plant and then encapsulated and stored at the WESF. Removal of the cesium and strontium from the underground tanks allowed for improved management of the underground tanks, enhanced isolation of the tank waste, and provided an opportunity for beneficial use of the encapsulated cesium and strontium.

The WESF is located adjacent to B-Plant in the 200-E Area on the Central Plateau of the Hanford Site. The mission of the WESF is the safe and compliant storage of 1,936 cesium and strontium capsules. As of June 2017, the capsules contain approximately 90 million curies and the inventory is continuing to decrease with time. This activity includes the short half-life daughter products, barium-137m and yttrium-90.

The capsules are stored underwater in pool cells. The WESF is an aging facility operating beyond its design life. The facility relies on active systems for ventilating, maintaining pool cell water levels, and monitoring the capsules. These systems are becoming more expensive and difficult to operate and maintain.

Recognizing the need for continued storage of the capsules, the U.S. Department of Energy, Richland Operations Office (DOE-RL) prepared the Mission Need Statement. The U.S. Department of Energy, Headquarters (DOE-HQ Office) approved this Mission Need Statement and Critical Decision 0 on November 5, 2015. Project W-135 was created to close the capability gaps identified in the Mission Need Statement.

The statement of mission need is as follows:

- *The Hanford Site needs to provide safe, compliant, and cost-effective storage of the cesium-137 and strontium-90 capsules. This storage capability will be necessary until a disposal path for the capsules is established and implemented.*
- *Fulfillment of this mission need will align management of the capsules with site goals for cleanup of the Central Plateau, including safe management of legacy material and long-term stewardship of the site.*

The approach for managing and controlling all activities necessary to successfully execute all responsibilities inherent to Project W-135 are described in CHPRC-02264, *MCSC Project Execution Plan for the Management of the Cesium and Strontium Capsules (MCSC) Project (W-135).*

1.2 Scope

CHPRC-03328, *Capsule Storage Area Conceptual Design Report (Project W-135)* was prepared to document the conceptual design. The conceptual design is consistent with meeting the mission need.

The Conceptual Design Report (CDR) defined the following major activities as the scope of Project W-135 to successfully transfer the capsules to a new storage capability:

1. Design and fabricate a storage capability that can safely, compliantly, and cost-effectively store the capsules until a disposal pathway for the capsules is available;
2. Design and construct the equipment necessary to retrieve, load, and transfer the capsules from the WESF pool cells to the storage capability;
3. Design and construct a CSA (including storage pad, fencing, lighting, and road access);
4. Design and construct the WESF modifications needed to support capsule retrieval, load, and transfer to the storage capability;
5. Prepare operational procedures, maintenance procedures, and training;
6. Perform operational startup readiness activities;
7. Prepare required environmental permits and approvals; and
8. Prepare safety basis documents and obtain DOE-HQ approval.

As stated previously, the CSA portion of Project W-135 consists of design and construction of the CSA and the transfer roadway and haul path facility access improvements from WESF to the CSA, as necessary to support transfer of the capsules utilizing the CSS-supplied VCT and tug.

1.2.1 Capsule Storage Area

The designated CSA is the storage site location selected for interim storage of the capsules and consists of several structures, systems, and components (SSCs), including the CSP and other sub-systems to support interim storage of the capsules until a disposal pathway becomes available. The CSA consists of:

- The CSP – A concrete monolith designed and sized to support the fully loaded Vertical Concrete Casks (VCCs) for the duration of interim storage.

- The Operating Pad and CSA Yard – The Operating Pad is a concrete monolith adjacent to the CSP. The Operating Pad provides a stable operating area for the maneuvering of the VCCs into designated positions utilizing a combination of a crane and the VCT and tug system previously utilized at the West Valley Demonstration Project's High-Level Waste Canister Relocation Project for similar purpose. The CSA Yard is the balance of the designated CSA open space that will be cleared, grubbed, and graveled with the gravel being compacted and leveled grade to match with the CSP and Operating Pad.

- The Security/Property Protection Sub-systems – These CSA sub-systems consist of fencing, vehicular and personnel access gates, pole-mounted flood lighting, public address system, and any other associated equipment as may be required and necessary based upon security assessment, hazard analysis, safety analysis, and housed SSCs quality level designations.

- The Temperature Monitoring System (TMS) and Control, Electrical, and Instrumentation (CE&I) interfaces and supports equipment – These CSA sub-systems consist of the CE&I interface between the TMS control cabinet and temperature sensors, a TMS control cabinet protective structure, and alarm annunciation at the Canister Storage Building (CSB).

1.2.2 Transfer Roadway and Facility Access Haul Path Improvements

Transfer roadway and facility access haul path improvements consist of improvements and modifications to Atlanta Avenue and 7th Street from WESF to the CSA, as well as roadway improvements from the truck loading area at WESF to Atlanta Avenue, necessary to support transfer of the capsules in the loaded VCCs utilizing the VCT and tug. This scope also includes extending site fire water lines to provide fire protection to the CSA.

1.2.3 Design Reviews and Approvals

The CH2M HILL Plateau Remediation Contract (CHPRC) W-135 Project Team is responsible for review, approval, and end-user acceptance of this Final Design Report (FDR). Final design activities for the CSA scope are expected to be completed by July 2018. Construction of the CSA scope is scheduled to begin in mid-fiscal year 2019 and is scheduled to be completed by September 2020.

2.0 DESIGN/PROCESS SELECTION

The final design for the CSA portion of Project W-135 presented in this FDR has been developed to meet the project requirements as defined in the Project W-135 key requirement documents CHPRC-02252, *Management of the Cesium and Strontium Capsules Project (W-135) Functions and Requirements Document*; CHPRC-02623, *Capsule Storage Area (CSA) Functional Design Criteria (Project W-135)*; CHPRC-03328, *Capsule Storage Area Conceptual Design Report (Project W-135);* CHPRC-03792, *Capsule Storage Area Code of Record (Project W-135)*; and CHPRC-02537, *Capsule Storage Area Preliminary Design Report (Project W-135)*. In addition to development of a design that meets the project requirement documents, the CSA design needs to meet the technical interface requirements of the CSS, as well as that of multiple CHPRC and other onsite Hanford services organizations as shown in Section 3.1.1.

2.1 Summary of Report

This FDR documents the final design for the CSA portion of Project W-135. This phase of the design, which evolved from the CDR and preliminary design phase, is composed of the following primary elements:

- Development of the project drawings.
- Development of the project procurement and construction specifications as necessary to ensure all associated project requirements are addressed, including all quality requirements.
- Development of the project calculations.
- Development of other Project Supporting Engineering Design Documents. (See Appendix A for the Functional Design Criteria [FDC] Compliance Matrix.)
- Development of an Equipment List (see Appendix B).
- Performance of an operations analysis for the receipt, transportation, interim storage, and permanent storage of the VCCs. This report is complete and the results are incorporated into the design. (See Appendix C.)

This FDR is consistent with guidance provided in PRC-STD-EN-40258, *Preliminary/Final Design Report*.

2.2 Design/Process Options

In addition to numerous “day-to-day” engineering design decisions, formal systems engineering processes were employed to determine significant design decisions/options. Significant design decisions were determined through a series of meetings and analysis; alternatives were developed, refined, and evaluated to support safe and cost-effective approaches for designing and constructing the CSA and the haul path improvements.

2.3 Selection of Design/Process

The successful determination of major design options was completed through the conceptual design process. Modifications/optimizations of the CDR and PDR have been incorporated throughout the design.

All design decisions documented in this FDR were determined in a manner consistent with guidance provided in U.S. Department of Energy (DOE) O 413.3A/B, *Program and Project Management for the Acquisition of Capital Assets*, and DOE G 413.3-1, *Managing Design and Construction Using Systems Engineering for Use with DOE O 413.3A.* Design decision methods were chosen and implemented to comply with CHPRC-02623, and to ensure that the level of analysis was commensurate with the magnitude of each particular design decision.

3.0 DESIGN/PROCESS OVERVIEW

The FDC documented in CHPRC-02623 provides the design requirements and technical baseline for the CSA portion of Project W-135. To ensure requirement compliance and consistency is accomplished, an FDC Compliance Matrix was completed and is included in Appendix A.

The design described in this FDR is compliant with the FDC requirements described in Appendix A. This FDR narrative and all associated final design media collectively demonstrate compliance with the FDC at a level of detail commensurate with a final design.

The following subsections provide an overview and summary of the anticipated operations and principal activities of the CSA portion of Project W-135 as they relate to each operable unit of the CSA SSCs, as well as their interface with existing infrastructure.

3.1 Interfaces with Existing Facilities/Systems

Interface management is a primary focus area in the final design phase. The CSA design needs to meet the technical interface requirements of the CSS, as well as those of multiple CHPRC and other onsite Hanford services organizations. A Design Basis Input Matrix was developed for the CSA portion of Project W-135 design as a working tool to capture and manage the design interfaces. (See Appendix D.)

3.1.1 Organizational Interfaces

The following organizations will interface with the W-135 Project at various points throughout project execution:

- Mission Support Alliance (MSA) Utilities (Electrical, Telecommunications, Water, and Roads);
- MSA Hanford Site Security;
- CHPRC Waste Management Operations;

- CHPRC Quality Assurance (QA), Safety, and Environmental/Permitting;
- CHPRC Fire Protection;
- MSA Hanford Fire Department and Hanford Fire Marshal Office;
- WESF Facility; and
- CSB Facility.

3.1.2 Interface Design Inputs and Assumptions

Design inputs for the CSA have been provided from numerous sources including:

- CSS Design Team
- MSA Hanford Site Utilities
- MSA Hanford Site Security
- CHPRC Fire Protection
- MSA Hanford Site Fire Department and Hanford Fire Marshal Office
- WESF and CSB Facilities (e.g., engineering, operations & maintenance)
- CHPRC Nuclear Safety
- CHPRC Industrial Health & Safety
- CHPRC Radiation Protection Program
- CHPRC Environmental
- CHPRC Construction Management
- CSA-specific Geotechnical Investigation (soil engineering properties), Surface Geophysical Survey (utility scans), and Civil Survey (location & topography)

Design inputs are documented in the relevant CSA design documents; e.g., engineering calculations and studies. Due to the status of available information regarding certain design interfaces, some design inputs are based on assumptions that require confirmation prior to CSA procurement, fabrication, or construction. These are further discussed below.

<u>Design Inputs Requiring Confirmation prior to Procurement, Fabrication, or Construction</u>

The CSA design inputs that are based on assumptions that require confirmation prior to procurement, fabrication, or construction have been identified and will be controlled. These assumptions are listed as part of the FDC Compliance Matrix (Appendix A). Consistent with PRC-STD-EN-40255, *Functional Design Criteria*, the W-135 Project will publish the FDC Compliance Matrix including these assumptions as a standalone document, and this document will undergo successive revisions as the listed assumptions are confirmed.

3.1.3 Existing Facilities and System Interfaces

Project W-135 shall interface with existing Hanford Site utilities and infrastructure, as needed, to support construction, capsule transfer operations, and long-term storage operations. Existing systems shall be used to the maximum extent possible to distribute required utilities. The project-specific interfaces (interfaces related to the CSA portion of Project W-135 design and construction) consist primarily of site electrical power, site fire water, site roads, WESF, and CSB. The key interfaces with these existing facilities/systems are:

- Fire water piping and hydrants for protection of the CSA will interface with the existing 200-E Area raw water/fire water piping system as shown on H-2-837594, Shts 1-2.

- Electrical power for the TMS and lighting at the CSA will interface with the existing 200-E area electrical grid as shown on drawings H-2-837601, Sht 1, H-2-837603, Sht 1, and H-2-837604, Sht 1.

- Alarm signal from the TMS control cabinet to the CSB as shown on drawings H-2-837609, Shts 1-4.

- The VCT facility access haul path will interface with existing overhead lines for the 200-E Area medium voltage power distribution lines, WESF power distribution, WESF/B-Plant series lighting loop, WESF PAX system, and MSA telecommunications infrastructure. Some overhead lines will be removed to provide clearances as shown on drawings H-2-837604, Sht 1, and H-2-837610, Shts 3-4.

- WESF series lighting will be removed by MSA Electrical Utilities. See drawing H-2-937610, Shts 3-4. Replacement of existing parking lot lighting will be performed by WESF Operations.

- The existing CSB public address system will be extended to the CSA by MSA. For conduit, see drawings H-2-837601, Sht 1, and H-2-837603, Sht 1. Conductors and speakers are by MSA. MSA will be engaged during construction to design install, and test the PAX System wiring and speakers. MSA will be engaged during construction to design, install, and test the PAX system wiring and speakers.

- The VCT transfer roadway and facility access haul path improvements will interface with the existing 200-E Area road system and the truck load pad at the WESF as shown on drawings H-2-837591, H-2-837592, H-2-837593, H-2-837596, and H-2-837597.

3.2 Nuclear Safety

The MCSC Project shall comply with the requirements of Title 10, *Code of Federal Regulations*, Part 830, "Nuclear Safety Management" (10 CFR 830) and DOE-STD-1189, *Integration of Safety into the Design Process*, as implemented by PRC-PRO-NS-700, *Safety Basis Development*. The specific strategy being used to ensure compliance is described in CHPRC-02236. Required safety documentation being developed by CHPRC includes a

Preliminary Documented Safety Analysis (PDSA) during CSA design and construction, and a final Documented Safety Analysis (DSA) prior to CSA operations.

3.3 Operations Integration

For design efforts associated with the CSA SSCs, two critical aspects of operations integration have been considered and evaluated at some level of detail: Human Factors and Siting.

Human Factors are largely self-explanatory. This element has significant impact on the constructability and operability of operable units, even though many would consider the CSA SSCs to be passive systems.

Siting is evaluated under this category as the locations selected and developed for the CSA and the transfer roadway/haul path are critical to the traffic, logistics, and material handling and control elements of the entire Project W-135.

3.3.1 Human Factors

The majority of the CSA SSCs are of a passive design nature (largely concrete, asphalt, gravel, and security/property protection fencing), which are designed and constructed to support safe transport and placement operations associated with the movement of empty and loaded VCCs utilizing the VCT, as well as the proper level of property protection and controlled access to the MCSC Project SSCs and operable units. Therefore, the primary focus was on the systems and design features associated with the CSA capital asset project SSCs and operable units discussed in the following subsections.

A Human Factors Engineering Report was prepared and is included in Appendix E.

3.3.1.1 VCT and Tug

The VCT and tug are not part of the CSA/CSP; however, they are one of two principal systems/components that drive the design features and requirements for the CSA scope of work.

During this final design phase, human factor aspects considered included the design of CSA SSCs/operable units that interface with the VCT and tug including transport roadway/access haul path improvements to assure that the systems can operate as designed, have less wear and tear placed upon them as a result of not having suitable travel surfaces, and have improvements that accommodate the width of operations during transit that will accommodate personnel accompaniment of the systems within the normal range of a control pendant without having to unnecessarily walk off pavement.

Relative to utilities interface with the VCT and tug, and in particular overhead lines, all cranes and supporting equipment shall be selected to ensure compliance with the applicable limited approach boundaries requirements of DOE-0359, *Hanford Site Electrical Safety Program*. This in turn supports human factor aspects associated with work in the vicinity of overhead power lines in a manner that is standard operating procedure.

3.3.1.2 VCCs

The VCCs themselves are also not part of the CSA portion of Project W-135; however, they are the other of the two principal systems/components that drive the design features and requirements for the CSA scope of work. Human factor aspects considered in the design of CSA SSCs/operable units that interface with the VCC include:

- Transfer roadway/facility access haul path improvements, which take into consideration that steering control for the VCT is often accomplished with a pendant control and an operator walking alongside the VCT; and

- Placement position consideration of minimizing pinch points between the VCT and adjacent VCCs.

3.3.1.3 CSA/CSP Security and Property Protection Lighting

Human factor aspects considered in the design of CSA operable units that interface with the lighting and fencing includes:

- Locating lighting poles for security and surveillance lighting outside of and adjacent to the outer fence at the CSA, so maintenance can be performed without the need to enter the controlled area of the CSP. This is also an ALARA measure, as the dose rates within the controlled area of the CSP are expected to be higher than those near the outer fence line; and

- Directing floodlighting toward the TMS protective shelter, and installing a switched lighting fixture inside the shelter; and

- Emergency crash bars on the personnel gates installed in each fence line at the CSP.

3.3.1.4 TMS and CE&I Interfaces

Human factor aspects considered in the design of the TMS and CE&I interface include:

- The design allowance for a protective three-sided structure located outside of the northeast corner of the CSA perimeter fence to house the TMS control panel and any operation and maintenance and/or upgrade/system replacement needs during the interim storage period.

- Based upon the results from the CSS design team's shielding analysis, the design dose rate at the outer fence line is less than or equal to 0.5 mRem/hr. As indicated in document 30059-5004 Rev. 0, the dose rates within the controlled area of the CSP are expected to be higher than those near the outer fence line. The CSS design team is responsible for the VCC shielding design and it is expected that a combination of both engineering and administrative controls will be required to minimize exposure.

3.3.2 Siting

Facility siting is a key factor in considering Operations Integration of the SSCs. The siting of the CSA was oriented around the WESF location. The CSA siting has been evaluated multiple times, was the subject of a formal Site Evaluation Study (2E-11-09, *Cesium and Strontium Capsules Dry Storage Project*), considered multiple possible locations, and was finalized when the corner coordinates were established.

Based on Site Evaluation 2E-11-09, the CSA will be located in the 200-E Area approximately 0.12 miles (200m) from the WESF. It is designated as Site 1 Site Evaluation 2E-11-09, Attachment 1. In accordance with the Site Evaluation, Site 1 is reserved for the Project W-135 with no outstanding land-use commitments.

Potential interferences noted in the Site Evaluation include buried pipelines (200-E-217-PL and 200-E-161-PL) crossing and parallel to 7th Street. A surface radiological survey of the CSA construction area was performed on March 16, 2018; no contamination was identified. The W-135 Project consulted with CHPRC Environmental on January 31, 2018, and was informed that there is no known reason to anticipate contamination at depth. The CSA site is sufficiently distant from 200-IS-1-OU pipelines and pipeline components (e.g., diversion boxes) that it is very unlikely for there to have been lateral subsurface migration of contamination from these sources into CSA construction footprint. During sub-surface investigations, soil bore holes were drilled to a depth of 150 ft., and no contamination was found (reference W-135 Project CSA Geotechnical Report 22-1-40034-006).

Site walk downs and corner staking efforts also identified the presence of ecology blocks on the north and east sides of the current site. Some ecology blocks will be removed and/or relocated to support fence line installation and CSA access haul path construction. The current ecology block configuration and installation requirements have been evaluated and modified to ensure that their function is otherwise met.

The CSA north boundary is located 20 ft from the existing overhead medium voltage power line to comply with Hanford Electrical Utilities' Right of Way requirements.

3.4 Technical Design Changes that Differ from CDR

The following provides a listing of major design items that have changed since the time the conceptual design was performed:

- Elimination of the need for the Storage, Laydown, and Fabrication (SLF) area.
- The inclusion of a fire water line and associated fire hydrants.
- The size and thickness of the CSP and Operations Pad (less volume of concrete).
- Quantity of casks (16 ea. for CDR).
- The requirement for a weathertight enclosure (building) for the TMS changed to a three-sided protective shelter.

- Terminal box rack is safety significant (see CHPRC-03774, *Capsule Storage Area Safety Equipment List*).

4.0 DESIGN

The following sections of this FDR and the design media contained in the appendices constitute the final design for the CSA portion of Project W-135. The final design includes the CSA, including the CSP, operating pad, fencing, lighting, and support devices for the TMS; haul path improvements between the WESF truck-loading pad and Atlanta Avenue; and haul path improvements on 7th Street.

The remainder of Section 4.0 and its subsections describe the civil/structural, geotechnical and electrical engineering and design approach associated with the CSA portion of Project W-135. The subsections are organized by discipline and reflect the final design approach implemented for each discipline-based portion of the design.

4.1 Civil/Structural Engineering

The civil/structural design for the CSA portion of Project W-135 addresses design of the CSA, including the CSP and operating pad; haul path improvements between the WESF truck loading pad and Atlanta Avenue; and haul path improvements on 7th Street. These design topics are described and detailed in the following subsections.

4.1.1 CSA (Including CSP and Operational Pad)

The CSA layout, as shown on the project drawings, is adequate to support the delivery and receipt of the VCCs, Transportable Storage Canisters (TSCs), and VCC lids, including storage of this equipment on the operating pad and CSP. The CSP is the concrete foundation upon which the CSSs will be placed for interim storage and is designed to accommodate 25 CSSs containing all MCSC-associated cesium and strontium capsules. There is sufficient remaining space available on the operating pad for manipulation and assembly of the VCCs, TSCs, and VCC lids. As the VCCs are assembled, they will be relocated to the north end of the operating pad in order to provide access to the CSP for placement of the full VCCs.

The design of the CSA yard calls for it to be cleared, grubbed, and graveled with the gravel being compacted and graded to allow for runoff away from the CSP and operating pad. Eight-foot high security fencing around both the CSA and the CSP has been designed to provide a safe and secure area. The fencing also includes vehicular and personnel access gates to facilitate safe and efficient work efforts in the area. The personnel access gates are equipped with crash bars that exit the area.

The need for fire hydrants to supply fire water to the CSA was incorporated into the design as dictated in Section 5.2.4 of CHPRC-02623, Rev. 2, *Capsule Storage Area CSA Functional Design Criteria.* The current design calls for a new 12-in fire water line to be installed along 7th Avenue to tie into the existing 12-in buried fire water line near the WESF and the CSB facilities. Two fire hydrants will be installed to provide fire protection at the CSA and two additional fire hydrants will be installed near the WESF.

Design of the CSP has been performed using Seismic Design Category (SDC)-2, Limit State (LS) C loading conditions, as defined in PRC-PRO-EN-097, *Engineering Design and Evaluation (Natural Phenomena Hazard)*, loading data for the VCCs, VCT and tug provided by the CSS contractor, and loading data for a typical crane that will be used for moving the VCCs within the CSA. The CSP was also designed to withstand the loads imposed on it by a cask being dropped from the VCT. The drop height is limited to 9 in. for an end drop per CHPRC-02623 and NAC International Document No. 30059-2020 Rev. 0. Following the guidelines of the Electric Power Research Institute (EPRI) technical report TR-108760, *Validation of EPRI Methodology of Analysis of Spent-Fuel Cask Drop and Tipover Events*, it was determined that the CSP is capable of withstanding an end drop from a height of approximately 10.5 in. and is adequate for the given project requirements. (See CHPRC-02539.)

A review was performed to determine the impact of radiation and high temperatures imposed on the CSP by the stored VCCs (see CHPRC-02539, *Design Analysis of the Concrete Pads for the 200 East Capsule Storage Area (CSA), Project W-135*, Attachment 6). This review concluded that radiation is not considered a major factor in concrete life degradation in this application and that temperature would be the limiting factor. It also determined that the limiting temperature value for concrete to experience serious degradation is approximately 572°F. The difference in volume changes in the aggregate and cement paste will not be detrimental as long as temperatures remain below this threshold. At temperatures below 572°F, the concrete may experience a 20% reduction in its compressive strength. This reduction is included in the structural analysis of the CSP (CHPRC-02539). The maximum bounding temperature for the CSP is 400°F per FDC CHPRC-02623, MCSC-CSS and Cask Array Shielding Evaluation 30059-5004 Rev. 0.

It is anticipated to use a mobile crane to assist with VCC component assembly on the operating pad. All crane operations shall meet the limited approach boundary requirements in DOE-0359 and the hoisting and rigging requirements in DOE-STD-1090-2011.

Further analysis was performed on the cement and aggregate materials with respect to the maximum bounding temperature of 400°F. The results of the analysis determined that the cement and aggregate specified in Construction Specification CHPRC-02534, *W-135 Capsule Storage Area Construction Specification* meet the requirements of ACI-349.

The operating pad is not currently required to meet the SDC-2 requirements but will be used for storage of empty canisters. It is therefore being designed to the same structural standards as the CSP.

The enclosure for the TMS and electrical panels is not safety-related but is consider a 3 over 1 issue as the TMS is safety significant (see CHPRC-03774). The design and anchorage for the enclosure was therefore performed using safety-significant loading conditions.

The TMS TBX rack assemblies are safety significant and were designed and specified to the appropriate safety-significant requirements.

4.1.2 Transfer Roadway and Haul Path Improvements

An assessment was performed of the transfer roadway and facility access haul path between the WESF and the CSA for transfer of the VCCs (see Appendix C). Several areas have been identified for improvement based upon multiple site walk downs and field measurements, meetings with MSA and CHPRC, review of marked up and annotated drawings from MSA (see CHPRC-03328), and review of VCT documentation. These areas include widening of Atlanta Avenue at the WESF turn off, and the widening of 7th Street from Atlanta Avenue to the CSA haul path turn off. As the design evolves, it is possible other necessary improvements may emerge.

An evaluation has been performed to assess the need to remove, relocate, and/or protect existing below- and above-grade utilities. This evaluation is documented on Drawings H-2-837591, H-2-837593, H-2-837594, H-2-837596, H-2-837606, H-2-837607, and H-2-837608. Multiple buried water (e.g., raw, sanitary), electrical, and radioactive lines were identified throughout the project area. Of particular note are the lines in the WESF access path to Atlanta Avenue and electrical and radioactive liquid lines on the north side of the CSA/CSP location along 7th Street. Overhead lines are located in the vicinity of the WESF access path and on the north side of the CSA/CSP location along 7th Street.

4.2 Geotechnical

CHPRC engaged the services of a geotechnical contractor to perform the geotechnical investigation of the CSA site. The final geotechnical report has been issued and the geotechnical investigation has been completed (reference W-135 Project CSA Geotechnical Report 22-1-40034-006). The design recommendations from this report are included in this final design.

4.3 Electrical Engineering

4.3.1 Power Distribution

Power for the CSA lighting and TMS will be provided from a new pole-mounted utility transformer supplied by the nearby existing 13.8kV overhead line. Service equipment, metering, and a power distribution panelboard will be installed in the TMS protective structure. Convenience receptacles will be installed in the protective structure and in each lighting pole.

Power to the CSA is 120/240V single phase, so an arc flash hazard evaluation does not apply and was not performed.

4.3.2 Lighting

Pole-mounted LED floodlights will be installed at the CSA outside of the outer fence line so most maintenance can be performed without entering either property protection fence. A maintenance road will be installed to the lighting poles. An integral convenience receptacle will be installed in each lighting pole above the handhole.

Lighting fixture selection considered energy efficiency guidance documents including DOE O 436.1, *Departmental Sustainability*; DOE G 413.3-6A, *High Performance Sustainability*

Building Requirements; and, Executive Order 13693, *Planning for Federal Sustainability in the Next Decade*.

LED floodlights were selected for long lamp life and low energy usage. Tapered aluminum round poles with internal vibration dampers were selected over steel poles. Aluminum poles have a 50-year service life versus 20 to 30 years for steel poles, and tapered round poles resist vibration damage from sustained wind better than straight round poles and square poles.

Calculation CHPRC-02535, *W-135 Capsule Storage Area Lighting Calculation*, was performed to determine lighting fixture spacing and pole heights to meet the design criteria in CHPRC-02623.

4.3.3 Access Control

There are no access control requirements that require power, signal, or video.

4.3.4 Temperature Monitoring System

Signal cables and raceways for the TMS will be provided from the TMS control cabinet to temperature sensors mounted on the VCCs and to ambient air temperature sensors near the CSP and at the TMS protective shelter.

Remote alarm signals for high temperature and loss of power will be routed to the CSB, and an annunciator installed in the CSB operations control room. Four spare annunciator windows and associated cabling from CSA to CSB will be provided for future alarms.

Power, lighting, and a protective shelter will be provided for the TMS control cabinet.

CSS-CSA interface locations:

- Field wiring terminals in the TMS control cabinet;
- Anchorage of TMS control cabinet to TMS protective shelter concrete slab;
- Field wiring terminals in ambient air temperature sensors;
- Mounting of ambient air temperature sensors; and
- Cable connectors inside the VCC junction box mounted on each VCC.

TMS components that are government furnished equipment (by CSS contractor):

- TMS control cabinet;
- Ambient air temperature sensors;
- VCC temperature sensors;

- VCC junction boxes and female connectors inside each junction box with wiring to VCC temperature sensors; and
- Conduit support mounted on VCC below VCC junction box for field-installed conduit.

Safety-significant TMS components based on CHPRC-03774:

- Signal cables from TMS control cabinet to VCC junction boxes (see H-2-837601, Sht. 1; H-2-837602, Sht 1; H-2-837606, Sht 1 Details 4 and 5; and, H-2-837608, Shts 1-3);
- Terminal boxes and terminal box racks (see H-2-837607, Shts 1-2);
- Slab for TMS protective shelter (see H-2-837599, Sht 1); and
- Anchorage of the TMS control cabinet (see H-2-837605, Sht 1).

General-service TMS components based on CHPRC-03774:

- Ambient air temperature sensors;
- TMS conduit and raceways;
- TMS protective shelter;
- CSB annunciator and remote alarm signals;
- Signal cables from TMS control cabinet to ambient air temperature sensors and CSB annunciator; and
- Power conductors and conduit to all TMS components.

The TMS Failure Modes and Effects Analysis and TMS component Safety Integrity Level (SIL) analysis are being performed by others. However, in order to prevent common cause, common mode, and dependent failures as described in ANSI/ISA-84.00.01, *Functional Safety: Safety Instrumented Systems for the Process Industry Sector*, physical separation of safety-significant cabling was implemented where practicable. For example, individual triad cables were specified rather than multi-triad cables, and four single-cable connectors rather than one four-cable connector were specified for cables to the VCC junction box. Physical separation requirements for safety-significant and general-service components were specified on drawings.

Temperature data for the CSP is located in NAC Document MCSC VCC Thermal Evaluations 30059-3001, Appendix J, which was provided as a design input for selection of TMS conductors and conduit. TMS conductor insulation is rated for 105°C/221°F which is above the worst-case temperature. The conductor type that was selected by the CSS design team for installation on the VCC is also specified on the CSA drawings for conductors between the VCCs and the TMS Control Cabinet.

Conductor types were reviewed by the CSS design team for compatibility with the TMS Control Cabinet termination points.

TMS conductor connectors in the VCC junction boxes were selected by the CSS design team, and a mating connector was specified on the CSA drawings.

The need for temporary shielding during electrical work at the VCC will be analyzed by the CSS design team. Design and analysis of temporary shielding, if determined to be required, will also be performed by others.

4.3.5 Lightning Protection

A lightning risk assessment was documented in CHPRC-02536, *W-135 Capsule Storage Area Lightning Risk Assessment*, in accordance with NFPA 780-2014, *Standard for the Installation of Lightning Protection Systems,* Annex L.

Since the tolerable lightning frequency is greater than the annual threat of occurrence, a lightning protection system is not recommended and has not been included in the scope of this effort.

4.3.6 Telecommunications

There are no requirements for installation of telephone or HLAN at the CSA.

There is currently no public address system (PAX) coverage at the CSA. The existing PAX at the CSB will be extended by MSA Telecommunications. MSA will perform both design and installation, and the cost estimate provided by MSA is included in the CSA construction estimate.

MSA will be engaged during construction to design, install, and test the PAX system wiring and speakers. PAX system conduit from the CSB to the CSA, for use by MSA, is shown on drawings H-2-837601 and H-2-837603.

4.3.7 WESF Truck Port Overhead Line Obstructions

There are multiple overhead lines blocking VCT access to the WESF truck port. All overhead lines blocking access will be removed. The series lighting line and some telecommunications lines are for legacy systems and will be permanently removed by MSA Electrical Utilities and MSA Telecommunications. Overhead lines for active power and telecommunications systems will be relocated to underground.

4.4 Functional Elements

CHPRC-02623 provides the design requirements and technical baseline for the CSA portion of Project W-135. The following sections describe the Project W-135 functional elements and their applicable requirements.

4.4.1 Fire Protection

CHPRC-03299, *Preliminary Fire Hazards Analysis for the Management of the Cesium and Strontium Capsules Project (W-135),* recommends the installation of crash bars at all personnel access gates. Therefore, the CSA personnel entry gates shall have crash bars for egress. Crash bars ensure that occupants would not be locked inside the CSA. For final design, personnel entry gates with crash bars for all protection fences at the CSA have been provided.

It was initially determined that it was unlikely that the CSA would need a fire hydrant water supply since the amount of combustible material stored will be minimal and wildland exposure fire separation distances appear to be adequate. This issue was re-evaluated, and it was determined that fire hydrants will be required at the CSA to provide fire protection. Worker Health and Safety

Project W-135 follows PRC-MP-SH-32219, *Worker Safety and Health Program Description*, which complies with Title 10, *Code of Federal Regulations*, Part 851, "Worker Safety and Health Program" (10 CFR 851), which invokes applicable parts of the following:

- Title 29, Code of Federal Regulations, Part 1926, "Safety and Health Regulations for Construction" (29 CFR 1926); and

- Title 29, *Code of Federal Regulations,* Part 1910, "Occupational Safety and Health Standards" (20 CFR 1910).

Project W-135 will use the CHPRC Integrated Safety Management System described in PRC-MP-MS-003, *Integrated Safety Management System/Environmental Management System Description*, to identify specific hazards associated with any given task.

As noted previously, the CSA personnel entry gates should have crash bars for egress. Crash bars would ensure that occupants would not be locked inside the CSA. For final design, personnel entry gates with crash bars for all protection fences at the CSA have been identified as a requirement.

For final design, it is assumed that the crane or equipment designation, as appropriate, has been assigned to the VCT in support of the applicable limited approach boundary requirements of DOE-0359.

4.4.2 Radiological Control

ALARA is the project's approach to radiation protection management. Controlling exposures (both individual and collective) to the work force and to the general public is paramount to successful implementation of any project. Fundamentally, ALARA is not a dose limit; it is a process that has the objective of attaining doses as far below the applicable limits as is reasonably achievable.

As a general approach, the ALARA principles will be incorporated into the design and will include the requirements of Title 10, *Code of Federal Regulations,* Part 835, "Occupational Radiation Protection" (10 CFR 835) Subpart K, "Design and Control." The basic requirements

concerning the use of ALARA aspects related to this design are imposed in CHPRC-00072, *CHPRC Radiation Protection Program*, CHPRC-00073, *CHPRC Radiological Control Manual*, and PRC-PRO-RP-1622, *CHPRC Radiological Design Review Process*.

Physical design features (distance) will be the primary method used to maintain exposures ALARA. The security/property protection fencing is the primary feature of the CSA in providing exposure control via access control to the CSA and CSP and sufficient distance to the CSA outer fence line to meet exposure limitation requirements. Based upon the results from the CSS design team's shielding analysis, the design dose rate at the outer fence line is less than or equal to 0.5 mRem/hr. As indicated in document 30059-5004 Rev. 0, the dose rates within the controlled area of the CSP are expected to be higher than those near the outer fence line. The CSS design team is responsible for the design of the VCC's shielding to meet these exposure limits at the fence line and within the CSA. It is expected that a combination of both engineering and administrative controls will be required to minimize exposure. The CSA design will provide some elements of those measures via the fencing for controlled area access limitation.

Another example of physical design features is locating the flood lamp/security lighting poles outside of the outer fence line so that maintenance can be performed without the need of entering the controlled area of the CSP. This is also an ALARA measure as the dose rates within the controlled area of the CSP are expected to be higher than those near the outer fence line. These design features are specifically identified in the discipline-based subsections (i.e., civil/structural and electrical) of Section 4.0 and the corresponding final design media. Optimization methods will be used to ensure that occupational exposure is maintained ALARA in developing and justifying the facility design and controls.

The method of connecting TMS wiring and conduit to the VCCs is shown on H-2-837606. The use of connectors in the VCC junction box, pre-installed conduit support on the VCC, and pre-made cables with connectors minimizes workers' time near the VCC while incorporating reliability into the installation. The dose rate at the VCC is reflected in MCSC-CSS and Cask Array Shielding Evaluations 30059-5004. The need for temporary shielding will be analyzed by others. Design and analysis of temporary shielding, if determined to be required, will also be done be others.

4.4.3 Environmental

The CSA portion of Project W-135 will conform to applicable Federal and State regulations. Project demolition and decommissioning will be accomplished in accordance with Hanford Site and CHPRC waste management, waste minimization, and demolition and decommissioning requirements.

Initial assessment has identified that the CSA siting location and at least two of the transport road/haul path road improvement/widening areas are adjacent to known and documented WIDS sites as noted below:

- The CSA siting location is adjacent to UPR-600-20.
- The CSA Access Roadway is adjacent to UPR-600-20 and possibly UPR-200-E-64.

- The WESF access roadway is adjacent to UPR-200-E-64 and possibly UPR-200-E-54, as well as 216-B-64.

Final Design is based on the following:

- Assumption: The CSA site is free of contamination (see Site Evaluation Report, 2E-11-09, *Cesium and Strontium Capsules Dry Storage Project*; and Shannon & Wilson Geotechnical Engineering Report No. 22-1-40034-006, *Geotechnical Engineering Report W-135 Project Capsule Storage Area*);

- The CSA construction footprint does not encroach on adjacent WIDS sites; and

- The CSA construction does not encroach on existing groundwater wells.

There are no known issues in the designated CSA site; however, the site radiological investigation is limited based upon Site Evaluation 2E-11-09. Further review is required of an area of contaminated soil (UPR-600-20) in the vicinity of the CSA site. A surface radiological survey of the CSA construction area was performed on March 16, 2018, Survey Report #CS-1800128 – no contamination was identified. CHPRC is planning to perform another radiological survey of the CSA footprint prior to the initiation of construction activities.

4.4.4 Safeguards and Security

Fence lines will be provided at the CSA for property protection per the security assessment. There will be two fence lines, one around the entire CSA and one around the CSP. The fences are designed as 8-ft-high chain link fence with outriggers and 3-strand barb wire. There will be a single vehicular gate in each fence. There will be three personnel gates in the outer fence and two in the inner fence; these gates will have emergency crash bars. All gates will have security lock capability (see Security Assessment HNF-2017-60846).

4.4.5 Criticality

There are no fissile materials associated with the cesium and strontium capsules; therefore, criticality is not a concern and criticality control measures are not a requirement of Project W-135.

4.4.6 Quality Assurance

Project activities have been performed in accordance with the ARES approved Quality Assurance (QA) Program and implementing procedures. This program meets the requirements of American Society of Mechanical Engineers (ASME) NQA-1-2008, *Quality Assurance Requirements for Nuclear Facility Applications*, with the ASME NQA-1a-2009 addenda. ASME NQA-1 is the implemented standard endorsed by DOE O 414.1D, *Quality Assurance*; and 10 CFR 830, Subpart A, "Quality Assurance Requirements." Application of QA requirements of 10 CFR 830.122, "Quality Assurance Criteria," were applied to items and activities using a graded approach as defined in PRC-PRO-QA-259, *Graded Approach*; and PRC-PRO-NS-700. Quality requirements of CHPRC-00189, *CH2M HILL Plateau Remediation Company Environmental Quality Assurance Program Plan*, were applied.

Per CHPRC-03774, the safety-significant items for the CSA Project are as follows:

- Concrete Storage Pad
  - Concrete
  - Reinforcing steel

- Temperature Monitoring System
  - TMS Control Cabinet (by CSS Contractor)
  - TMS Control Cabinet Anchors
  - Signal Cables
  - Terminal Boxes
  - Terminal Box Racks and Concrete Footings
  - TMS Control Cabinet Slab (concrete and reinforcing steel).

5.0 FINAL DESIGN DOCUMENT INVENTORY

Table 5-1 represents the final design media for the CSA portion of Project W-135.

Table 5-1. Final Design Media.

Document No.	Title
Drawing List	
H-2-837589-1	Capsule Storage Area Drawing List & Title Sheet
Drawings - Civil/Structural	
H-2-837590-1	Capsule Storage Area Abbreviations, Legend & General Notes
H-2-837591-1	Capsule Storage Area Civil Overall Site Plan
H-2-837592-1	Capsule Storage Area Civil Grading Plan
H-2-837593-1	Capsule Storage Area Civil Enlarged Plan
H-2-837594-1	Capsule Storage Area Civil Fire Water Plan & Profile
H-2-837594-2	Capsule Storage Area Civil Fire Water Plan & Profile
H-2-837596-1	Capsule Storage Area Civil Truck Port Apron Area Enlarged Plan
H-2-837597-1	Capsule Storage Area Civil 7th Street Enlarged Plan
H-2-837598-1	Capsule Storage Area Civil Fire Water Details
H-2-837598-2	Capsule Storage Area Civil Fire Water Details
H-2-837598-3	Capsule Storage Area Civil Fire Water Details
H-2-837598-4	Capsule Storage Area Civil Sections & Details
H-2-837598-5	Capsule Storage Area Civil Pad Marking Details
H-2-837598-6	Capsule Storage Area Civil Security Fence Details
H-2-837599-1	Capsule Storage Area Civil Electrical Enclosure Slab
Drawings - Electrical/Instrumentation	
H-2-837600-1	Capsule Storage Area Electrical One-Line Diag and Panel Schedule
H-2-837601-1	Capsule Storage Area Electrical CSA Enlarged Plan
H-2-837602-1	Capsule Storage Area Instrumentation CSP Enlarged Plan
H-2-837603-1	Capsule Storage Area Electrical CSB Enlarged Plan
H-2-837604-1	Capsule Storage Area Electrical Truck Port Enlarged Plan

Table 5-1. Final Design Media.

Document No.	Title
H-2-837605-1	Capsule Storage Area Electrical Power & TMS Assembly
H-2-837606-1	Capsule Storage Area Electrical Details
H-2-837607-1	Capsule Storage Area Instrumentation TMS TBX Rack Assembly
H-2-837607-2	Capsule Storage Area Instrumentation TMS TBX Rack Assembly
H-2-837608-1	Capsule Storage Area Electrical Wire Run & Cnd Schedule
H-2-837608-2	Capsule Storage Area Electrical Wire Run & Cnd Schedule
H-2-837608-3	Capsule Storage Area Electrical Wire Run & Cnd Schedule
H-2-837609-1	Capsule Storage Area Instrumentation TMS Annunciator Assembly
H-2-837609-2	Capsule Storage Area Instrumentation TMS Annunciator Assembly
H-2-837609-3	Capsule Storage Area Instrumentation TMS Annunciator Diagrams
H-2-837610-1	Capsule Storage Area Electrical 1PH Xfmr Pole Assembly
H-2-837610-2	Capsule Storage Area Electrical Lighting Pole Assembly
H-2-837610-3	Capsule Storage Area Electrical Pole Elevations
H-2-837610-4	Capsule Storage Area Electrical Downguy/Anchor Assembly
Calculations - Civil/Structural	
CHPRC-02539	Design Analysis of the Concrete Pads for the 200 East Capsule Storage Area (CSA), Project W-135
CHPRC-02532	Storm Water Evaluation for W-135 CSA and WESF Truck Loading Area
CHPRC-03632	Design and Analysis of Road Improvements for Project W-135
CHPRC-03634	Anchorage Analysis of the CSA TMS Electrical Equipment Enclosure
CHPRC-03635	Structural Analysis of CSA Electrical Equipment Racks and TMS Anchorage (Safety-Significant)
Calculations - Electrical	
CHPRC-02535	W-135 Capsule Storage Area Lighting Calculation
CHPRC-02536	W-135 Capsule Storage Area Lightning Risk Assessment
Procurement Specifications	
CHPRC-02540	W-135 Capsule Storage Area Procurement Specification for Aluminum Cantilever Slide Gates
CHPRC-03633	W-135 Capsule Storage Area Procurement Specification for Prefabricated Electrical Equipment Enclosure
Construction Specification	
CHPRC-02534	W-135 Capsule Storage Area Construction Specification
Supporting Documents	
046414.17.01-007	Design/Construction Verification Plan for Project W-135 Capsule Storage Area
CHPRC-02533	W-135 Capsule Storage Area Construction Acceptance Test Plan
CHPRC-02537	Capsule Storage Area Preliminary Design Report (Project W-135)
CHPRC-02538	Capsule Storage Area Final Design Report (Project W-135)
CHPRC-03828	Project W-135 Capsule Storage Area Cost Estimate Package
Facility Modification Packages	
ECR-18-000990	CSA Temperature Monitoring System Annunciator Installation
ECR-18-000991	Modify Service Lateral to Bldgs 225-BA, 282-B, and 282-BA

6.0 APPLICABLE REQUIREMENTS

Applicable requirements will be passed down to sub-tier contractors as applicable and implementation of those requirements will be verified. The specific technical and quality requirements, material certifications, qualification and certification of personnel, inspections, examinations/testing, and applicable QA records have been established during the final design phase and included in the final design documents. Contractors will have an effective program preventing the introduction of suspect/counterfeit items through the design, procurement, fabrication, and modification process, as described in DOE G 414.1-2B, *Quality Assurance Program Guide*, Section 5.0, "Guidance on Suspect and Counterfeit Items," and DOE O 414.1D.

6.1 Cost Estimate and Project Schedule

A Construction Cost Estimate and Schedule have been prepared which contain all cost and schedule activities associated with procurement and construction.

A Work Breakdown Structure was used to organize the cost estimate and construction schedule.

The cost estimate was prepared utilizing the design media shown in Section 5.0 as the technical basis. The CDR Project Cost Estimate was also used as a reference. Given the level of current detail, costs were derived using a quantity-based cost estimating approach by developing costs for each estimate detail at the cost element level (examples of cost elements are labor, material, equipment, etc.). Appropriate mark-ups, from labor productivity factors to sales tax, have also been applied to arrive at a total cost for each estimate detail. A Cost Estimate Basis, which explains the technical basis, organization, methodology, and assumptions used to create the estimate, was also prepared.

The Construction Cost Estimate is provided under separate cover. See CHPRC-03828, *Project W-135 Capsule Storage Area Cost Estimate Package*.

7.0 DESIGN COMPLETION STRATEGY/CONSTRUCTION ACQUISITION PLAN

CHPRC directed the Architect/Engineer during the final design phase, and will obtain construction contractors, equipment vendors, and independent inspectors as required to execute the CSA Construction Phase of Project W-135. CHPRC will provide the project management and engineering support to effectively and efficiently manage the work scope. This includes management of all contractors (including cost, schedule, and technical baselines), providing technical direction, reporting performance, preparation, and maintenance of required project documentation, permitting, and QA-related activities.

CHPRC will utilize the final design to assemble bid packages to competitively solicit a contract in order to perform all construction activities for the project.

CHPRC will also perform all construction management activities supporting the project. It is anticipated that CHPRC will retain the same Architect/Engineer who prepared the final design to perform engineering support during construction activities.

8.0 REFERENCES

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

10 CFR 835, "Occupational Radiation Protection," *Code of Federal Regulations,* as amended.

10 CFR 851, "Worker Safety and Health Program," *Code of Federal Regulations,* as amended.

29 CFR 1910, "Occupational Safety and Health Standards," *Code of Federal Regulations,* as amended.

29 CFR 1926, "Safety and Health Regulations for Construction," *Code of Federal Regulations,* as amended.

80 FR 57, 2015, "Executive Order 13693–Planning for Federal Sustainability in the Next Decade," *Federal Register*, Vol. 80, pp. 15871-15884 (March 25).

ASME NQA-1, 2008 Edition, *Quality Assurance Requirements for Nuclear Facility Applications*, American Society of Mechanical Engineers, New York, New York.

ANSI/ISA-84.00.01, *Functional Safety: Safety Instrumented Systems for the Process Industry Sector*, ISA, Research Triangle Park, North Carolina.

CHPRC-00072, 2017, *CHPRC Radiation Protection Program*, Rev. 7, CH2M HILL Plateau Remediation Company, Richland, Washington.

CHPRC-00073, 2017, *CHPRC Radiological Control Manual*, Rev. 12, CH2M HILL Plateau *Remediation* Company, Richland, Washington.

CHPRC-00189, 2017, *CH2M HILL Plateau Remediation Company Environmental Quality Assurance Program Plan*, Rev. 14, CH2M HILL Plateau Remediation Company, Richland, Washington.

CHPRC-02236, 2017, *Waste Encapsulation and Storage Facility Management of Cesium and Strontium Capsules (Project W-135) Safety Design Strategy*, Rev. 1, CH2M HILL Plateau Remediation Company, Richland, Washington.

CHPRC-02252, 2017, *Management of the Cesium and Strontium Capsules Project (W-135) Functions and Requirements Document*, Rev. 3, CH2M HILL Plateau Remediation Company, Richland, Washington.

CHPRC-02264, *MCSC Project Execution Plan for the Management of the Cesium and Strontium Capsules (MCSC) Project (W-135)*, Rev. 2, CH2M HILL Plateau Remediation Company, Richland, Washington.

CHPRC-02535, 2018, *W-135 Capsule Storage Area Lighting Calculation*, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington.

CHPRC-02536, 2018, *W-135 Capsule Storage Area Lightning Risk Assessment*, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington.

CHPRC-02537, 2018, *Preliminary Design Report W-135 Capsule Storage Area Project*, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington.

CHPRC-02623, 2018, *Capsule Storage Area (CSA) Functional Design Criteria (Project W-135)*, Rev. 4, CH2M HILL Plateau Remediation Company, Richland, Washington.

CHPRC-03299, *Preliminary Fire Hazards Analysis for the Management of the Cesium and Strontium Capsules Project [W-135]*, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington.

CHPRC-03328, 2017, *Capsule Storage Area Conceptual Design Report (Project W-135)*, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington.

CHPRC-03774, 2018, *Capsule Storage Area Safety Equipment List*, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington.

CHPRC-03792, 2018, *Capsule Storage Area Code of Record (Project W-135)*, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington.

CHPRC-03828, 2018, *Project W-135 Capsule Storage Area Cost Estimate Package*, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington.

DOE G 413.3-1 Chg 1 (Admin Chg), 2008, *Managing Design and Construction Using Systems Engineering for Use with DOE O 413.3A*, U.S. Department of Energy, Washington, D.C.

DOE G 413.3-6A Chg 1 (Admin Chg), 2011, *High Performance Sustainability Building Requirements*, U.S. Department of Energy, Washington, D.C.

DOE G 414.1-2B Chg 2 (Admin Chg), 2011, *Quality Assurance Program Guide*, U.S. Department of Energy, Washington, D.C.

DOE O 413.3A/B, 2010, *Program and Project Management for the Acquisition of Capital Assets*, U.S. Department of Energy, Washington, D.C.

DOE O 414.1D Chg 1, 2011, *Quality Assurance*, U.S. Department of Energy, Washington, D.C.

DOE O 436.1, 2015, *Departmental Sustainability*, U.S. Department of Energy, Washington, D.C.

DOE-0359, 2018, *Hanford Site Electrical Safety Program (HSESP)*, Rev. 3-1, U.S. Department of Energy, Richland, Washington.

DOE/RL-2012-47, *Mission Need Statement for the Management of the Cesium and Strontium Capsules*, Rev. 6, U.S. Department of Energy, Richland, Washington.

DOE-STD-1090-2011, *Hoisting and Rigging*, U.S. Department of Energy, Washington, D.C.

DOE-STD-1189, 2016, *Integration of Safety into the Design Process*, U.S. Department of Energy, Washington, D.C.

EPRI TR-108760, 1997, *Validation of EPRI Methodology of Analysis of Spent-Fuel Cask Drop and Tipover Events*, Electric Power Research Institute, Palo Alto, California.

Geotechnical Engineering Report W-135 Project Capsule Storage Area, Report No. 22-1-40034-006, Rev. 0, Shannon & Wilson, Inc., Pasco, Washington.

NAC International Document No. 30059-P-01, *MPC-Capsule Storage System (MPC-CSS) Operations and Maintenance Manual*, Rev. B, NAC International, Norcross, Georgia.

NFPA 780, 2014, *Standard for the Installation of Lightning Protection Systems*, National Fire Protection Association, Quincy, Massachusetts.

PRC-MP-MS-003, 2016, *Integrated Safety Management System/Environmental Management System Description*, Rev. 4, Change 0, CH2M HILL Plateau Remediation Company, Richland, Washington.

PRC-MP-SH-32219, 2015, *Worker Safety and Health Program Description*, Rev. 2, Change 1, CH2M HILL Plateau Remediation Company, Richland, Washington.

PRC-PRO-EN-097, 2015, *Engineering Design and Evaluation (Natural Phenomena Hazard)*, Rev. 2, CH2M HILL Plateau Remediation Company, Richland, Washington.

PRC-PRO-NS-700, 2015, *Safety Basis Development*, Rev. 2, Change 0, CH2M HILL Plateau Remediation Company, Richland, Washington.

PRC-PRO-QA-259, 2017, *Graded Approach*, Rev. 2, Change 0, CH2M HILL Plateau Remediation Company, Richland, Washington.

PRC-PRO-RP-1622, 2017, *CHPRC Radiological Design Review Process*, Rev. 2, Change 0, CH2M HILL Plateau Remediation Company, Richland, Washington.

PRC-STD-EN-40255, 2015, *Functional Design Criteria*, Rev. 0, Change 5, CH2M HILL Plateau Remediation Company, Richland, Washington.

PRC-STD-EN-40258, 2011, *Preliminary/Final Design Report*, Rev. 0, Change 1, CH2M HILL Plateau Remediation Company, Richland, Washington.

Site Evaluation 2E-11-09, 2011, *Cesium and Strontium Capsules Dry Storage Project*, CH2M Plateau Remediation Company, Richland, Washington.

Statement of Work, *Detailed Design for W-135 WESF Modifications and Capsule Storage Area*, Rev. 4, CH2M HILL Plateau Remediation Company, Richland, Washington.

APPENDIX A

FUNCTIONAL DESIGN CRITERIA COMPLIANCE MATRIX

Management of the Cesium and Strontium Capsules Project (W-135)
FDC Design Verification Matrix
CSA Final Design

Item No.	Requirement Basis (CHPRC-02623 Section No.)	Requirement Text	Requirement Met? Y (Yes), N (No), or N/A	How was the requirement met? Provide reference to where evidence is found in design output document or explain why the item is N/A.	Verification Method
Applicable Project Requirements:					
	4	**Major Systems, Functions, and Requirements**			
	4.1	**Capsule Storage Area**			
1	4.1	The CSA will include a concrete operating area adjacent to the CSP sufficient for CSS placement activities and surveillance and maintenance operations. The remainder of the CSA will be graded, compacted gravel.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawing H-2-837593 and in Appendix C of CHPRC-02538, which provides an analysis of the handling and placement of the VCCs.	Design Review
2	4.1	The fencing will be used to limit radiological exposure to non-radiological workers from the loaded CSSs and will provide required physical security.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawings H-2-837593 and H-2-837598, Sheet 6; HNF-2017-60846; and NAC 30059-5004, Rev. 0.	Design Review
3	4.1	The CSA shall include features to address stormwater, in a manner that does not interfere with the operation of the CSS (e.g., passive cooling).	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawings H-2-837592 and H-2-837593, as well as CHPRC-02532, *Storm Water Evaluation for W-135 CSA and WESF Truck Loading Area.*	Design Review
	4.1.1	**Siting**			
4	4.1.1	The CSA will be located in the 200E Area approximately 0.17 miles from WESF	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawing H-2-837591.	Design Review
5	4.1.1	The CSA design contractor shall be responsible for identifying any potential utility interferences based on the selected design solution, including but not limited to the potential interferences describe above, and proposing the best means for resolving them to CHPRC.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed within drawings H-2-847590, H-2-837593, H-2-837594, H-2-837596, H-2-837597, and H-2-837604, as well as Section 31 20 00 of CHPRC-02534, *W-135 Capsule Storage Area Construction Specification* . The referenced drawings inlcude information gathered through an extensive document search and subsurface geophysical investigations.	Design Review
	4.1.2	**Capsule Storage Pad**			
6	4.1.2	The CSP shall be within the CSA fenced area.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawing H-2-837593.	Design Review
7	4.1.2	The CSP shall be designed to accommodate 25 CSSs containing all MCSC-associated cesium and strontium capsules, and shall be designed to allow for routine surveillance and monitoring as required by the CSS design requirements, the *Resource Conservation and Recovery Act of 1976* (RCRA) permit, and operations procedures.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawing H-2-837593 and CHPRC- 02539, *Design Analysis of the Concrete Pads for the 200 East Capsule Storage Area (CSA), Project W-135.*	Design Review
8	4.1.2	The CSS design and operational approach for placing the CSSs on the CSP will include a concrete operating area adjacent to the CSP sufficient for CSS operations, and surveillance and maintenance operations.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawing H-2-837593 and CHPRC- 02539, *Design Analysis of the Concrete Pads for the 200 East Capsule Storage Area (CSA), Project W-135.*	Design Review
9	4.1.2	Reinforced concrete pads that support confinement casks in storage do not constitute "pavements." As such, the CSP shall be designed and constructed as foundations under an applicable code.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawing H-2-837593 and CHPRC-02539, *Design Analysis of the Concrete Pads for the 200 East Capsule Storage Area (CSA), Project W-135.*	Design Review
10	4.1.2	The CSP design shall be based on the CSS design/fabrication contractor's anticipated storage layout, and shall consider loading from the CSS drop and tip-over analysis.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawing H-2-837593 and CHPRC- 02539, *Design Analysis of the Concrete Pads for the 200 East Capsule Storage Area (CSA), Project W-135.*	Design Review
11	4.1.2	Based on these assumptions, the CSP shall be a square design, 90 ft on each side.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawing H-2-837593.	Design Review

Management of the Cesium and Strontium Capsules Project (W-135)
FDC Design Verification Matrix
CSA Final Design

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Applicable Project Requirements:					
12	4.1.2	The elevation of this pad shall be above the finish grade of the CSA as required to promote drainage.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawings H-2-837592 & H-2-837593.	Design Review
13	4.1.2	The CSP shall be centered within the fenced area, which shall provide for a minimum 85-ft wide area around the CSP.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawing H-2-837593.	Design Review
14	4.1.2	The CSP and the CSS have been determined to be safety significant SSCs (refer Section 7.0, Nuclear Safety Requirements). The design basis classification for seismic design shall be seismic design criteria (SDC-2) and limit state (LS C) in accordance with CHPRC procedure PRC-PRO-EN-097, *Engineering Design and Evaluation (Natural Phenomena Hazard)* .	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawing H-2-837593 and CHPRC- 02539, *Design Analysis of the Concrete Pads for the 200 East Capsule Storage Area (CSA), Project W-135.*	Design Review
15	4.1.2	Grading around the CSP shall be such that all storm water shall flow away from the structure.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed on drawing H-2-837592 and H-2-837593	Design Review
16	4.1.2	Drainage features shall be incorporated throughout the CSA that will convey water away from the structure and approach roadways.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawings H-2-837592 and H-2-837593, as well as CHPRC-02532, *Storm Water Evaluation for W-135 CSA and WESF Truck Loading Area.*	Design Review
17	4.1.2	The design of the drainage system shall be such that it minimizes maintenance needs (surface drainage to swales and ditches are preferred over drainage structures and pipes) while still complying with relevant site surface water discharge permit requirements.	N	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawings H-2-837592 and H-2-837593, as well as CHPRC-02532, *Storm Water Evaluation for W-135 CSA and WESF Truck Loading Area.*	Design Review
18	4.1.2	The CSA design contractor shall determine if any soil improvements are required to support the loads on the CSP. If significant soil modifications or other preparations are required, the CSA design contractor shall review options and make recommendations to CHPRC for review and approval.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawing H-2-837590, Note 8, H-2-837598, Sh 4 and CHPRC-02539, *Design Analysis of the Concrete Pads for the 200 East Capsule Storage Area (CSA), Project W-135.*	Design Review
19	4.1.2	Environmental design conditions and existing site soil conditions shall be considered in the design and analysis of the CSP foundations. The CSA design contractor shall consider the potential for liquefaction or other soil instabilities attributable to vibrating ground motion, and the pad shall be designed with this in mind.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawing H-2-837590, Note 8, H-2-837598, Sh 4 and CHPRC-02539, *Design Analysis of the Concrete Pads for the 200 East Capsule Storage Area (CSA), Project W-135.*	Design Review
20	4.1.2	The CSP shall meet the requirements of WAC-173-303-630 (7)(c) and (7)(d) for impervious surface precipitation control. Therefore, the CSA design contractor shall design and construct the CSP such that: · it is sloped or is otherwise designed and operated to drain and remove liquid resulting from precipitation; or · The storage casks are otherwise protected from contact with accumulated liquids.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawings H-2-837592 and H-2-837593, as well asd CHPRC-02532, *Storm Water Evaluation for W-135 CSA and WESF Truck Loading Area.*	Design Review
21	4.1.2	The grading and drainage calculation shall include requirements for concrete slabs, roadways and structures in the area of the CSP, and any excavation and backfill requirements for installation of the CSP.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawing H-2-837592 and CHPRC-02532, *Storm Water Evaluation for W-135 CSA and WESF Truck Loading Area.*	Design Review
22	4.1.2	Steel embedments in reinforced concrete structures must satisfy the requirements of the design code applicable to the reinforced concrete structure. Similarly, structural steel must satisfy the requirements of the applicable steel design code.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawing H-2-837593 and CHPRC-02539, *Design Analysis of the Concrete Pads for the 200 East Capsule Storage Area (CSA), Project W-135.*	Design Review

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Applicable Project Requirements:					
23	4.1.2	The CSP layout shall consider transportation equipment and heavy equipment access required to place the CSS for each successive loading. The CSP shall incorporate a design approach apron between the road and the CSP to bridge the elevation difference and allow casks to be placed directly on the CSP with the VCT in order to provide operational efficiency by eliminating the need for crane lifts of the loaded casks.	Y	This requirement has been met with the design/engineering documentation performed during design. An operational analysis was also performed for the CSA (Project W-135 Capsule Storage Area Operations Analysis Report). This document performed an operations analysis for the receipt, transportation, interim storage, and permanent storage of the Vertical Concrete Casks (VCCs), Transportable Storage Canisters (TSCs), and Transportable Storage Canister (TSC) lids. This was provided as Appendix C of CHPRC-02538.	Design Review
24	4.1.2	The CSP shall be protected with metal edging at each pad access point.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawing H-2-837593.	Design Review
25	4.1.2	The heat transfer from CSS shall be totally passive, by natural convection, radiation and conduction, without any moving parts. The storage pad shall be designed for the maximum temperature of concrete surfaces in accordance with the guidelines and requirements of ACI 349, *Code Requirements for Nuclear Safety-Related Concrete Structures* .	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in CHPRC-02539, Design Analysis of the Concrete Pads for the 200 East Capsule Storage Area (CSA), Project W-135. Final Design Report CHPRC-02538 (Section 3.1.2) addresses assumptions that must be verified, re-evaluated, and documented prior to CSA procurement activities.	Design Review
26	4.1.2	The CSA design contractor will be provided with thermal data for the CSS by the CSS design/fabrication contractor, and shall provide in the basis for the design of the CSA an analysis of maximum concrete temperatures and demonstrate how this complies with the system design life requirements. Expected concrete temperatures shall be assumed to be 400ºF.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in CHPRC-02539, *Design Analysis of the Concrete Pads for the 200 East Capsule Storage Area (CSA), Project W-135.* Final Design Report CHPRC-02538 (Section 3.1.2) addresses assumptions that must be verified, re-evaluated, and documented prior to CSA procurement activities.	Design Review
27	**4.1.2**	The CSP design shall consider expected radiation exposure over the design life of the pad.		This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in CHPRC-02539, Design Analysis of the Concrete Pads for the 200 East Capsule Storage Area (CSA), Project W-135. Final Design Report chpRC-02538 (Section 3.1.2) addresses assumptions that must be verified, re-evaluated, and documented prior to CSA procurement activities.	Design Review
	4.1.3	**Operating Area**			
28	4.1.3	The CSA design shall include a concrete operating pad adjacent to the CSP sufficient for receipt, assembly and staging of empty CSS casks; CSS loading activities and placement of loaded CSSs on the CSP for interim storage; and CSA surveillance and maintenance operations. The remainder of the CSA will be graded, compacted gravel.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawing H-2-837593.	Design Review
29	4.1.3	The operating area shall be concrete and shall be designed to support expected loads. The design basis load requirements shall be provided by the CSS design/fabrication contractor. If the existing soil will not support this bearing capacity, then the area shall be rebuilt to obtain the required bearing capacity.	Y	The soil capacity is documented in the Shannon & Wilson Geotechnical Engineering Report No. 22-1-40034-006.	Design Review
30	4.1.3	The operating area shall include the apron between the CSP and the access road.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawing H-2-837592 and H-2-837593.	Design Review
31	4.1.3	The operating area shall be sized to allow storage of up to 25 empty VCCs and 24 empty TSC/TSCBs. Storage of empty components shall not interfere with moving and placing loaded CSSs. The operating area shall also support the placement of empty TSC/TSCBs into empty VCCs. All CSS assembly activities shall be completed before any capsule loading activity occurs at WESF.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawings H-2-837593 and H-2-837598, as well as CHPRC-02539, *Design Analysis of the Concrete Pads for the 200 East Capsule Storage Area (CSA), Project W-135* and in Appendix C of CHPRC-02538, which provides an analysis of the handling and placement of the VCCs.	Design Review

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Applicable Project Requirements:					
	4.1.4	**CSA Security Fencing, Lighting, and Access Control Requirements**			
32	4.1.4	CSA design shall include security requirements in accordance with MSC-PRO-396, *Planning Construction Projects in Security Areas,* MSC-PRO-427, *Site Safeguards and Security Program Planning Requirements,* and MSC-RD-11440, *Physical Protection of Property and Facilities* , including any required lighting, surveillance and access control.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawing H-2-837601 and CHPRC-02535, W-135 Capsule Storage Area Lighting Calculation. Also follow Security Assessment HNF-2017-60846.	Design Review
33	4.1.4	CSA perimeter shall be enclosed by a chain link fence with outriggers.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawing H-2-837598 sht 6 and CHPRC-02534. Also follow Security Assessment HNF-2017-60846.	Design Review
34	4.1.4	Vehicle gates shall be sufficiently sized and placed for entry and movement of transporters and cranes for receipt operations and maintenance activities. Personnel entry gates with crash bars shall be provided for routine entry by personnel from the CSB; high security locks shall be provided on each fence gate.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawings H-2-837593 and H-2-837598, Sheet 6 and CHPRC-02534. Also follow Security Assessment HNF-2017-60846.	Design Review
35	4.1.4	Lighting around the perimeter of the storage location shall be provided with an illumination level of not less than that recommended by IES 2013, *The Lighting Handbook* . Lighting shall be replaceable without need to enter the fenced area.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawing H-2-837601 and the CHPRC-02535, *W-135 Capsule Storage Area Lighting Calculation. Also follow Security Assessment HNF-2017-60846.*	Design Review
36	4.1.4	The need for a security alarm system, communications, and other measures to prevent unauthorized access to CSA and the stored materials shall be determined by a security requirement analysis performed by others and provided to the CSA design contractor. Safeguards and security features shall prevent theft, vandalism, and other malicious acts that could release radioactive material or disrupt facility operations.	Y	CHPRC provided direction that PIDAS is not required (including no cameras). Normal fencing, truck/man gates, and lighting will be required on the perimeter of the CSA and the CSP (but no lighting is required at the CSP). In all cases, the fence is designed as 8-ft high chain link fence with outriggers and 3-strand barb wire, 10 ft on center anchor poles with top rail. There will be a single vehicular gate in each fence. There will be two personnel gates for the inner fence, and three personnel gates for the outer fence. All gates will have emergency crash bars. All gates shall have security lock capability. Ecology blocks on the north side can 'dogleg' around the CSA pad and meet up with the ecology blocks on the east side. Security require a simple swing barrier to close 7th Street at approximate location of current gate; gate design to be equal to or better than existing design. Reference HNF-2017-60846. Also follow Security Assessment HNF-2017-60846.	Design Review
	4.1.5	**Temperature Monitoring System**			
37	4.1.5	The CSA design contractor shall design support equipment for the TMS to include but not be limited to: - a protective structure located adjacent to the CSA to house the CSS design/fabrication contractor supplied monitoring/recording panel, accessible as required to allow evaluation of CSS temperature conditions - all conduits/cabling required to provide power to the TMS components at the CSA - CE&I cabling to connect the signals from the CSS (four per CSS) and the ambient air temperature monitors (2 located at the CSP) to the centralized monitoring/recording panel at the CSA - all conduits/cabling and interfaces to provide signals to a remote annunciation panel/interface at the CSB. - all conduits/cabling required to provide power to the TMS components at the CSB - a remote annunciation panel/interface at the CSB.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawings H-2-837601, H-2-837603, H-2-837605, H-2-837607, H-2-837608, and H-2-837609, and CHPRC-03633, *W-135 Capsule Storage Area Procurement Specification for Prefabricated Electrical Equipment Enclosure.*	Design Review
	4.1.6	**CSA Utility and Support System Requirements**			
38	4.1.6	The MCSC Project shall interface with the existing Hanford Site electrical distribution system. The CSA design contractor shall provide designs to modify or extend the existing 13.8kV system as required to provide for construction power and for long-term CSA operations. Designs for interfaces to the electrical distribution system shall be coordinated with Hanford Site Electrical Utilities group (EU).	Y	The requirement for power to long-term operations has been met with the design/engineering documentation performed during design. This requirement is addressed in drawings H-2-837600, H-2-837601, H-2-837610 Sh 1. CHPRC directed that temporary power for construction is not required to be in the design.	Design Review

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Applicable Project Requirements:					
39	4.1.6	Existing systems at WESF and the CSB shall be used to the maximum extent possible to distribute required utilities (e.g., water, power). Assessment of utilities and infrastructure interfaces shall occur following preliminary facility definition and interface definition.	Y	This requirement has been met with the design/engineering documentation performed during design. The water utility requirement is addressed in drawings H-2-837597 and H-2-83598. The power interface requirement is addressed in drawings H-2-837600 and H-2-837601.	Design Review
40	4.1.6	If existing systems modified to support long-term storage operations are not adequate to support construction and capsule transfer operations, then temporary means shall be used to supply the required utilities. Assessment of the adequacy of the 13.8 kV electrical distribution system is to be done in conjunction with EU.	Y	An Electrical Service Request was submitted to MSA Electrical Utilities for the tie-in point for power. There is adequate power capacity for CSA loads on the existing 13.8kV overhead line. An ECR/FMP ECR-18-000991 has been wirtten for the modification to the existing 13.8kV overhead line.	Design Review
41	4.1.6	General personnel access to the CSA shall be configured for ease of entry from the CSB for routine operations, surveillance, and maintenance.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawing H-2-837593. Area lighting and an internal lighting fixture is provided for the electrical equipment shelter and is addressed in drawings H-2-837601, H-2-837605.	Design Review
42	4.1.6	The use of existing roadways, electrical distribution systems, and communications network shall be maximized to satisfy CSA requirements; however, modifications (e.g., roadway enhancements to support anticipated vehicle loads; movement of overhead interferences) may be required.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawings H-2-837591, H-2-837601, H-2-837610 Sheet 1, and H-2-837604. CHPRC directed that HLAN and phone are not required at the CSA. MSA will provide and install a public address system (PAX) at the CSA by extending the Canister Storage Building PAX system. This MSA scope will be included in the final construction estimate.	Design Review
43	4.1.6	CSS delivery to the CSP shall be by the vehicular entrance established further to the east off of 7th Street to take advantage of previously disturbed areas.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawing H-2-837593.	Design Review
44	4.1.6	Any required support personnel will be housed at existing CSB facilities. MCSC Project will not provide new facilities or capabilities to house support personnel for CSA operations.	Y	There is no design associated with this requirement as indicated in the requirement text.	Design Review
45	4.1.6	Access roads, aprons, and walkways for CSA will be integrated with the existing infrastructure at CSB.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawing H-2-837593.	Design Review
46	4.1.6	A raw water system is required for the CSA in order to supply fire water to fire hydrants. There are no structures associated with the CSA. Therefore, automatic fire sprinkler systems are not required. The CSA will interface with the on-site water distribution for raw water.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawings H-2-837597 and H-2-837598.	Design Review
47	4.1.6	Raw and potable water systems shall meet the requirements specified in Washington State Department of Health (DOH) 331-123, *Water System Design Manual* . Cross-connection control features shall prevent cross-connection of raw and potable water systems. The Hanford Site water purveyor controls the water system.	Y	This requirement is not applicabe as the only water system being used is the raw water system for fire protection. It will be isolated by Installation of a Global Air Gap on Raw Water System implemented by Water Utilities.	Design Review
48	4.1.6	The applicable requirements of Contractor Requirements Document (CRD) O 420.1C (Supplemented Rev. 0), *Facility Safety* , Section 3 and DOE-STD-1066-2012, *Fire Protection* shall be followed for fire suppression (sprinklers and/or hydrants) water supplies. Per the RL Authority Having Jurisdiction (AHJ), Section 3.b.3 of CRD O 421.1C (Supplemented Rev. 0) is not applicable to the CSA since it is not a building.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawings H-2-837597 and H-2-837598.	Design Review

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Applicable Project Requirements:					
49	4.1.6	The CSA will be a Category 2 nuclear facility. Therefore, CRD O 420.1C, (Supplemented Rev. 0), Section 3.b.4.a requires that a minimum of two operational fire hydrants shall be provided such that parts of the exterior of the facility can be reached by hose lays of not over 300 feet. Additional fire hydrants may be require depending on the location of the water connection.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawings H-2-837597 and H-2-837598.	Design Review
50	4.1.6	DOE-STD-1066-2012 requires that hydrants shall be provided such that: o Hydrants are no closer than 40 feet to the facility. o Hose runs from the hydrants are no more than 300 feet to all exterior portions of the facility (i.e. coverage over the entire pad, plus 35 ft of clear space to wildland areas on all open sides). o A minimum of two hydrants per facility are provided. The location, access, and arrangement of fire hydrants is subject to the review and approval of the CHPRC cognizant Deputy Fire Marshal and the Hanford Fire Chief. o Branch piping between the water main and hydrants shall not be greater than 300 feet.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawings H-2-837597 and H-2-837598.	Design Review
51	4.1.6	The installation of the raw water system shall be in accordance with Hanford Water Utility Standards. NFPA 24, Standard for the Installation of Private Fire Service Mains and Their Appurtenances should be used as reference for the installation of the raw water system. Thrust blocking should be provided as required in accordance with NFPA 24. o The fire water supply shall be capable of providing the minimum fire flow per NFPA 1, Fire Code, as adjusted by the Hanford Fire Chief. The minimum fire flow is 3500 gpm at 20 psi for a minimum duration of four hours in accordance with the Hanford Fire Marshal's Office Interpretation/Clarification Request (ICR) 2017-02, Rev 1. o Detailed plans, specifications, and calculations shall be submitted to the CHPRC cognizant fire protection engineer (FPE) for review and approved prior to installation.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawings H-2-837597, H-2-837598 and CHPRC-02534, *W-135 Capsule Storage Area Construction Specification, Section 33 10 00 Water Utilities, paragraph 3.2.*	Design Review
52	4.1.6	Inspection, testing, and maintenance for fire water supplies shall be performed in accordance with NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*	Y	This requirement has been determined to not be applicable as NFPA 25 is applicable to existing systems.	Design Review
53	4.1.6	A lightning risk assessment shall be performed per NFPA 780, *Standard for the Installation of Lightning Protection Systems.* If the assessment determines lightning protection is required, then it shall be provided.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in CHPRC-02536, *Capsule Storage Area Lightning Risk Assessment.*	Design Review
54	4.1.6	Cathodic protection systems shall be provided if required by the MCSC Project design and shall be designed in accordance with the guidelines provided in NACE SP0285, *External Corrosion Control of Underground Storage Tank Systems by Cathodic Protection* , and NACE SP0169, *Control of External Corrosion on Underground or Submerged Metallic Piping Systems.*	Y	This requirement has been determined to not be applicable as there are no underground storage tank systems in scope.	Design Review
55	4.1.6	Communications systems shall be designed in accordance with DOE O 200.1A, *Information Technology Management* . MCSC Project shall use existing telephone capabilities at WESF and CSB for internal and external communication. CSA will not be a normally occupied area and will not require installation of a telephone system. Portable communication devices will be used at CSA. It is not anticipated that any new telephone conduits will need to be installed for communication lines.	Y	This requirement has been determined to not be applicable as stated in requirement text.	Design Review

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Applicable Project Requirements:					
56	4.1.6	MCSC Project shall use the existing public address system at WESF and CSB and ensure that the public address system broadcasts to all CSA areas.	Y	The existing CSB and WESF public address system (PAX) does not broadcast to the CSA, so MSA will provide and install the PAX system at the CSA by extending the CSB PAX. MSA will be engaged during construction to design, install, and test the PAX system wiring and speakers. The PAX system conduit from the CSB to the CSA, for use by MSA, is shown on drawings H-2-837601 and H-2-837603. The construction and design cost has been included in the CSA detailed cost estimate contained in 046414.17.01-006.	Design Review
57	4.1.6	MCSC Project shall use the existing computer intranet system available at WESF and CSB for interfaces with the Hanford Local Area Network, unless new system capacity is identified as needed for the TMS. It is not anticipated that any new computer intranet system interfaces will be required at CSA.	Y	There is no design associated with this requirement as indicated in the requirement text.	Design Review
	4.2	**Transfer Roadway**			
58	4.2	To the greatest extent possible, the MCSC Project shall take advantage of existing asphalt road (7th - Street) at the site.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawing H-2-837597, Sheet 1, and CHPRC-03632, *Design and Analysis of Road Improvements for Project W-135* .	Design Review
59	4.2	The MCSC Project shall extend the existing roadways to the CSA boundary.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawing H-2-837597, Sheet 1, and CHPRC-03632, *Design and Analysis of Road Improvements for Project W-135.*	Design Review
60	4.2	The construction workforce, facility operations workers, and CSSs will arrive at CSA by existing and extended roadways.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawings H-2-837596, Sheet 1, H-2-837597, Sheet 1, and CHPRC-03632, *Design and Analysis of Road Improvements for Project W-135.*	Design Review
61	4.2	The extension of existing roadways and construction of new roadways shall be compatible with existing roadways.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawings H-2-837596 Sheet 1, H-2-837597 Sheet 1, and H-2-837598 Sheet 4, and CHPRC -03632 Rev A, *Design and Analysis of Road Improvements for Project W-135* .	Design Review
62	4.2	The Transfer Roadway shall be modified/improved as necessary to provide for the safe transfer of the CSSs from WESF to the CSA with minimal maintenance being required during the transfer operations period.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawings H-2-837596 Sheet 1, H-2-837597 Sheet 1, and H-2-837598 Sheet 4, and CHPRC -03632 Rev A, *Design and Analysis of Road Improvements for Project W-135* .	Design Review
63	4.2	The Transfer Roadway will require modifications as needed to accommodate the VCT width, loaded weight, and turning radius. These modifications may include widening, grade adjustments, subgrade improvements, new paving, and protections as may be required to under road utilities, drainage culverts, etc.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawings H-2-837596 Sheet 1, H-2-837597 Sheet 1, and H-2-837598 Sheet 4, and CHPRC -03632 Rev A, *Design and Analysis of Road Improvements for Project W-135* .	Design Review
64	4.2	Above grade structures such as fences, bullocks, overhead lines, etc. may also require relocation to accommodate the CSS transport equipment.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawings H-2-837591, H-2-837604, H-2-837610 Sh 3. Active and legacy overhead lines blocking transport access to the truck port will be removed, and active lines relocated underground.	Design Review
65	4.2	Roadways, subsurface conditions, and existing infrastructure (i.e., drainage culverts, underground utility lines, overhead lines) shall be investigated and confirmed to be adequate to support and sustain the loading that will be imposed by the transport of the CSSs to the CSA.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawing H-2-837591, H-2-837593, H-2-837596 and CHPRC-03632, *Design and Analysis of Road Improvements for Project W-135.* MSA Electrical Utilities has approved the tie-in point for power. There is adequate power capacity for CSA loads on the existing 13.8kV overhead line.	Design Review

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Applicable Project Requirements:					
66	4.2	Should the roadways and existing infrastructure not be adequate for the design loads and life-cycle use, then replacement structure design or modifications shall be provided. Proof testing with a simulated design load is an acceptable means for determining the adequacy of the existing infrastructure, except that before proof testing can be performed, calculations shall show that the structures and underground utilities to be traversed are capable of supporting the proposed loading. If not, then the locations above the areas of concern shall be adequately reinforced to assure that no damage to the utility or structure will occur.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawing H-2-837591 and CHPRC-03632, *Design and Analysis of Road Improvements for Project W-135.*	Design Review
67	4.2	Unless otherwise directed, access roadways within the CSA shall typically be concrete or crushed stone and shall be designed to support expected loads. If the existing soil will not support this bearing capacity, then the area shall be rebuilt to obtain the required bearing capacity.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawing H-2-837591 and CHPRC-03632, *Design and Analysis of Road Improvements for Project W-135.*	Design Review
68	4.2	DOE-0359, *Hanford Site Electrical Safety Program (HSESP)* , identifies limited approach boundaries for overhead lines that could be impacted by equipment and cranes in transit or performing work. The CSA contractor shall evaluate overhead electrical and communication lines that are in or near the path that will be used by the VCT to transfer loaded or unloaded CSSs and move or raise any lines that do not meet DOE-0359 requirements.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawings H-2-837604, H-2-837610 Sh 3. Active and legacy overhead lines blocking VCT access to the truck port will be removed, and active lines relocated underground. Existing 13.8kV overhead lines with adequate clearance for the VCT to travel under are not being modified per CHPRC direction.	Design Review
	5	**Interfaces**			
	5.2	**Utility Interfaces**			
	5.2.1	**Hanford Site Utilities/Infrastructure**			
69	5.2.1	MCSC Project shall interface with existing Hanford Site utilities and infrastructure as needed to support construction, capsule transfer operations, and long-term storage operations.	Y	This requirement has been met with the design/engineering documentation performed during design. The water utility interface requirement is addressed in drawings H-2-837597, H-2-837598. The power utility interface requirement is addressed in drawings H-2-837600, H-2-837601, H-2-837610 Sh 1. MSA Electrical Utilities has approved the tie-in point.	Design Review
70	5.2.1	MCSC Project shall use existing systems at WESF and the CSB (or as elsewhere may be identified) to distribute required utilities (e.g., water, electricity, and sanitation).	Y	This requirement has been met with the design/engineering documentation performed during design. The water utility interface requirement is addressed in drawings H-2-837597, H-2-837598. The power utility interface requirement is addressed in drawings H-2-837600, H-2-837601, H-2-837610 Sh 1. MSA Electrical Utilities has approved the tie-in point.	Design Review
71	5.2.1	If existing systems modified to support long-term storage operations are not adequate to support construction and capsule transfer operations, then temporary means shall be used to supply the required utilities.	Y	The design has demonstrated that modified existing systems will be adequate for construction and capsule transfer operations so temporary utilities are not required. Reference Design Input Matrix, item #5.	Design Review
72	5.2.1	Initial assessment of utilities and infrastructure interfaces shall occur following completion of conceptual design.	Y	This requirement has been performed during design by interfacing with MSA Utilities organizations. The water utility interface is addressed in drawings H-2-837597, H-2-837598. MSA Water Utilities has approved the tie-in points. The power utility interface is addressed in drawings H-2-837600, H-2-837601, H-2-837610 Sh 1. MSA Electrical Utilities has approved the tie-in point.	Design Review
73	5.2.1	Access roads, aprons, and walkways for the CSA will be integrated into the existing CSB infrastructure.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawing H-2-837591.	Design Review

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Applicable Project Requirements:					
	5.2.2	**Service Roads**			
74	5.2.2	To the greatest extent possible, MCSC Project shall take advantage of existing asphalt roads at the selected site.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawing H-2-837591.	Design Review
75	5.2.2	The CSA design contractor's design shall extend the existing roadways to the CSA boundary.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawing H-2-837591. Service roads have been added on the west and south sides of the CSA outer boundary for servicing lighting poles and fixtures.	Design Review
76	5.2.2	The extension of existing roadways and construction of new roadways shall be compatible with the existing roadways.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawing H-2-837591.	Design Review
77	5.2.2	A design analysis shall be performed to confirm that the existing roadways can accommodate the vehicles transporting casks to and from CSA; if existing roadways cannot accommodate cask transport, modification to the roadways shall be designed by the contractor.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawing H-2-837591 and CHPRC-03632, *Design and Analysis of Road Improvements for Project W-135.*	Design Review
78	5.2.2	Any new roads or road modifications for the MCSC Project shall meet the requirements of M 41‑10, *Standard Specification for Road, Bridge, and Municipal Construction* .	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawing H-2-837591, CHPRC-03632, *Design and Analysis of Road Improvements for Project W-135, and CHPRC-02534, W-135 Capsule Storage Area Construction Specification.*	Design Review
	5.2.3	**Interface with Existing 13.8 kV Primary Electrical Distribution System**			
79	5.2.3	MCSC Project electrical power needs – as may be required - shall interface with the existing Hanford Site electrical distribution system. MCSC Project shall provide extension of the existing electrical power grid as required for construction power and long-term CSA operations. Depending on facility location and power requirements, the existing electrical distribution system may require upgrades.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawings H-2-837600, H-2-837601, H-2-837610 Sh 1. Meetings between ARES and MSA on the power required for the CSA determined that there is adequate power capacity for CSA long-term operations loads on the existing 13.8kV overhead line. An ECR/FMP ECR-18-000991 has been wirtten for the modification to the existing 13.8kV overhead line.	Design Review
80	5.2.3	The assessment and definition of interface requirements for a MCSC Project substation shall occur following final CSA siting within the designated siting area and definition of electrical loads. Designs for interfaces to the electrical distribution system shall coordinated with EU.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawings H-2-837600, H-2-837601. Meetings between ARES and MSA on the power required for the CSA determined that there is adequate power capacity for CSA loads on the existing 13.8kV overhead line, and MSA Electrical Utilities has approved the tie-in point for power. Reference Design Input Matrix, item #5.	Design Review
81	5.2.3	Electrical power delivered to the system and electrical installation and any modifications to the site electrical utilities distribution system, including the 13.8 kVac-480 Vac transformers, shall conform to NFPA 70-2008, *National Electric Code* , and IEEE C2, *National Electrical Safety Code* .	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawings H-2-837600 , Note 2, and H-2-837590, Note 1.	Design Review
	5.2.4	**Interface with Site Water Distribution**			
82	5.2.4	A raw water system is required for the CSA in order to supply fire water to fire hydrants. There are no structures associated with the CSA. Therefore, automatic fire sprinkler systems are not required. The CSA will interface with the on-site water distribution for raw water.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawings H-2-837591 and H-2-837594, H-2-837597, and H-2-837598.	Design Review
83	5.2.4	Raw and potable water systems shall meet the requirements specified in DOH 331-123. Cross connection control features shall prevent cross-connection of raw and potable water systems. The Hanford Site water purveyor controls the water system.	Y	This requirement is not applicabe as the only water system being used is the raw water system for fire protection. It will be isolated by Installation of a Global Air Gap on Raw Water System implemented by Water Utilities.	Design Review

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Applicable Project Requirements:					
84	5.2.4	The applicable requirements of CRD O 420.1C (Supplemented Rev. 0), Section 3 and DOE-STD- 1066-2012 shall be followed for fire suppression (sprinklers and/or hydrants) water supplies. Per the RL AHJ, Section 3.b.3 of CRD O 421.1C (Supplemented Rev. 0) is not applicable to the CSA since it is not a building.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawings H-2-837597 and H-2-837598.	Design Review
85	5.2.4	The CSA will be a Hazard Category 2 nuclear facility. Therefore, CRD O 420.1C, (Supplemented Rev. 0), Section 3.b.4.a requires that a minimum of two operational fire hydrants shall be provided such that parts of the exterior of the facility can be reached by hose lays of not over 300 feet. Additional fire hydrants may be required depending on the location of the water connection.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawing H-2-837593 and H-2-837594, Sheets 1 and 2.	Design Review
86	5.2.4	DOE-STD-1066-2012 requires that hydrants shall be provided such that: o Hydrants are no closer than 40 feet to the facility. o Hose runs from the hydrants are no more than 300 feet to all exterior portions of the facility (i.e. coverage over the entire pad, plus 35 ft of clear space to wildland areas on all open sides). o A minimum of two hydrants per facility are provided. The location, access, and arrangement of fire hydrants is subject to the review and approval of the CHPRC cognizant Deputy Fire Marshal and the Hanford Fire Chief. o Branch piping between the water main and hydrants shall not be greater than 300 feet.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawing H-2-837593 and H-2-837594, Sheet 1 .	Design Review
87	5.2.4	The installation of the raw water system shall be in accordance with Hanford Water Utility Standards. NFPA 24 should be used as reference for the installation of the raw water system. Thrust blocking should be provided as required in accordance with NFPA 24. o The fire water supply shall be capable of providing the minimum fire flow per NFPA 1, as adjusted by the Hanford Fire Chief. The minimum fire flow is 3500 gpm at 20 psi for a minimum duration of four hours in accordance with the Hanford Fire Marshal's Office ICR 2017-02, Rev 1. o Detailed plans, specifications, and calculations shall be submitted to the CHPRC cognizant FPE for review and approved prior to installation.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawings H-2-837597, H-2-837598, CHPRC-02534, *W-135 Capsule Storage Area Construction Specification,* Section 33 10 00, *Water Utilities* paragraph 3.2 Installation.	Design Review
88	5.2.4	Inspection, testing, and maintenance for fire water supplies shall be performed in accordance with NFPA 25	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawings H-2-837597, H-2-837598 and CHPRC-02534, *W-135 Capsule Storage Area Construction Specification, Section* 33 10 00, *Water Utilities.* The fire water supply for the CSA is being designed in such a way that the testing and maintenance requirements of NFPA 25 will be met.	Design Review

Management of the Cesium and Strontium Capsules Project (W-135)
FDC Design Verification Matrix
CSA Final Design

Item No.	Requirement Basis (CHPRC-02623 Section No.)	Requirement Text	Requirement Met? Y (Yes), N (No), or N/A	How was the requirement met? Provide reference to where evidence is found in design output document or explain why the item is N/A.	Verification Method
Applicable Project Requirements:					
	6	**General Requirements**			
	6.1	**Discipline Specific Design Requirements**			
	6.1.1	**Mechanical/HVAC**			
89	6.1.1	Per DOE O 420.1C, safety significant mechanical handling equipment shall meet the requirements of the codes listed in Table 4-1.	Y	There is no mechanical handling equipment as part of the design.	Design Review
90	6.1.1	All cranes, hoists, and lifting devices designed or used for activities associated with the MCSC Project shall meet the requirements of DOE-STD-1090-2011, *Hoisting and Rigging,* and DOE/RL-92-36, *Hanford Site Hoisting and Rigging Manual* .	Y	This requirement is met as indicated in CHPRC-02538.	Design Review
	6.1.2	**Civil / Structural**			
91	6.1.2	The CSP shall have a design basis classification of seismic design criteria (SDC-2) and limit state (LS C) in accordance with CHPRC procedure PRC-PRO-EN-097, *Engineering Design and Evaluation (Natural Phenomena Hazard)* .	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in CHPRC-02539, *Design Analysis of the Concrete Pads for the 200 East Capsule Storage Area (CSA), Project W-135,* and CHPRC-03635, *Structural Analysis of CSA Electrical Equipment Racks and TMS Anchorage (Safety-Significant).*	Design Review
92	6.1.2	Per DOE O 420.1C, safety significant structures shall, at a minimum and unless more restrictive requirements are otherwise specified elsewhere in this FDC, meet the requirements of the codes listed in Table 6-2.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in CHPRC-02539, *Design Analysis of the Concrete Pads for the 200 East Capsule Storage Area (CSA), Project W-135,* and CHPRC-03635, *Structural Analysis of CSA Electrical Equipment Racks and TMS Anchorage (Safety-Significant).*	Design Review
93	6.1.2	The maximum temperature of concrete surfaces of the storage pad shall be in accordance with the guidelines and requirements of ACI 349. The maximum temperature of the pad shall be assumed to be 400ºF.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in CHPRC-02539, *Design Analysis of the Concrete Pads for the 200 East Capsule Storage Area (CSA), Project W-135.*	Design Review
94	6.1.2	The CSA design contractor's design documents shall specify that construction-phase activities associated with the installation, inspection, and testing of structural concrete, structural steel, soils and foundations shall be performed under the quality assurance requirements outlined in Section 10 of this FDC. The determination of, and basis for the application of, specific safety basis codes and standards shall be documented in a project specific nuclear safety document which shall be prepared by CHPRC and supported by the CSA design contractor and other project contractors.	Y	This requirement has been met with the design/engineering documentation performed during design and is addressed in CHPRC-02534, *W-135 Capsule Storage Area Construction Specification.*	Design Review
95	6.1.2	All activities associated with the installation, inspection, and testing of structural concrete, structural steel, soils and foundations shall also meet and support the requirements and design basis of the CSS. Therefore, the CSA design contractor shall obtain the necessary design inputs from the CSS design/fabrication contractor, including thermal analysis, as they relate to the CSP design.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in CHPRC-02539, *Design Analysis of the Concrete Pads for the 200 East Capsule Storage Area (CSA), Project W-135* and CHPRC-02534, *W-135 Capsule Storage Area Construction Specification.*	Design Review

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Applicable Project Requirements:					
	6.1.3	**Instrumentation Systems**			
96	6.1.3	The design of instrumentation systems shall conform to the General Industry safety requirements as specified in 29 CFR 1910, "Occupational Safety and Health Standards," and DOE-0359	Y	This requirement has been met with the design/engineering documentation performed during design. OSHA flows down the requirement for electrical equipment, devices, and materials to be NRTL listed. This requirement is addressed in drawings H-2-837600 Note 2, H-2-837609 Sh 1 Notes.	Design Review
97	6.1.3	Instrument components and devices shall comply with NEMA ICS 1, *Industrial Control and Systems: General Requirements* , and UL 508, *Standard for Industrial Control Equipment* . Control devices shall be designed in accordance with NUREG-0700, *Human System Interface Design Review Guidelines* , as appropriate based on a safety evaluation. Instrument components and devices shall comply with 29 CFR 1910 and shall conform to NFPA 70-2008 and the FM Global, *Approval Guide* . Instrument panels shall comply with UL508A, *Standard for Industrial Control Panels* .	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawing H-2-837600 Note 2, H-2-837609 Sh 1 Notes, and CHPRC-02534, *W-135 Capsule Storage Area Construction Specification,* and Report Number 046414.17.01-008, *Project W-135 Capsule Storage Area Human Factors Engineering Report.*	Design Review
98	6.1.3	In addition, the instrumentation and components shall meet the requirements for the following industry standards as applicable to the project: · Instruments and components selected for the expected environment	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawings H-2-837600, H-2-837607, H-2-837608, H-2-837609. TMS instrument conductor insulation is rated for 105C, 300V, and wet locations per CSS design inputs. Below grade conduit for TMS conductors is PVC-coated galvanized rigid steel. TMS TBX enclosures are rated NEMA 4.	Design Review
99	6.1.3	· Enclosure type ratings in accordance with NEMA 250, *Enclosures for Electrical Equipment (1000 Volts Maximum)*	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawing H-2-837607, Sh 1. TMS TBX enclosures are rated NEMA 4.	Design Review
100	6.1.3	· Instrumentation equipment certification by an Occupational Safety & Health Administration-registered nationally recognized testing laboratory as required by DOE-0359	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement for NRTL listing is addressed in drawing H-2-837600 Notes and H-2-837609 Notes.	Design Review
101	6.1.3	· Instrumentation and component design and installation to facilitate operations and maintenance	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawing H-2-837609 for the CSB Annunciator and H-2-837605 for the TMS Control Cabinet shelter.	Design Review
102	6.1.3	· Instrument calibration with National Institute of Standards and Technology traceable documentation.	Y	There is no instrument calibration in the CSA contract design scope. Instruments (VCC RTDs and ambient air temperature sensors) are government furnished equipment provided by the CSS contractor. CHPRC is evaluating which contract will be responsible for preparing and executing the overall project W-135 Acceptance Test Procedure.	Design Review
103	6.1.3	The design of safety-related instrumentation shall provide for the periodic in-place testing and calibration of instrument channels.	Y	There is no instrument selection or calibration in the CSA design scope. Instruments (VCC RTDs and ambient air temperature sensors) are government furnished equipment provided by the CSS contractor. The TMS control cabinet shelter provides a weather shelter, lighting, and receptacle for periodic in-place work at the TMS Control Cabinet; see drawing H-2-837605.	Design Review
104	6.1.3	Per DOE O 420.1C, safety significant instrumentation and alarm components shall meet the requirements of the codes listed in Table 6-3 as applicable to the specific MCSC Project design.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in CHPRC-02534, *W-135 Capsule Storage Area Construction Specification* . Instruments (VCC RTDs and ambient air temperature sensors) are government furnished equipment provided by the CSS contractor, however, conductors between VCC RTDs and the TMS Control Cabinet are safety significant and are in the CSA scope.	Design Review

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Applicable Project Requirements:					
105	6.1.3	All TMS support equipment, inclusive of the TMS protective structure, CE&I cabling, conduit and other CSA design contractor provided TMS support equipment shall meet the following criteria as applicable: · Enclosure environmental ratings shall meet or exceed NEMA 250 rating	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in assembly drawings H-2-837605, H-2-837607. TMS TBX enclosures are rated NEMA 4. Electrical power and metering enclosures are rated NEMA 3R or better.	Design Review
106	6.1.3	· Maximum expected radiation dose in areas containing temperature monitoring system components shall be considered in the design and component selection	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawings H-2-837601, H-2-837606 Detail 4. Placement of conduit stub up on CSP and connection of TMS conductors and conduit to VCC are being made with as little worker time at VCC as possible. Wiring connection is with flexible conduit and cable connectors at VCC junction box (GFE by CSS contractor). TMS TBX's are located outside of CSP inner fence to minimize worker exposure.	Design Review
107	6.1.3	· Expected service life shall be adequate to meet both short term operational needs and long term monitoring needs as applicable	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawings H-2-837601, H-2-837602. PVC-coated galvanized rigid steel conduit is being installed for long service life of conductors.	Design Review
108	6.1.3	· Quality level and safety significant requirements shall be met as identified in nuclear safety documentation.	Y	This requirement has been met with the design/engineering documentation performed during design. Safety significant components are defined in CHPRC-03774. Safety class and quality levels are addressed in drawings H-2-837600, H-2-837605, H-2-837606, H-2-837607, H-2-837608. All electrical and instrumentation components are being procured as Quality Level 3 per H-2-837600 Notes.	Design Review
	6.1.4	**Electrical**			
109	6.1.4	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. The CSA design contractor shall provide designs to modify or extend the existing 13.8kV system as required to provide for construction power and for long-term CSA operations. Designs for interfaces to the electrical distribution system shall be coordinated with EU. Electrical power delivered to the CSS system, any new electrical installations as may be required, 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. All electrical work is subject to the lockout/tagout requirements of DOE-0336, *Hanford Site Lockout/Tagout Procedure* .	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawings H-2-837600, H-2-837601, H-2-837610 Sh 1. There is adequate power capacity for CSA long-term operational loads on the existing 13.8kV overhead line, and MSA Electrical Utilities has approved the tie-in point for power. CHPRC has directed that temporary construction power is not required.	Design Review
110	6.1.4	Where applicable, modifications or extensions of the 13.8kV electrical system will be in accordance with IEEE C2.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawing H-2-837600 Note 2.	Design Review
111	6.1.4	The electrical distribution system designed by the CSA design contractor shall conform to NFPA 70-2008 and NFPA 70E-2009, *Standard for Electrical Safety in the Workplace.*	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawing H-2-837600 Note 2.	Design Review
112	6.1.4	An electrical meter shall be installed to allow monitoring of power usage at the CSA.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawings H-2-837600, H-2-837605.	Design Review
113	6.1.4	On-site acceptance testing shall be required for each major electrical system to which there has been any modification or new installation. Tests shall be specified to demonstrate that each function and important parameter is implemented. Specific criteria shall be included to determine pass/fail acceptance.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in CHPRC-02534, *W-135 Capsule Storage Area Construction Specification.*	Design Review

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Applicable Project Requirements:					
114	6.1.4	Acceptance and testing procedures for the electrical 480/208/120V distribution equipment shall conform to ANSI/NETA ATS-2013, *Standard for the Acceptance Testing Specifications for Electrical Power Equipment and Systems,* and any other stipulated site specific inspection or safety requirements.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in CHPRC-02534, *W-135 Capsule Storage Area Construction Specification.*	Design Review
115	6.1.4	All electrical equipment installed or used on the Hanford Site shall labeled or listed for use by a nationally recognized testing laboratory as required by DOE-0359.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawing H-2-837600 Note 2.	Design Review
116	6.1.4	MCSC Project lighting levels shall be guided by *The IES Lighting Handbook* . Energy efficient lighting shall be used where practical.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawings H-2-837605, H-2-837610 Sh 2, and in CHPRC-02535, *W-135 Capsule Storage Area Lighting Calculation.* Area lighting and shelter lighting are LED.	Design Review
117	6.1.4	Emergency power systems or legally required standby systems as defined by NFPA 70-2008 Articles 700 and 701 are not expected to be required for MCSC Project equipment at CSA. If emergency power is determined to be necessary, it shall be provided as required to support safety functions, in accordance with NFPA 110, Standard for Emergency Standby Power Systems or NFPA 111, Standard on Stored Electrical Energy Emergency and Standby Power Systems. Emergency power shall provide uninterruptible power where continuity of monitoring is essential. If required, on-site Class 1E electrical distribution systems, including batteries, shall be designed with independence, testability, and redundancy. These distribution systems shall be sufficient to perform safety-related functions under single-failure conditions.	Y	If UPS power is required for the TMS Control Cabinet, it will be provided by the CSS contractor. Adequate space exists in the electrical equipment shelter for a UPS should one be added to the CSS scope.	Design Review
118	6.1.4	As may be required for any upgrades or modifications to existing electrical systems, a lightning risk assessment shall be performed per NFPA 780, Annex L. If the assessment determines lightning protection is required, then it shall be provided.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in CHPRC-02536, *Capsule Storage Area Lightning Risk Assessment*. A lightning protection system is not recommended by the results of the assessment.	Design Review
119	6.1.4	Cathodic protection systems shall be designed, if required, in accordance with the guidelines provided in NACE SP0285 and NACE SP0169.	Y	This requirement has been determined to not be required.	Design Review
120	6.1.4	Per DOE O 420.1C, safety significant and safety class electric systems shall meet the requirements of the codes listed in Table 6-4 and Table 6-4 as applicable to the specific MCSC Project design.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawing H-2-837600 and CHPRC-02534, *W-135 Capsule Storage Area Construction Specification.*	Design Review
	6.2	**Design Life**			
	6.2.1	**General Requirements**			
121	6.2.1	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.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is met as indicated in CHPRC-02538.	Design Review
122	6.2.1	Unless otherwise stated, all systems and equipment provided shall be designed, to the maximum extent practical, to provide a minimum five year, maintenance-free service life unless stipulated otherwise.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is met as indicated in CHPRC-02538.	Design Review
123	6.2.1	Tools provided shall be designed, to the maximum extent practical, to provide a minimum one year, maintenance-free service life.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is met as indicated in CHPRC-02538.	Design Review

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Applicable Project Requirements:					
124	6.2.1	Consumables shall have a one year minimum service life and be located for ease of inspection, maintenance, and replacement.	Y	There are no consumables in the scope. However, to provide for long service life and ease of maintenance, all components have been placed outside of the CSP fence for ease of maintenance and replacement except where components are required to connect directly to the VCCs. Spare TMS cables and connectors are specified to be provided to CHPRC. See drawing H-2-837606 Sh 1 Detail 5 and associated Notes.	Design Review
	6.2.2	**Capsule Storage Area**			
125	6.2.2	Components within CSA shall have a minimum design life of 100 years, or be designed to be easily replaced without relocation of the capsules from the storage configuration.	Y	This requirement has been met with the design/engineering documentation performed during design. All components have been placed outside of the CSP fence for ease of maintenance and replacement except where components are required to connect directly to the VCCs. PVC coated rigid metal conduit was selected for long service life. Round tapered aluminum lighting poles were selected for longer service life than steel poles and for resistance to vibration degradation, and poles are located outside of the outer fence for ease of maintenance. The TMS control cabinet and associated power distribution equipment were placed in a shelter to improve reliability and service life. See Final Design Report CHPRC-02538, and drawings H-2-837601 Sh 1, H-2-837605 Sh 1, H-2-837610 Sh 2.	Design Review
	6.2.3	**Design Life Analysis**			
126	6.2.3	The contractor is responsible to document that components meet design life requirements as described in this document.	Y	This requirement has been met with the design/engineering documentation performed during design. All components have been placed outside of the CSP fence for ease of maintenance and replacement except where components are required to connect directly to the VCCs.	Design Review
	6.3	**Human Factors**			
127	6.3	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.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawings H-2-837601, H-2-837605, H-2-837609 for the electrical equipment shelter and CSB TMS Annunciator.	Design Review
128	6.3	Decisions concerning which system functions to allocate to the human versus the machine 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.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in ARES Report Number 046414.17.01-008, *Project W-135 Capsule Storage Area Human Factors Engineering Report.*	Design Review
129	6.3	Systems, subsystems, and equipment shall consider the human engineering guidelines of DOE‑HDBK-1140, *Human Factors/Ergonomics Handbook for the Design for Ease of Maintenance* , NUREG-0700, and IEEE Standard 1023, *IEEE Recommended Practice for the Application of Human Factors Engineering to Systems, Equipment, and Facilities of Nuclear Power Generating Stations and Other Nuclear Facilities.*	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawings H-2-837601, H-2-837605, H-2-837609 for the electrical equipment shelter and CSB TMS Annunciator.	Design Review
130	6.3	A human factors evaluation shall be performed and documented on the completed design.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in ARES Report Number 046414.17.01-008, *Project W-135 Capsule Storage Area Human Factors Engineering Report.*	Design Review
	6.4	**Reliability, Availability, Maintainability, and Inspectability**			
131	6.4	The MCSC Project design shall consider requirements associated with reliability, availability, maintainability, and inspectability.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed within the project drawings, calculations, and specifications.	Design Review

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Applicable Project Requirements:					
	6.4.1	**Availability Requirements**			
132	6.4.1	Key performance indices associated with Availability are losses due to unexpected breakdown, lengthy and unplanned for repeat set-up and adjustment, frequent stoppage and quality defect losses, and poor durability and productive life-span. The CSA design contractor shall provide input to a CHPRC analysis which demonstrates that the throughput requirements can be met.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed within the project drawings, calculations, and specifications.	Design Review
	6.4.2	**Maintainability & Inspectability**			
133	6.4.2	The MCSC Project 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 operation.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed within the project drawings, calculations, and specifications.	Design Review
134	6.4.2	Design decisions shall consider life-cycle costs and all other programmatic requirements affecting WESF and CSS. The initial construction cost shall be balanced against operating 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.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed within the project drawings, calculations, and specifications.	Design Review
135	6.4.2	The design shall consider maintainability factors particular to the specific equipment used. The CSA design shall provide for routine maintenance, repair, or replacement of equipment subject to failure.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed within the project drawings, calculations, and specifications.	Design Review
	6.5	**ALARA Requirements**			
136	6.5	As low as reasonably achievable (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 as low as reasonably achievable. Design considerations shall include contamination control, shielding, remote activities, failure recovery, and maintenance.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawing H-2-837593 which shows inner and outer perimeter fencing around the CSP to prevent unintended worker exposure. This requirement is addressed in drawing H-2-837602 which shows TMS TBX locations. TBX's are located outside of the CSP inner fence to minimize worker exposure. Conductors from the TMS Control Cabinet to the TMS TBX's will be installed and terminated by the construction contractor before VCCs are placed on the CSP. This requirement is addressed in drawing H-2-837606 Detail 4 which shows connection of TMS instrument cables to VCC's. Placement of conduit stub up embedded in CSP and connection of TMS conductors and conduit to VCC are being made with as little worker time at VCC as possible. Wiring connection is with flexible conduit and cable connectors at VCC junction box (GFE by CSS contractor), and a conduit support will be embedded in the VCC (GFE by CSS contractor). Also drawing H-2-837598 Sheet 5 talks about the direction of the the vent casks. The existing ALARA plan CHPRC-03593 is being revised and will be completed before construction of the CSA.	Design Review

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Applicable Project Requirements:					
	6.5.1	**Key ALARA Requirements**			
137	6.5.1	MCSC Project shall be designed to limit occupational radiation exposures in accordance with the requirements of 10 CFR 835, "Occupational Radiation Protection" and CHPRC-00073, *CH2M HILL Plateau Remediation Company Radiological Control Manual* . 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."	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawing H-2-837593 which shows inner and outer perimeter fencing around the CSP to prevent unintended worker exposure. This requirement is addressed in drawing H-2-837602 which shows TMS TBX locations. TBX's are located outside of the CSP inner fence to minimize worker exposure. Conductors from the TMS Control Cabinet to the TMS TBX's will be installed and terminated by the construction contractor before VCCs are placed on the CSP. This requirement is addressed in drawing H-2-837606 Detail 4 which shows connection of TMS instrument cables to VCC's. Placement of conduit stub up embedded in CSP and connection of TMS conductors and conduit to VCC are being made with as little worker time at VCC as possible. Wiring connection is with flexible conduit and cable connectors at VCC junction box (GFE by CSS contractor), and a conduit support will be embedded in the VCC (GFE by CSS contractor). Also drawing H-2-837598 Sheet 5 talks about the direction of the the vent casks. The existing ALARA plan CHPRC-03593 is being revised and will be completed before construction of the CSA.	Design Review
138	6.5.1	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.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawing H-2-837593 which shows the inner and outer perimeter fencing.	Design Review
	6.6	**Safety**			
	6.6.1	**Occupational Safety and Health**			
139	6.6.1	MCSC Project 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."	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawing H-2-837591.	Design Review
	6.6.2	**Confinement Strategy**			
140	6.6.2	MCSC Project 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.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawing H-2-837591 through use of multiple fence lines surrounding the CSA and the stored casks, along with the design verification performed on the CSS.	Design Review
	6.6.3	**Fire Mitigation Strategy**			
141	6.6.3	MCSC Project shall protect personnel from fires in accordance with the DOE O 420.1C Contractor Requirements Document (CRD), NFPA 101, *Life Safety Code* , *International Building Code* , 29 CFR 1910, and 29 CFR 1926. MCSC Project shall minimize requirements for fire protection by eliminating unprotected combustible materials from the facility design to the extent practical. The design shall consider fire retardant materials based on ASTM E84, *Standard Test Method for Surface Burning Characteristics of Building Materials* , and NFPA 701, *Standard Methods of Fire Tests for Flame Propagation of Textiles and Films* .	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawing H-2-837597 and H-2-837598.	Design Review
	6.6.5	**Safety Analysis**			
142	6.6.5	The MCSC Project shall 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, Waste Encapsulation and Storage Facility Management of Cesium and Strontium Capsules (Project W- 135) Safety Design Strategy. The CSP shall have a design basis classification of PC-2, safety significant.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in CHPRC- 02539, *Design Analysis of the Concrete Pads for the 200 East Capsule Storage Area (CSA), Project W-135.*	Design Review

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Applicable Project Requirements:					
	6.7	**Safeguards and Security**			
143	6.7	MCSC Project shall comply with applicable requirements in DOE O 470.4B, *Safeguards and Security Program* . The need for a security alarm system, communications, and other measures to prevent unauthorized access to CSA and nuclear materials shall be determined by completion of a security requirements analysis. Safeguards and security measures shall prevent theft, vandalism, and other malicious acts that could release radioactive material or disrupt facility operations.	P	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawing H-2-837593.	Design Review
144	6.7	· Canisters and debris will be handled, overpacked and placed into shielded storage within the CSA fenced area. Therefore, logistics required for Security, in processing of materials, tools, equipment and personnel (including removal and restoration of security barriers, if required) into and out of the controlled area shall be considered in the design	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawings H-2-837593 and H-2-837597.	Design Review
145	6.7	· Sufficient lighting and accessibility shall be provided for the storage casks on the storage pad to enable their visual inspection on all sides for security purposes from a distance of 250 feet, and no less than 0.2 foot candles	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawing H-2-837601, H-2-837610 Sh 2, and CHPRC-02535, *W-135 Capsule Storage Area Lighting Calculation.*	Design Review
146	6.7	· In addition to the existing 200E Area perimeter fence, additional local fencing, alarms and security features will be provided as necessary at CSA	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawing H-2-837593 for fencing and padlockable gates. CHPRC has directed that no additional security features (perimeter intrusion detection and alarms, cameras, card readers) are required.	Design Review
147	6.7	· Movement and/or relocation of existing ecology blocks in the vicinity of the CSA location shall be evaluated	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in drawings H-2-837591, H-2-837593.	Design Review
	6.8	**Natural Phenomena Criteria**			
	6.8.1	**Seismic**			
148	6.8.1	Seismic design criteria for CSA SSCs shall be established and implemented as specified in PRC-PRO-EN- 097, *Engineering Design and Evaluation (Natural Phenomena Hazard)* , using SDC-2/LS C seismic design criteria.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in CHPRC-02539, Design Analysis of the Concrete Pads for the 200 East Capsule Storage Area (CSA), Project W-135, CHPRC-03634 Anchorage Analysis of the CSA TMS Electrical Equipment Enclosure, and CHPRC-03635 Structural Analysis of CSA Electrical Equipment Racks and TMS Anchorage (Safety-Significant).	Design Review
149	6.8.1	DOE-STD-1189 and ANSI/ANS 2.26-2004, *Categorization of Nuclear Facility Structures, Systems and Components for Seismic Design* , (ANS 2.26) were used to determine the general seismic criteria for the new CSA. DOE-STD-1189, Appendix A states the following: "The seismic design classifications of ANS 2.26 are to be used in association with DOE radiological criteria provided in this appendix. It is intended that the requirements of Section 5 of ANS 2.26 and the guidance in Appendix A of 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, Appendix A, specifically Table A-1, radiological criteria. The LS designations will be derived using Section 5 and Appendix A of ANS 2.26.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in CHPRC-02539, *Design Analysis of the Concrete Pads for the 200 East Capsule Storage Area (CSA), Project W-135,* CHPRC-03634 *Anchorage Analysis of the CSA TMS Electrical Equipment Enclosure,* and CHPRC-03635, *Structural Analysis of CSA Electrical Equipment Racks and TMS Anchorage (Safety-Significant).* For further interpretation, see PRC-PRO-EN-097, *Engineering Design and Evaluation (Natural Phenomena Hazard).*	Design Review

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Applicable Project Requirements:					
150	6.8.1	SDC Determination: Using the guidance provided by DOE-STD-1189, Appendix A for seismic design of SSCs and the unmitigated consequences from a seismic event in the existing WESF DSA, a Seismic Hazard Category of SDC-2 will be used for 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. CHPRC procedure PRC-PRO-EN-097 provides seismic design criteria based on SDC and LS designation. Seismic design criteria for SDC-2/LS C will be specified in design documentation. Since the CSA has been classified as SDC-2/LS C, the structural design will be implemented using ASCE/SEI 7-2010.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in CHPRC-02539, *Design Analysis of the Concrete Pads for the 200 East Capsule Storage Area (CSA),* Project W-135, CHPRC-03634 *Anchorage Analysis of the CSA TMS Electrical Equipment Enclosure* , and CHPRC-03635 *Structural Analysis of CSA Electrical Equipment Racks and TMS Anchorage (Safety-Significant)* .	Design Review
	6.8.2	**Natural Phenomena Other Than Seismic**			
151	6.8.2	Natural phenomena impacts other than seismic, including storm drainage runoff and collection, will be in accordance with DOE-STD-1020-12, Natural Phenomenon Hazards Analysis and Design Criteria for Department of Energy Facilities, HNF-SD-GN-ER-501, Natural Phenomena Hazards, Hanford Site, Washington, and PRC-PRO-EN-097.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in CHPRC-02532, *Storm Water Evaluation for W-135 CSA and WESF Truck Loading Area.*	Design Review
152	6.8.2	When applicable, 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.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed in CHPRC-02532, *Storm Water Evaluation for W-135 CSA and WESF Truck Loading Area.*	Design Review
153	6.8.2	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.	Y	Did not use data from HMS that is different than that specified in PRC-PRO-EN-097.	Design Review
	6.9	**Decontamination and Decommissioning**			
154	6.9	The MCSC Project shall comply with the design criteria in DOE O 430.1B, *Real Property Asset Management* , and 10 CFR 835. The design shall enable future closure of CSA in accordance with 40 CFR 264, "Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," and WAC 173 303-610, "Closure and Post-Closure." Designs consistent with the program requirements of DOE O 430.1B 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.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed within the project drawings, calculations, and specifications.	Design Review

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Applicable Project Requirements:					
155	6.9	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 the requirements set forth in ANSI N512, *Protective Coatings (Paints) for the Nuclear Industry* .	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is met as indicated in CHPRC-02538.	Design Review
	7	**Nuclear Safety Requirements**			
	7.1	**Nuclear Safety**			
156	7.1	The MCSC Project shall comply with the requirements of 10 CFR 830 and DOE-STD-1189, as implemented by PRC-PRO-NS-700, *Safety Basis Development*. The specific strategy that will be used to ensure compliance is described in CHPRC-02236. CHPRC-03293, Conceptual Safety Design Report for the Capsule Storage Area, includes an initial list of safety equipment. The CSP and the TMS have been identified as safety significant. Required safety documentation that will be developed by CHPRC for the CSA includes a preliminary hazard analysis, a conceptual safety design report, a preliminary DSA, and a final DSA document. The CSA design contractor will provide input to the CHPRC analysis as described in the CSA design contractor SOW.	Y	This requirement has been met with the design/engineering documentation performed during design. The TMS requirement is addressed drawing H-2-837600 Note 6. The CSP requirement is addressed in CHPRC- 02534, *W-135 Capsule Storage Area Construction Specification,* Section 03 15 21 *Post installed Concrete Anchors (Safety-Significant)* and Section 03 30 21 *Cast-in-Place Concrete (Safety-Significant).*	Design Review
	7.2	**Safety Basis**			
157	7.2	The CSA design contractor will provide input to a CHPRC analysis and shall develop nuclear safety documentation as required by the CSA 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 contractor's design, activities to transfer the canisters from WESF to CSA, and all hazards associated with long-term storage of the capsules at CSA. The impacts of natural phenomena hazards shall be addressed consistent with the requirements of PRC-PRO-EN-097.	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed within the project drawings, calculations, and specifications.	Design Review

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Applicable Project Requirements:					
	7.3	**Fire Hazards Analysis**			
158	7.3	Required documentation that will be developed by CHPRC with support from the CSA design contractor includes a preliminary FHA and a final FHA for WESF and CSA. The FHAs will be developed according to the requirements of PRC-PRO-FP-40420, *Fire Protection Analysis* . CHPRC shall perform an analysis of fire, blast, missile, and overpressure hazards, and the CSA design contractor will provide input to CHPRC to the extent identified in the SOW to demonstrate compliance with DOE requirements.	Y	This requirement has been met with the design/engineering documentation performed during design. This is addressed in drawing H-2-837597 and H-2-837597.	Design Review
159	7.3	Preliminary analysis has determined that the CSA design shall include a minimum of two fire hydrants. An automatic water suppression system for fire protection is not required.	Y	This requirement has been met with the design/engineering documentation performed during design. This is addressed in drawing H-2-837597 and H-2-837597.	Design Review
	9	**Environmental / Permitting Requirements**			
	9.1	**Dangerous Waste Permitting**			
160	9.1	MCSC Project shall comply with the following sections of WAC 173-303:			Design Review
		· WAC 173-303-280 – "General requirements for dangerous waste management facilities"	Under Ecology review pending issuance of Part B permit.	RCRA Part B Permit application (DOE/RL-2017-44, Rev. 0) was transmitted to Ecology by DOE-RL letter 18-AMRP-0013, dated November 16, 2017. Substantive requirements associated with this section are assumed to have been met pending Ecology's issuance of a permit.	
		· WAC 173-303-281 – "Notice of intent"	Y	DOE-RL letter to Ecology, 17-AMRP-0147, dated April 26, 2017.	
		· WAC 173-303-282 – "Siting criteria"	Y	DOE-RL letter to Ecology, 17-AMRP-0147, dated April 26, 2017.	
		· WAC 173-303-283 – "Performance standards"	Under Ecology review pending issuance of Part B permit.	RCRA Part B Permit application (DOE/RL-2017-44, Rev. 0) was transmitted to Ecology by DOE-RL letter 18-AMRP-0013, dated November 16, 2017. Substantive requirements associated with this section are assumed to have been met pending Ecology's issuance of a permit.	
		· WAC 173-303-290 – "Required notices"	N/A	The CSA will not be receiving dangerous waste from sources outside the United States per the FDC.	
		· WAC 173-303-300 – "General waste analysis"	Under Ecology review pending issuance of Part B permit.	RCRA Part B Permit application (DOE/RL-2017-44, Rev. 0) was transmitted to Ecology by DOE-RL letter 18-AMRP-0013, dated November 16, 2017. Substantive requirements associated with this section are assumed to have been met pending Ecology's issuance of a permit.	
		· WAC 173-303-310 – "Security"	Under Ecology review pending issuance of Part B permit.	RCRA Part B Permit application (DOE/RL-2017-44, Rev. 0) was transmitted to Ecology by DOE-RL letter 18-AMRP-0013, dated November 16, 2017. Substantive requirements associated with this section are assumed to have been met pending Ecology's issuance of a permit.	
		· WAC 173-303-320 – "General inspection"	Under Ecology review pending issuance of Part B permit.	RCRA Part B Permit application (DOE/RL-2017-44, Rev. 0) was transmitted to Ecology by DOE-RL letter 18-AMRP-0013, dated November 16, 2017. Substantive requirements associated with this section are assumed to have been met pending Ecology's issuance of a permit.	
		· WAC 173-303-330 – "Personnel training"	Under Ecology review pending issuance of Part B permit.	RCRA Part B Permit application (DOE/RL-2017-44, Rev. 0) was transmitted to Ecology by DOE-RL letter 18-AMRP-0013, dated November 16, 2017. Substantive requirements associated with this section are assumed to have been met pending Ecology's issuance of a permit.	
		· WAC 173-303-335 – "Construction quality assurance program"	N/A	The requirements of this section are applicable for all surface impoundments, waste piles, and landfill units. The CSA is neither of these.	
		· WAC 173-303-340 – "Preparedness and prevention"	Under Ecology review pending issuance of Part B permit.	RCRA Part B Permit application (DOE/RL-2017-44, Rev. 0) was transmitted to Ecology by DOE-RL letter 18-AMRP-0013, dated November 16, 2017. Substantive requirements associated with this section are assumed to have been met pending Ecology's issuance of a permit.	
		· WAC 173-303-350 – "Contingency plan and emergency procedures"	Under Ecology review pending issuance of Part B permit.	RCRA Part B Permit application (DOE/RL-2017-44, Rev. 0) was transmitted to Ecology by DOE-RL letter 18-AMRP-0013, dated November 16, 2017. Substantive requirements associated with this section are assumed to have been met pending Ecology's issuance of a permit.	
		· WAC 173-303-360 – "Emergencies"	Under Ecology review pending issuance of Part B permit.	RCRA Part B Permit application (DOE/RL-2017-44, Rev. 0) was transmitted to Ecology by DOE-RL letter 18-AMRP-0013, dated November 16, 2017. Substantive requirements associated with this section are assumed to have been met pending Ecology's issuance of a permit.	
		· WAC 173-303-370 – "Manifest system"	N/A	CSA will not be receiving waste from off-site, i.e. off the Hanford Site	
		· WAC 173-303-380 – "Facility recordkeeping"	Y	PRC-PRO-EP-52832, Operating Record for Treatment, Storage, and Disposal Units	

Item No.	Requirement Basis (CHPRC-02623 Section No.)	Requirement Text	Requirement Met? Y (Yes), N (No), or N/A	How was the requirement met? Provide reference to where evidence is found in design output document or explain why the item is N/A.	Verification Method
Applicable Project Requirements:					
		· WAC 173-303-395 – "Other general requirements" (1) Precautions for ignitable and reactive waste (2) Compliance with other environmental protection regulations…. (3) Reserve (4) Loading and unloading areas (5) Storage time limit for impoundments and piles (6) Labeling for containers and tanks	(1) N/A (2) Y (3) N/A (4) Under Ecology review pending issuance of Part B permit. (5) N/A (6) Under Ecology review pending issuance of Part B permit.	(2) See DOE/RL letter to Ecology, 18-AMRP-0043, dated January 18, 2018 (4) and (6) RCRA Part B Permit application (DOE/RL-2017-44, Rev. 0) was transmitted to Ecology by DOE-RL letter 18-AMRP-0013, dated November 16, 2017. Substantive requirements associated with this section are assumed to have been met pending Ecology's issuance of a permit.	
		· WAC 173-303-600 – "Final facility standards"	Under Ecology review pending issuance of Part B permit.	RCRA Part B Permit application (DOE/RL-2017-44, Rev. 0) was transmitted to Ecology by DOE-RL letter 18-AMRP-0013, dated November 16, 2017. Substantive requirements associated with this section are assumed to have been met pending Ecology's issuance of a permit.	
		· WAC 173-303-610 – "Closure and post-closure"	Under Ecology review pending issuance of Part B permit.	RCRA Part B Permit application (DOE/RL-2017-44, Rev. 0) which included a closure plan was transmitted to Ecology by DOE-RL letter 18-AMRP-0013, dated November 16, 2017. Substantive requirements associated with this section are assumed to have been met pending Ecology's issuance of a permit.	
		· WAC 173-303-630 – "Use and management of containers"	Under Ecology review pending issuance of Part B permit.	RCRA Part B Permit application (DOE/RL-2017-44, Rev. 0) which included a closure plan was transmitted to Ecology by DOE-RL letter 18-AMRP-0013, dated November 16, 2017. Substantive requirements associated with this section are assumed to have been met pending Ecology's issuance of a permit. It is noted that the RCRA Part B Permit application identified 16 containers whereas the final design media documentation identified 25. See drawing H-2-837598, Sh. 5, Rev. D and CHPRC-02538, Rev. A, Final Design Report, Appendix C.	
		· WAC 173-303-680 – "Miscellaneous units"	Under Ecology review pending issuance of Part B permit.	CRA Part B Permit application (DOE/RL-2017-44, Rev. 0) which included a closure plan was transmitted to Ecology by DOE-RL letter 18-AMRP-0013, dated November 16, 2017. Substantive requirements associated with this section are assumed to have been met pending Ecology's issuance of a permit.	
		· WAC 173-303-803 – "Permit application requirements"	Under Ecology review pending issuance of Part B permit.	RCRA Part B Permit application (DOE/RL-2017-44, Rev. 0) which included a closure plan was transmitted to Ecology by DOE-RL letter 18-AMRP-0013, dated November 16, 2017. Administrative requirements associated with this section are assumed to have been met pending Ecology's issuance of a permit.	
		· WAC 173-303-806 – "Final facility permits"	Under Ecology review pending issuance of Part B permit.	RCRA Part B Permit application (DOE/RL-2017-44, Rev. 0) which included a closure plan was transmitted to Ecology by DOE-RL letter 18-AMRP-0013, dated November 16, 2017. Administrative requirements associated with this section are assumed to have been met pending Ecology's issuance of a permit.	
		· WAC 173-303-830 – "Permit changes."	Y	RCRA Part B Permit application (DOE/RL-2017-44, Rev. 0) was transmitted to Ecology by DOE-RL letter 18-AMRP-0013, dated November 16, 2017. Administrative requirements associated with this section of the WAC are assumed to be met in those instances where a "modification" to the permit has been identified. However, CHPRC procedures associated with Design Change Notices (PRC-PRO-EN-8016) and Work Package Engineering documents (PRC-PRO-EN-20050) do not have built into them any environmental review as other engineering documents (FMPs) for purposes of screening changes to determine if a change is considered a "permit change" and what type of permit modification it is.	
		The CSA design contractor shall be responsible for designing the CSA and any assigned WESF interface modifications in accordance with the requirements of the above sections of WAC 173-303. The CSA design contractor will be responsible for preparing the 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, but is not limited to, design documents, and the documentation required by WAC 173-303-806(4)(a) through (m), as appropriate to the CSA design. This includes certification of design drawings, specifications, and engineering studies by a registered professional engineer as required by WAC 173-303-806(4)(a).	Y	This requirement has been met with the design/engineering documentation performed during design. This requirement is addressed within the project drawings, calculations, and specifications. All drawings, calculations, and specifications are sealed by one or more professional engineers licensed in the State of Washington.	

Item No.	Requirement Basis (CHPRC-02623 Section No.)	Requirement Text	Requirement Met? Y (Yes), N (No), or N/A	How was the requirement met? Provide reference to where evidence is found in design output document or explain why the item is N/A.	Verification Method
Applicable Project Requirements:					
	9.2	**Environmental Protection and Pollution Control**			
161	9.2	CSA will be permitted as a RCRA miscellaneous unit that is fully compliant with WAC 173-303-280, "General Requirements for Dangerous Waste Management Facilities," and WAC-173-303-680, "Miscellaneous Units."	Under Ecology review pending issuance of Part B permit.	RCRA Part B Permit application (DOE/RL-2017-44, Rev. 0) which included a closure plan was transmitted to Ecology by DOE-RL letter 18-AMRP-0013, dated November 16, 2017. Administrative requirements associated with this section are assumed to have been met pending Ecology's issuance of a permit.	Design Review
	9.3	**Environmental Design**			
162	9.3	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*) shall be implemented to the extent practical.	Y	CHPRC has developed and implemented an environmental management system (EMS) (PRC-MP-EP-40182, EMS Manual) that has been certified to the International Organization for Standardization's (ISO) 14001 standard per the Contractor Requirements Document found in Attachment 1 of that directive.	Design Review
	9.5	**Managing Waste Generated**			
163	9.5	The MCSC Project shall interface with existing Hanford Site waste treatment and disposal facilities for disposition of hazardous and radioactive solid wastes generated by MCSC Project. CSA design contractor provided systems shall be designed with intent to minimize future generation of waste requiring management and disposal by the MCSC Project.	Y	This implemented per Level 2 procedures, e.g. PRC-PRO-WM-52692, Waste Planning, Packaging, and Labeling.	Design Review
	9.6	**Airborne Emissions**			
164	9.6	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."	N/A	The construction and operation of the CSA will not generate any toxic or airborne emissions based on review of available design media.	Design Review
165	9.6	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."	Y	Based on current design, there is no bases for either a radiological or toxic air permit. A permit from BCCA may be needed for fugitive dust generated during construction earthwork at the CSA site. Staging and use of any portable generator driven by an internal combustion engine has not been identified to date and could trigger permitting under the Hanford Air Operating Permit. This permitting during construction will be addressed during the construction contracting process and utilization of Special Provision (SP)-5, On Site Services, per standard contracting language.	Design Review
166	9.6	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.	N/A	The CSA will be storing "sealed" sources that are exempt from permitting under 40CFR61 and WAC 246-247.	Design Review

Item No.	Requirement Basis (CHPRC-02623 Section No.)	Requirement Text	Requirement Met? Y (Yes), N (No), or N/A	How was the requirement met? Provide reference to where evidence is found in design output document or explain why the item is N/A.	Verification Method
Applicable Project Requirements:					
	10	**Quality Assurance Requirements**			
167	10	MCSC Project will be performed under a quality assurance program meeting the requirements of ASME NQA-1-2008, *Quality Assurance Requirements for Nuclear Facility Applications,* 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, 2.5, 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." 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* .	Y	The design will be performed in accordance with upper level QA requirements as well as the subcontractors QA Program (which is on the approved Evaluated Supplier List). Quality assurance requirements for equipment and materials are flowed down through drawings and in CHPRC-02534, *W-135 Capsule Storage Area Construction Specification.*	Design Review

Management of the Cesium and Strontium Capsules Project (W-135)
FDC Design Verification Matrix
CSA Final Design

Item No.	Requirement Basis (CHPRC-02623 Section No.)	Requirement Text	Requirement Met? Y (Yes), N (No), or N/A	How was the requirement met? Provide reference to where evidence is found in design output document or explain why the item is N/A.	Verification Method
Applicable Project Requirements:					
Design Input Assumptions Requiring Confirmation Prior to CSA Fabrication or Construction					
1	6.5.1	Confirm that the dose rates at the CSA outer fence from CSS casks in their final storage configuration will meet the FDC requirement of less than or equal to 0.5 mrem/hr. (Note: CSS final design has not been issued as of this date. Based on Calculation No. 30059-5004, MCSC CSS and Cask Array Shielding Evaluations, Revision 0, from the CSS contractor, CHPRC directed an assumption that the dose rate will meet the FDC requirement.)			
2	6.6.1	Confirm the CSS cask surface temperatures. (Note: CSS final design has not been issued as of this date. Therefore a design input assumption was established for selection of TMS conductors and conduit. Based on unreleased Calculation No. 30059-3001, MCSC VCC Thermal Evaluations, Revision 1, from the CSS contractor, the assumption is that the VCC worst case temperature is approximately 170°F at 7 ft height, with lower temperatures at lower locations on the VCC, and lower temperatures on/in the CSP. TMS signal conductors are rated for 105°C/221°F. The conductor type that was specified by the CSS contractor for installation on the VCC is also specified on the CSA drawings for conductors between the VCCs and the TMS Control Cabinet.)			
3	4.1.5	Confirm TMS conductor connector specification. (Note: CSS final design has not been issued as of this date. However, the CSS contractor specified TMS conductor connectors in the VCC junction boxes, and a corresponding mating connector was specified on the CSA drawings.)			
4	6.5	Confirm that CSA design satisfies ALARA requirements. (Note: CSS final design, which is the key input to the ALARA analysis for the CSA, has not been issued as of this date. A design assumption was made that the general layout for the CSA will allow for implementation of standard radiological control methods to meet ALARA requirements; however, this shall be confirmed following release of final radiological dose calculation from the CSS contractor; e.g., Calculation No. 30059-5004, MCSC CSS and Cask Array Shielding Evaluations.)			
5	4.1.6	Confirm that topographical survey information and subsurface geophysical data is available for the tie-in locations of the new fire protection raw water line. (Notes: These surveys were delayed but are now complete. The affected design drawings will be updated prior to procurement and construction to incorporate this information.)			
6	4.1.2	Confirm that the radiation dose to the CSP (concrete pad) is less than or equal to the design assumption. (Note: The CSS final design, including dose analyses, has not been released as of this date. Therefore an assumption was made based on unreleased Calculation No. 30059-5004, MCSC CSS and Cask Array Shielding Evaluations, Revision 0, from the CSS contractor.)			
7	4.1.2, 4.1.3, 4.2	Confirm CSS transport equipment-related design input assumptions. (Note: The CSS final design has not been released as of this date. Design input assumptions required to develop ARES CSA Report No. 046414.17.01-003, Project W-135 Capsule Storage Area Operations Analysis Report the CSA Operations Analysis Report, Revision 0, were obtained from Document No. 30059-R-03, NAC Preliminary Design Report for the Management of Cesium and Strontium Capsules Project (MCSC), Revision 0, and respective equipment manuals.)			
8	4.1.2, 4.1.3, 4.2	Confirm CSS cask design assumptions. (Note: The CSS cask final design has not been released as of this date; therefore, the CSA design employed input assumptions [e.g., dimensions, materials, weight] based on Document No. 30059-R-03, NAC Preliminary Design Report for the Management of Cesium and Strontium Capsules Project (MCSC), Revision 0, and unreleased Calculation No. 30059-2001, Vertical Concrete Cask, MPC, Weight & C.G. Calculation, Revision 0.)			
9	7.1	Confirm no changes to the CSA Safety Equipment List (SEL) following PDSA approval. (Notes: The CSA design, including designation of safety significant SSCs, is based on the SEL as issued prior to PDSA approval. Confirm that additional SSCs such as power distribution to the TMS are not designated as safety significant after PDSA is approved.)			

Item No.	Requirement Basis (CHPRC-02623 Section No.)	Requirement Text	Requirement Met? Y (Yes), N (No), or N/A	How was the requirement met? Provide reference to where evidence is found in design output document or explain why the item is N/A.	Verification Method
Applicable Project Requirements:					
10	7.1	Confirm no impacts in general to the CSA design based on the approved PDSA. (Notes: The PDSA is not expected to be completed and approved until after initial issue of the CSA final design documents. Therefore, upon PDSA approval, all aspects of the CSA design shall be evaluated for impact.)			
11	6.5	Confirm prior to construction that most recent radiological surveys continue to confirm that the CSA site is uncontaminated. (Notes: This assumption is based on the W-135 Project's understanding of the history of the CSA site as well as the results of the following: Initial Site Evaluation Study (2E-11-09); Excavation Permit; surface radiological survey; and continuous radiological surveys during the geotechnical investigation (7 borings). Prior to any CSA excavation activities, the Excavation Permit will be revised if required. Radiological surveys will be performed prior to and during all excavation activities. If at any time contamination is detected, CHPRC will direct appropriate responses.)			
12	4.1.2, 4.1.3	Confirm prior to construction that most recent characterization data (e.g., further geophysical ground scans; results of exploratory test pits) for subsurface utilities does not indicate changes with respect to that in the design documents.			
13	4.1.6	Confirm that MSA will provide services to design, install, and test the PAX system wiring and speakers and that this scope will not be part of the CSA construction contract. (Notes: The existing PAX at the CSB will be extended to the CSA by MSA Telecommunications. It was assumed that MSA will be engaged by CHPRC during construction to design, install, and test the PAX system wiring and speakers. PAX system conduit from the CSB to the CSA, for use by MSA, is shown on the CSA drawings.)			
14	4.2	Confirm that MSA Electrical Utilities will provide the services to remove the WESF series outdoor lighting system during or prior to construction. (Notes: Elements of the WESF series outdoor lighting system must be removed during or prior to construction. Replacement parking lot lighting is not in CSA design scope as agreed upon by WESF Operations.)			

APPENDIX B

EQUIPMENT LIST

Equipment List

Item No.	Equip ID No. (EIN)	Component Name / Description	System	Status	Location	Safety Class	Manufacturer	Model No.	Vendor File No.	Ref Drawing
1	CSA-DP-001	Panelboard	Electrical		CSA	GS	Square D	NQ18L1		H-2-837605
2	CSA-DS-001	Disconnect Switch	Electrical		CSA	GS	Square D	H223NRB		H-2-837605
3	CSA-TMS-ANN	Annunciator	I&C		CSB	GS	H-2-837609 Assy 1, 2			H-2-837609
4	CSA-TMS-PS	Power Supply	I&C		CSB	GS	H-2-837609 Assy 3, 4			H-2-837609
5	LP1	Lighting Pole	Lighting		CSA	GS	H-2-837610 Assy 30			H-2-837610
6	LP2	Lighting Pole	Lighting		CSA	GS	H-2-837610 Assy 30			H-2-837610
7	LP3	Lighting Pole	Lighting		CSA	GS	H-2-837610 Assy 30			H-2-837610
8	LP4	Lighting Pole	Lighting		CSA	GS	H-2-837610 Assy 30			H-2-837610
9	LP5	Lighting Pole	Lighting		CSA	GS	H-2-837610 Assy 30			H-2-837610
10	CSA-TBX-01	TMS Terminal Box	I&C		CSA	SS	H-2-837607 Assy 6			H-2-837607
11	CSA-TBX-02	TMS Terminal Box	I&C		CSA	SS	H-2-837607 Assy 6			H-2-837607
12	CSA-TBX-03	TMS Terminal Box	I&C		CSA	SS	H-2-837607 Assy 6			H-2-837607
13	CSA-TBX-04	TMS Terminal Box	I&C		CSA	SS	H-2-837607 Assy 6			H-2-837607
14	CSA-TBX-05	TMS Terminal Box	I&C		CSA	SS	H-2-837607 Assy 6			H-2-837607
15	CSA-TBX-06	TMS Terminal Box	I&C		CSA	SS	H-2-837607 Assy 6			H-2-837607
16	CSA-TBX-07	TMS Terminal Box	I&C		CSA	SS	H-2-837607 Assy 6			H-2-837607
17	CSA-TBX-08	TMS Terminal Box	I&C		CSA	SS	H-2-837607 Assy 6			H-2-837607
18	CSA-TBX-09	TMS Terminal Box	I&C		CSA	SS	H-2-837607 Assy 6			H-2-837607
19	CSA-TBX-10	TMS Terminal Box	I&C		CSA	SS	H-2-837607 Assy 6			H-2-837607
20	CSA-TBX-11	TMS Terminal Box	I&C		CSA	SS	H-2-837607 Assy 6			H-2-837607
21	CSA-TBX-12	TMS Terminal Box	I&C		CSA	SS	H-2-837607 Assy 6			H-2-837607
22	CSA-TBX-13	TMS Terminal Box	I&C		CSA	SS	H-2-837607 Assy 6			H-2-837607
23	CSA-TBX-14	TMS Terminal Box	I&C		CSA	SS	H-2-837607 Assy 6			H-2-837607
24	CSA-TBX-15	TMS Terminal Box	I&C		CSA	SS	H-2-837607 Assy 6			H-2-837607
25	CSA-TBX-16	TMS Terminal Box	I&C		CSA	SS	H-2-837607 Assy 6			H-2-837607
26	CSA-TBX-17	TMS Terminal Box	I&C		CSA	SS	H-2-837607 Assy 6			H-2-837607
27	CSA-TBX-18	TMS Terminal Box	I&C		CSA	SS	H-2-837607 Assy 6			H-2-837607
28	CSA-TBX-19	TMS Terminal Box	I&C		CSA	SS	H-2-837607 Assy 6			H-2-837607
29	CSA-TBX-20	TMS Terminal Box	I&C		CSA	SS	H-2-837607 Assy 6			H-2-837607
30	CSA-TBX-21	TMS Terminal Box	I&C		CSA	SS	H-2-837607 Assy 6			H-2-837607
31	CSA-TBX-22	TMS Terminal Box	I&C		CSA	SS	H-2-837607 Assy 6			H-2-837607
32	CSA-TBX-23	TMS Terminal Box	I&C		CSA	SS	H-2-837607 Assy 6			H-2-837607
33	CSA-TBX-24	TMS Terminal Box	I&C		CSA	SS	H-2-837607 Assy 6			H-2-837607
34	CSA-TBX-25	TMS Terminal Box	I&C		CSA	SS	H-2-837607 Assy 6			H-2-837607
35	CSA-TMS-CAB-001	TMS Control Cabinet	I&C		CSA	SS	Government Furnished Equipment, Contractor Installed			H-2-837602

Equipment List

Item No.	Equip ID No. (EIN)	Component Name / Description	System	Status	Location	Safety Class	Manufacturer	Model No.	Vendor File No.	Ref Drawing
36	TE-201	Ambient Temperature Sensor	I&C		CSA	GS	Government Furnished Equipment, Contractor Installed			H-2-837602
37	TE-202	Ambient Temperature Sensor	I&C		CSA	GS	Government Furnished Equipment, Contractor Installed			H-2-837602

APPENDIX C

CAPSULE STORAGE AREA OPERATIONS ANALYSIS REPORT

PROJECT W-135
CAPSULE STORAGE AREA
OPERATIONS ANALYSIS REPORT

prepared for

CH2M HILL PLATEAU REMEDIATION COMPANY

Contract No. 64824
Report No. 046414.17.01-003
Revision 2

August 2018

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PROJECT W-135
CAPSULE STORAGE AREA
OPERATIONS ANALYSIS REPORT

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Revision 2

August 2018

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Revision Description

Rev.	Reason for Revision	Change Description	Affected Pages (Page/Sec./Para.)	Date
0	Original Issue			April 2018
1	Final Issue	Updated globally to use 25 Cask Storage Systems. Updated Figure B5 to illustrate turning radius of Vertical Cask Transporter. General formatting changes.	All pages.	08/09/2018
2	Final Issue	Requested by Client to referenced preliminary and copyright information.	Revised Section 3.1, added new reference to Section 5.0, modified figure on Page A-3, and removed Figure A-1.	08/20/2018

EXECUTIVE SUMMARY

The overall objective of the Management of Cesium and Strontium Capsules Project is to transition the capsules from underwater storage in the Waste Encapsulation and Storage Facility (WESF) pool cells to a new dry-storage facility for long-term storage pending availability of a permanent disposal option. Major project operational activities include: retrieval of the capsules from the pool cells, packaging of the capsules into a Cask Storage System (CSS), and transfer of the casks to a new Capsule Storage Area (CSA). Major supporting activities to prepare for operations include: procurement of the CSS, design and construction of WESF modifications to accommodate CSS packaging equipment, and design and construction of the new CSA including cask haul path improvements.

The Vertical Concrete Casks (VCCs), Transportable Storage Canisters (TSCs), and VCC lids will be constructed off-site and will be delivered and received at the CSA. Once assembled, these components will comprise an empty CSS. The capability to assemble these components needs to be provided at the CSA. Empty CSSs will be transported to WESF using the Vertical Cask Transporter (VCT) where the loaded Universal Capsules Sleeves (USCs) will be placed into the empty CSSs. The loaded CSSs will then be transported back to the CSA using the VCT. The loaded CSSs will be placed on the Capsule Storage Pad (CSP) for long-term storage.

The CSA layout as shown in Appendix B is adequate to support the delivery and receipt of the VCCs, TSCs, and VCC lids, including storage of this equipment on the CSP. There is sufficient remaining space available on the operating pad for manipulation and assembly of the VCCs, TSCs, and VCC lids. As the empty CSSs are assembled, they will be relocated to the north end of the operating pad in order to provide access to the CSP for placement of the loaded CSSs. Atlanta Avenue and the intersection of Atlanta Avenue and 7th Street are sufficiently wide for transport of the CSSs using the VCT and GT50 TUG Aircraft Gate Tractor (tug). However, the shoulders of 7th Street should be widened (approximately 2 ft on each side) in order to accommodate the width of the VCT (17.75 ft) and still have some available space for misalignment and to avoid overloading the edges of the paved surface.

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Acronyms

CHPRC	CH2M HILL Plateau Remediation Company
CSA	Capsule Storage Area
CSP	Capsule Storage Pad
CSS	Cask Storage System
DOE	U.S. Department of Energy
MCSC	Management of Cesium and Strontium Capsules
TSC	Transportable Storage Canister
tug	GT50 TUG Aircraft Gate Tractor
UCS	Universal Capsule Sleeve
VCC	Vertical Concrete Cask
VCT	Vertical Cask Transporter
WESF	Waste Encapsulation and Storage Facility

Units

' / ft	foot
"	inch
lb	pound

1.0 PURPOSE AND SCOPE

As a Prime Contractor to the U.S. Department of Energy (DOE), the CH2M HILL Plateau Remediation Company (CHPRC) is focused on safe environmental cleanup of the Central Plateau of the DOE Hanford Site. The CHPRC scope of work includes: environmental remediation activities, treatment and disposal of radioactive waste streams, management of spent nuclear fuel, and disposition of nuclear materials and non-reactor nuclear facilities.

The Management of Cesium and Strontium Capsules (MCSC) Project will fill the capability gap for interim storage of cesium and strontium capsules currently stored underwater at the Waste Encapsulation and Storage Facility (WESF). The MCSC Project is centered on the WESF which is a Hazard Category 2 non-reactor nuclear facility located adjacent to B Plant in the 200 East Area of the Hanford Site. The mission of WESF is the safe and compliant storage of 1,936 cesium and strontium capsules.

The overall objective of the MCSC Project is to transition the capsules from underwater storage in the WESF pool cells to a new dry-storage facility for long-term storage pending availability of a permanent disposal option. Major project operational activities include retrieval of the capsules from the pool cells, loading of the capsules into a Cask Storage System (CSS), and transfer of the casks to a new Capsule Storage Area (CSA). Major supporting activities to prepare for operations include: procurement of the CSS, design and construction of WESF modifications to accommodate CSS packaging equipment, and design and construction of the new CSA including cask haul path improvements.

This document is the operations analysis for the receipt, assembly, and interim storage of CSS components (the Vertical Concrete Casks [VCCs], Transportable Storage Canisters [TSCs], and VCC lids). It also evaluates movement of empty and loaded CSSs at the CSA, transfer of empty and loaded CSSs between the CSA and WESF, and placement of loaded CSSs in their storage locations.

2.0 DESIGN INPUTS

The input data for the operations analysis are as follows:

- Descriptions of the various MCSC Project terminologies (i.e., CSA, VCC, Universal Capsule Sleeve [UCS], etc.) are provided in CHPRC-03328, *Capsule Storage Area Conceptual Design Report (Project W-135)* and CHPRC-02623, *Capsule Storage Area (CSA) Functional Design Criteria (Project W-135).*

- Up to 25 CSSs may be required to store all of the capsules from the WESF Storage Pool. (CHPRC-02623, Section 4.1.2)

- An empty VCC will weigh approximately 127,740 lb. (Doc. No. 30059-P-01, Table 3.2-1)

- A loaded CSS (loaded with TSC liner, basket, and capsules) will weigh approximately 155,000 lb. (Doc. No. 30059-P-01, Table 3.5-1)

- The VCC has a diameter of 120 in. (CHPRC-02623, Section 4.1.2)

- Vertical Cask Transporter (VCT) Track Width: 16' 7.5". (CHPRC-03326, *NAC Hanford MCSC Conceptual Design Report (30059-R-02, 2017)*, Appendix C, "NAC's Interface Requirements")
- VCT Track Length: 26' 8 5/16". (CHPRC-03326, Appendix C)
- VCT Overall Width: 17' 9". (CHPRC-03326, Appendix C)
- VCT Overall Height (maximum extension): 22' 7/8". (CHPRC-03326, Appendix C)
- VCT Length: 35' 7 5/8". (CHPRC-03326, Appendix C)
- VCT Turning Radius: 33' 5/8" (inside) 56 4 3/8" (outside). (CHPRC-03326, Appendix C)
- Overall Length (includes length of GT-50): 54' 3 5/8". (CHPRC-03326, Appendix C)
- The CSSs will be arranged on the Capsule Storage Pad (CSP) in a 5 x 5 grid with 15' center-to-center distance and an outside clear perimeter of 10'. (CHPRC-02623, Section 4.1.2)
- The TSCs and VCC lids will be delivered on 24 pallets each (48 total). Each pallet will be no larger than 8' x 8' and may be stored approximately 1' apart from one another. These dimensions are based upon the TSC diameter (52.5") and lid diameter (49.37"). (Doc. No. 30059-P-01, Section 3.4)

3.0 EVALUATION

The VCCs, TSCs, and VCC lids will be constructed off-site and will be delivered and received at the CSA via various methods as described in Section 3.1. The TSCs, VCC lids, and VCCs will also be assembled at the CSA. Once assembled, these components will be collectively referred to in this report as empty CSSs. Assembly of the empty CSS is described in Section 3.2. The empty CSSs will be transferred to WESF where the loaded USCs will be placed into the CSSs. Transfer, loading, and storage of the VCC are described in Section 3.3.

3.1 Delivery/Receipt

The VCCs will be delivered to the CSA on a Goldhofer-type trailer which is approximately 72 ft long. The VCCs may be transported in either the vertical position or the horizontal position using an assembly similar to that shown in the Lift Systems, Inc. *General Arrangement Drawing of the Rubber-Tired Towed Cask Transporter for NAC International at the West Valley Project* (Lift systems, Inc., 2010). The flatbed trailer will be backed onto the operating pad, along with a crane (see Appendix A). The crane will most likely be at least a 200 ton crane (i.e., Terex Demag AC 200-1 All Terrain Crane). The crane will be used to unload the VCCs from the trailer (including repositioning the VCC from horizontal to vertical as necessary). The VCCs will be placed on the operating pad behind the crane. The crane and semi-truck/trailer may then be removed from the operating pad and the VCC may be placed onto either the CSP or operating pad using the VCT and a GT50 TUG Aircraft Gate Tractor (tug). An illustration of the delivery configuration of the crane, semi-truck/trailer, and VCCs is provided in Appendix B (Figure B1).

The TSCs and VCC lids will be delivered to the CSA on pallets which are no larger than 8' x 8' square. The method of transport for the TSCs and VCC lids may be performed via a variety of various truck and/or trailer configurations. A forklift will then be utilized to unload the pallets and place them on the storage pad as shown in Figure B1. The specifics of the truck and/or trailer and forklift need not be specified at this time since the specifications and operational requirements of this equipment will be governed by that for delivery and receipt of the VCCs.

3.2 CSS Assembly

In preparation for placing the loaded UCSs into the VCCs, the TSCs and TSC lids must be placed into the VCCs (assembled). Assembly of the CSSs may take place on the operating or CSP wherever space is available at the time. The VCCs located on the operating pad should be used for assembly first in order to provide room for the empty CSSs as they are assembled. As each empty CSS is completed, it will be placed on the north-east side of the operating pad working to the south-west. The empty CSSs will be relocated using the VCT and tug and the exterior gate of the CSA will be opened as necessary such that the CSA driveway may be utilized for additional space. The interim (approximately half complete) and assembled illustrations are shown in Appendix B (Figures B2 and B3).

3.3 Loading, Transport and Placing of the Loaded CSSs

The empty CSSs may be stored on the operating pad for an extended period of time before the capsules at WESF are ready to be loaded into the UCSs and placed in the CSSs. The empty CSSs will be transferred to WESF (using the VCT and tug). The empty VCC will be placed on the new concrete pad outside of the WESF truck port and the empty VCC will be transported into WESF using an air pallet. The CSS will then be loaded with USCs. When the loaded CSSs are returned to the CSA, they will be placed on the CSP for long-term storage in a configuration as shown in Appendix B (Figure B4) with 5 ft spacing between each CSS and a minimum of 10 ft spacing between the edge of the CSS and the edge of the concrete. By meeting these spacing requirements (as stipulated in CHPRC-03326, Appendix C), the VCT is capable of placing and maneuvering the VCCs/CSSs as necessary on and off of the storage and operating pads.

3.4 Existing Roads

The VCT and tug will travel between the CSA and WESF along 7th Street and Atlanta Avenue. The width of Atlanta Avenue is sufficient to accommodate the width of the VCT (17.75 ft). Additionally, the intersection of 7th Street and Atlanta Avenue is sufficient to provide the required turning radius for the VCT and tug. However, 7th Street is barely wide enough for the VCT to fit within it (shoulder-to-shoulder). Therefore, 7th Street should be widened by at least 2 ft on each side, (or 4 ft on one side) in order to accommodate the VCT and tug and still have some available space for misalignment and to avoid overloading the edges of the paved surface. The axle loads of the VCT are not significantly higher than those of cranes typically used at the Hanford site (132,500 lb vs 124,669 lb). The typical cranes are used on asphalt roads at the Hanford site on a regular basis and the typical asphalt road construction is sufficient to resist the crane loads. The new section of 7th Street and the WESF truck port and CSA haul paths will be designed with asphalt and base course thickness which exceed typical roadway thicknesses. Therefore, typical Hanford practices provide justification that the overall haul

path, including the existing roadways and new section of 7th Street and haul paths at the WESF and CSA, are sufficient to resist the loading of the VCT.

3.5 Grading

The existing grade of 7th Street near the CSA is approximately 710 ft. The existing surface of the ground at the CSA site varies, but in general is at an elevation of approximately 709.5 ft. The elevation of the CSP and operating pad will be set at an elevation of approximately 710 ft. This will allow the CSA haul path to be constructed approximately level. The adjacent grade will be leveled to an elevation of approximately 709.5 ft. This grade elevation will allow for minimal grading, cutting, and smoothing of the area surrounding the CSA yard.

3.6 Traffic Control

The VCT will be required to travel between the CSA and the WESF truck port for the loading and placement of each CSS (up to 24 round trips). The estimated travel distance for each way is approximately 1000 ft. At a speed of approximately 5 mph (maximum tow speed), the transport will likely be performed in less than 10 minutes each way. The VCT width (~18 ft) is not much narrower than the width of the updated 7th Street (24 ft) and Atlanta Avenue (~30 ft). Therefore, while there is potentially sufficient room for emergency vehicles to pass by the VCT on Atlanta Avenue, there is likely not sufficient space for emergency vehicles to pass by the VCT along 7th Street. However, there are sufficient alternative routes in the WESF and CSA areas, that this condition need not be mitigated in support of such a short duration effort of minimal repetition. Therefore, extra widening of 7th Street and/or Atlanta Avenue need not be performed for the specific support of emergency vehicles. The proper emergency authorities should be contacted prior to activities which block 7th Street or Atlanta Avenue.

3.7 Haul Path Geometry

The turning radius of the VCT is approximately 56 ft as illustrated in Appendix B (Phase III). The haul path, WESF truck port pad, operation pad, and CSP (including configuration thereof) are sufficiently sized to provide space for relatively easy maneuverability of the CSSs and related components. Additionally, as illustrated in Appendix B, Phase I, there is sufficient space for the trailers, cranes, forklifts, etc. to navigate and perform the required work without significant challenges associated with vehicle maneuverability. The size (width, length, height, etc.) of the VCCs and associated delivery trailer will require special consideration for traveling between the VCC fabrication site and the CSA. The travel route should be evaluated once the route is known in order to verify that the travel path is equipped with sufficient turn radii, widths, overhead clearances, etc. There is sufficient space on the CSA haul path to support the required turning radius of a delivery trailer with sufficient capacity to haul the VCCs.

The VCT is capable of traversing up to 4% grades (CHPRC-03326, Appendix C). Both the truck port and CSA haul paths have grades below 4% (thus preventing overstress of the VCT and tug components).

4.0 CONCLUSIONS

The CSA layout, including the operating pad, CSP, and haul path as shown in Appendix B is adequate to support the planned operations necessary to receive, assemble, transport, and store up to 25 CSSs.

Atlanta Avenue and the intersection of Atlanta Avenue and 7th Street are sufficiently wide and structurally adequate for transport of the CSSs using the VCT and tug. However, the shoulders of 7th Street should be widened (at least 4 ft) in order to accommodate the width of the VCT (17.75 ft) and still have some available space for misalignment and to avoid overloading the edges of the paved surface. Additionally, widening around the truck port haul path should also be performed in order to provide additional clearance for the VCT and tug to enter and exit Atlanta Avenue.

The improved haul path at the WESF is adequate for transport of the CSSs. The WESF truck port pad will be improved by the WESF portion of Project W-135.

5.0 REFERENCES

CHPRC-02623, 2018, *Capsule Storage Area (CSA) Functional Design Criteria (Project W-135)*, Rev. 3, CH2M HILL Plateau Remediation Company, Richland, Washington.

CHPRC-03326, 2017, *NAC Hanford MCSC Conceptual Design Report (30059-R-02, 2017)*, Rev. 0, Appendix C, "NAC's Interface Requirements," CH2M HILL Plateau Remediation Company, Richland, Washington. (Official Use Only)

CHPRC-03328, 2017, *Capsule Storage Area Conceptual Design Report (Project W-135)*, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington.

Doc. No. 30059-P-01, 2018, *MPC-Capsule Storage System (MPC-CSS) Operations and Maintenance Manual*, Rev. B (Preliminary Phase DRAFT), NAC International, Norcross, Georgia.

Lift Systems, Inc., 11-17-2010, *General Arrangement Drawing of the Rubber-Tired Towed Cask Transporter for NAC International at the West Valley Project*, Rev. B, Lift Systems, Inc., East Moline, Illinois.

APPENDIX A

EQUIPMENT ILLUSTRATIONS

Note that equipment illustrations may not match the final design exactly; however, the illustrations are sufficiently accurate to the current design for facilitation of the operations analysis.

Vertical Cask Transporter

Vertical Cask Transporter

VCT Dimensions

- Maximum width: 17.75 feet
- Overall height: Fully Extended 21.75 feet
- Wheel diameter: ~5 feet

Weight/Lifting Capacity

- Unburdened transporter weight: ~47.5 tons
- Rated lifting capacity: 90 tons
- VCT weight with loaded cask: 135 tons

Cask Engagement Features

- 4 inch thick lifting lugs attach to Vertical Storage Cask
- Lifting lug yoke on swivel attaches to mobile gantry crane

Engineered for Safe Cask Transport

- NAC International, an international supplier of nuclear fuel storage systems, and Lift Systems, Inc., which specializes in equipment to lift and transport heavy and oversized loads, designed and constructed the Vertical Cask Transporter to interface with the WVDP's Vertical Storage Casks.
- The equipment is designed and tested to meet stringent industry standards.
- Safety features include advanced systems for stopping, parking, load securement and lift limiting devices.

The Vertical Cask Transporter (top photo) that will be used for outdoor transport of HLW storage casks at the West Valley Demonstration Project and the tow tractor that will pull it are pictured above.

The West Valley Demonstration Project (WVDP) is preparing to package and relocate 278 canisters (275 production canisters and 3 end-of-process canisters) of vitrified high-level waste (HLW) from inside the Main Plant Process Building (MPPB) to a new on site storage location. The 47-ton Vertical Cask Transporter (VCT) is a mobile hydraulic gantry crane that will be used for the heavy hauling operation at the WVDP.

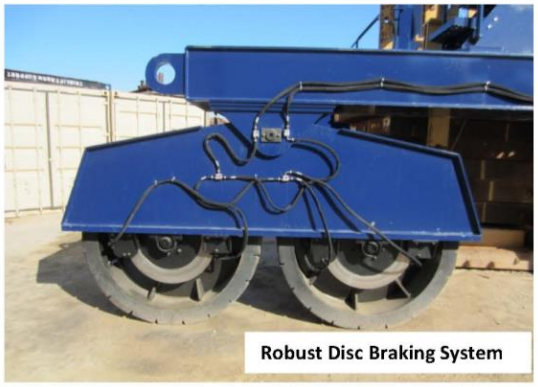
The specially-designed VCT is one of three task-specific pieces of heavy lifting/hauling equipment that will be used to maneuver the storage casks through loading and storage procedures. The VCT will operate entirely outdoors, where it will transport empty concrete storage casks to the MPPB and the 87-ton loaded casks from the MPPB to the Storage Pad. It is equipped with a diesel engine for lifting the casks, but will be towed by a separate GT50 aircraft tow tractor, which is commonly used to move airplanes.

The VCT is designed to operate under the wide temperature and humidity ranges that exist at the WVDP. Operating at its maximum loaded speed of approximately 2 miles per hour, on-site transport of a loaded storage cask from the MPPB to the Storage Pad will take approximately 3 hours.

West Valley Demonstration Project 10282 Rock Springs Road West Valley, NY 14171 July 2014

Vertical Cask Transporter

Load Testing at Vendor Facility



Robust Disc Braking System

A Similar Transporter Used to Transport a Nuclear Fuel Storage Cask

Cask Loading and Transport

The series of steps involved with loading and transporting the High-Level Waste (HLW) Vertical Storage Casks (VSC) from the Main Plant Process Building (MPPB) to the HLW Storage Pad require several movements of the bulky steel-line concrete storage casks. The WVDP's Vertical Cask Transporter (VCT) will play an important role in transporting casks for loading and placement in storage. To facilitate loading and storage, the VCT will:

- Pick up empty VSCs at the fabrication area in the WVDP's North Parking Lot
- Deliver the empty VSCs to the entrance of the Load-In Facility (LIF)
- Pick up VSCs loaded with 5 canisters at the LIF
- Transport loaded VSCs approximately one-half mile from the MPPB to the HLW Storage Pad
- Position the loaded VSCs on the Storage Pad

Lifting and transporting the VSCs requires precision and the utmost attention to safety. Design of the Vertical Cask Transporter, which is specifically made for outdoor movement and positioning of the WVDP's casks, is based on similar transport equipment used for moving spent nuclear fuel in concrete storage casks at nuclear power plants.

Proven, Safe, Long-Term Storage Technology

The WVDP HLW Storage System

- Maximizes the use of off-the-shelf technology
- Safely and securely packages HLW in multi-pack configuration to reduce handling and shipping costs
- Offers maintenance-free, passive storage
- Meets high nuclear quality assurance standards
- Interfaces with NRC Type-B licensed transportation casks

APPENDIX B

CSA ILLUSTRATIONS

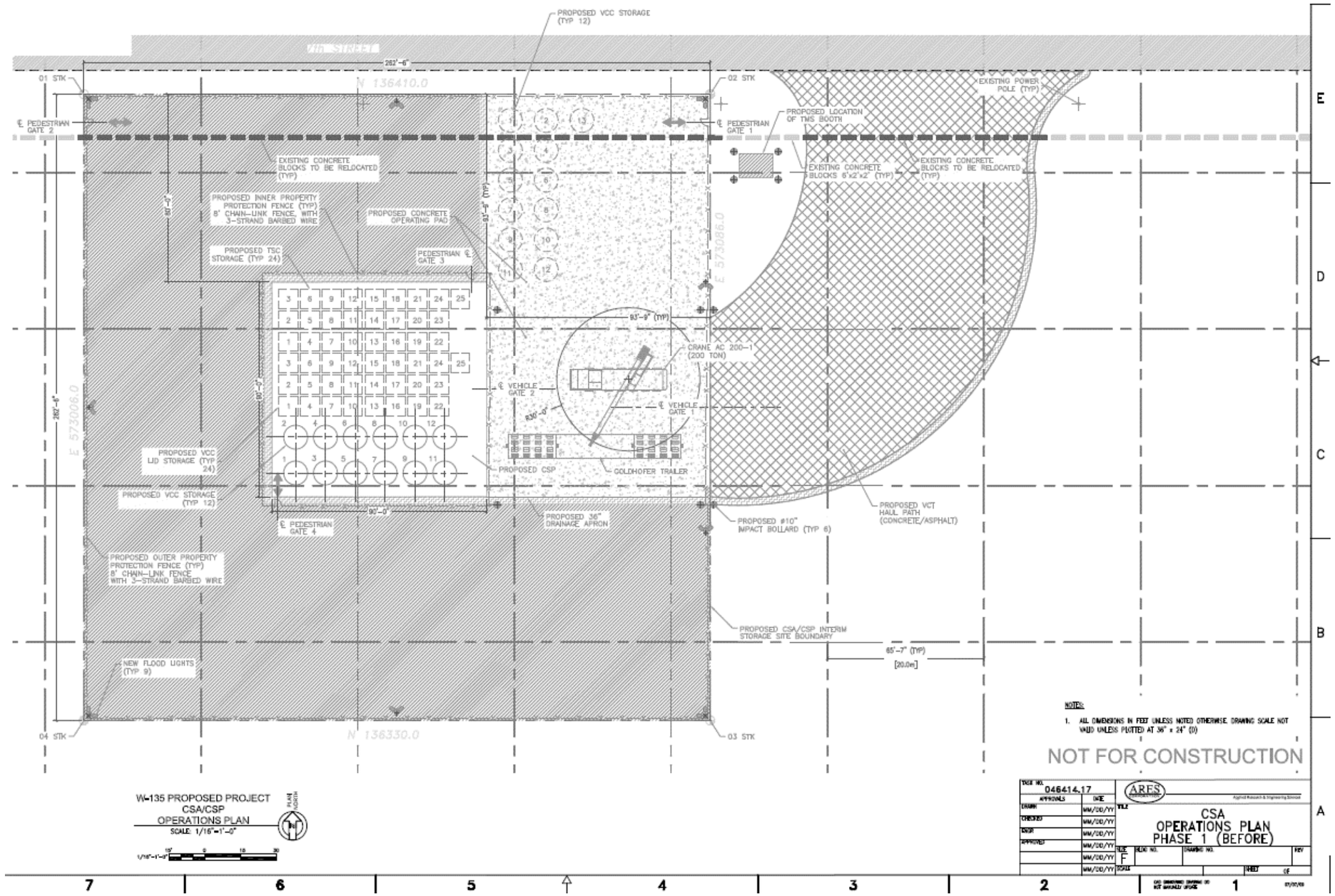


Figure B1. CSA Operations Plan Phase 1 (Before).

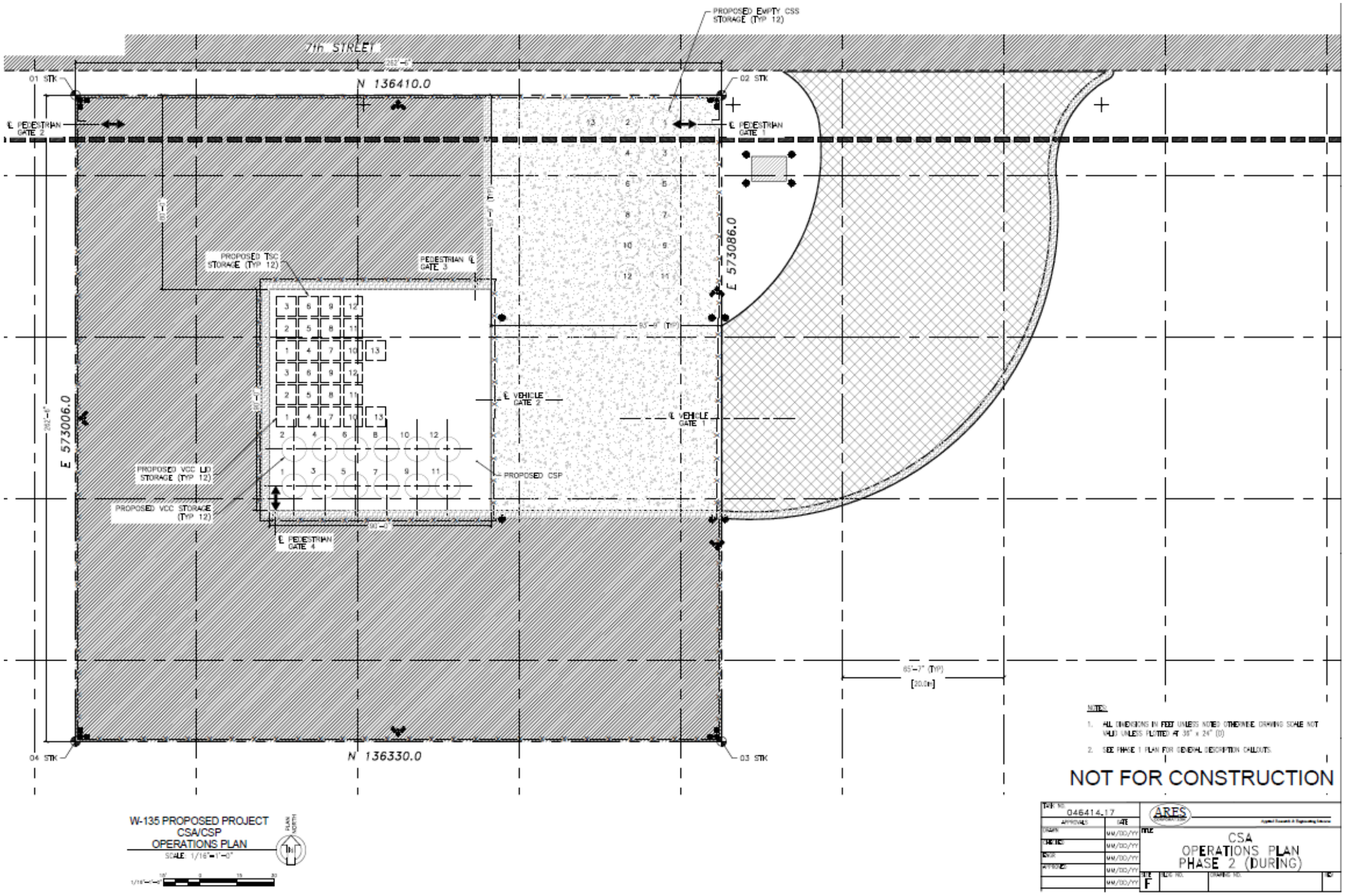


Figure B2. CSA Operations Plan Phase 2 (During).

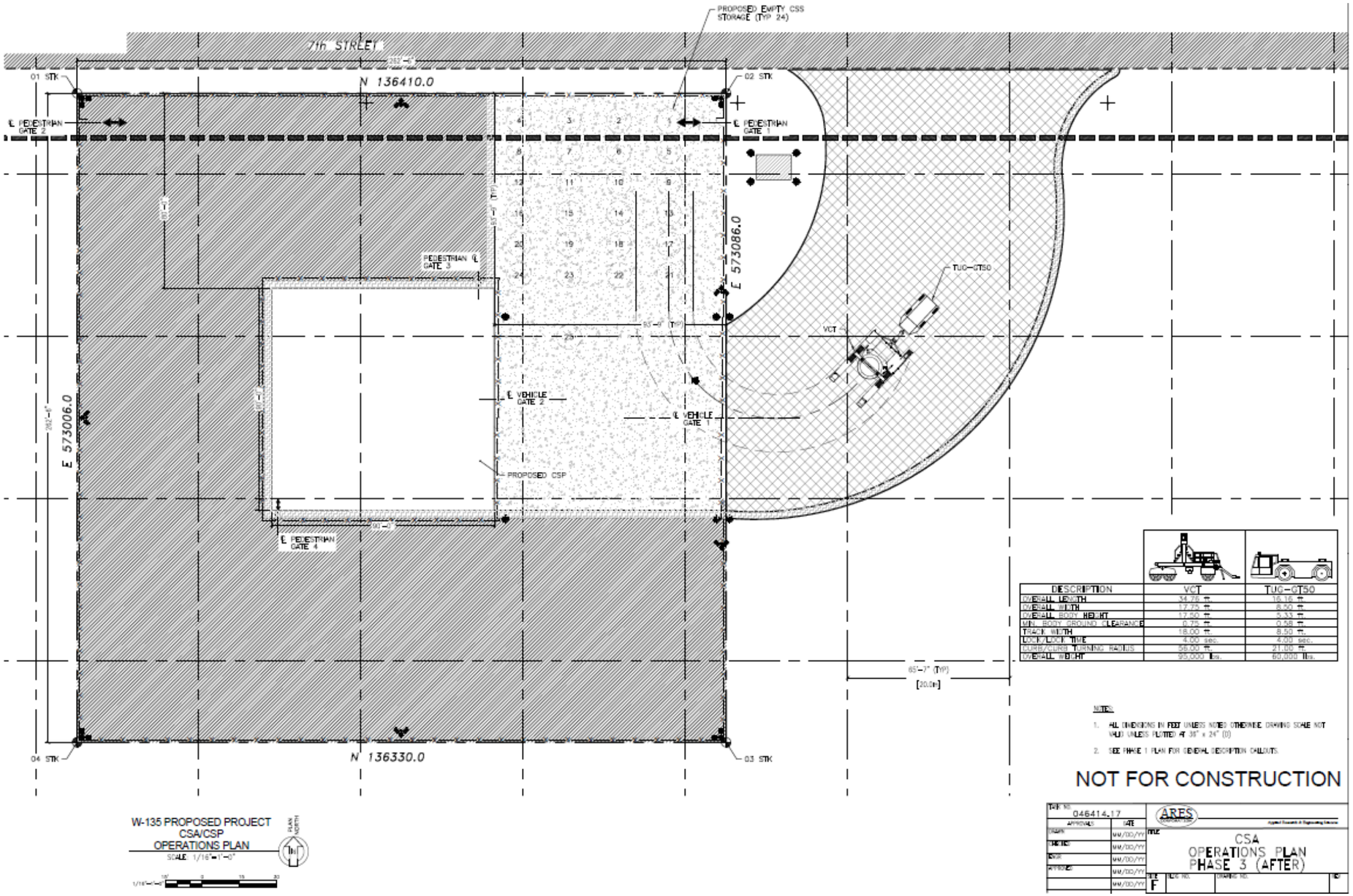


Figure B3. CSA Operations Plan Phase 3 (After).

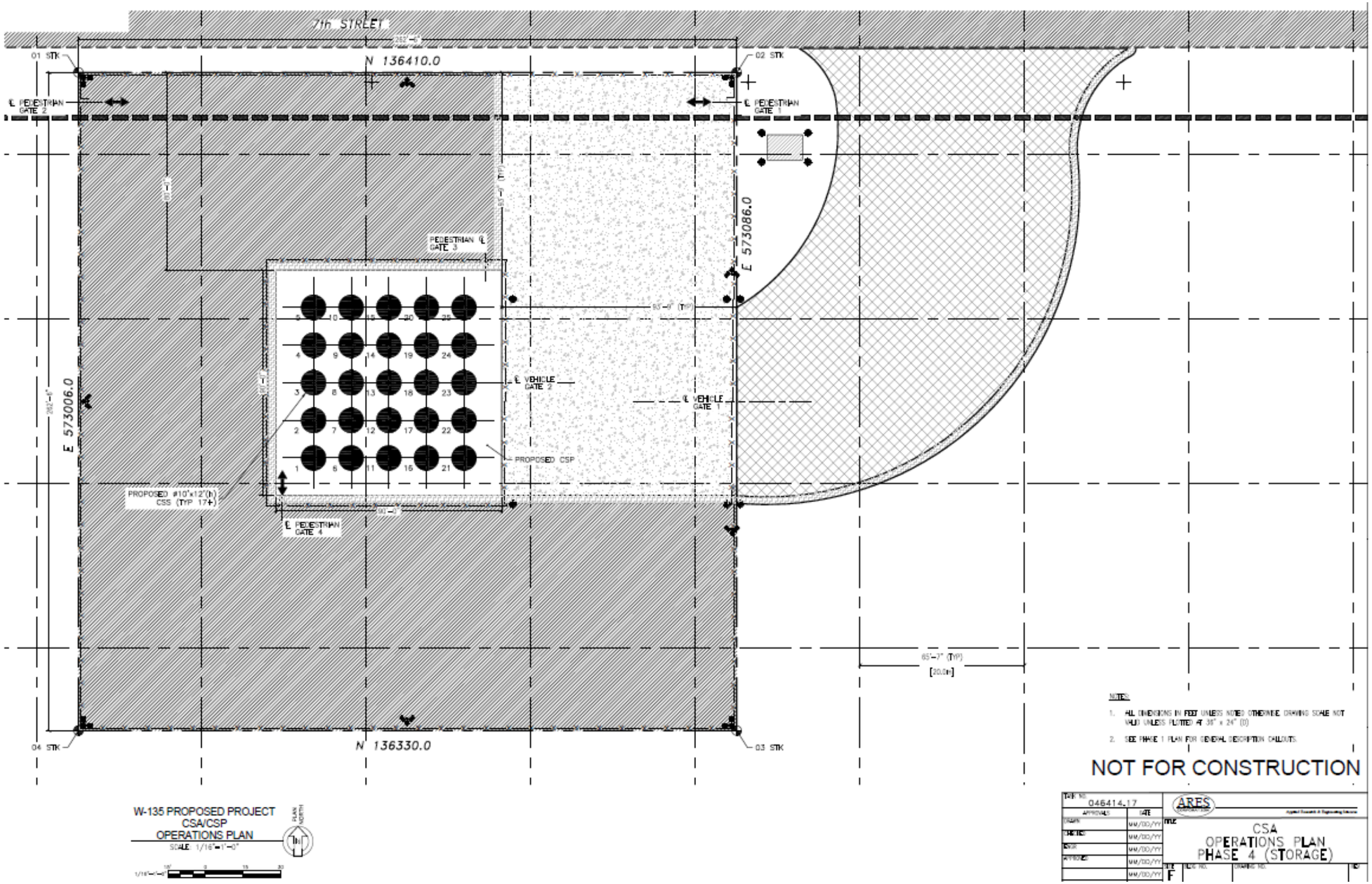


Figure B4. CSA Operations Plan Phase 4 (Storage).

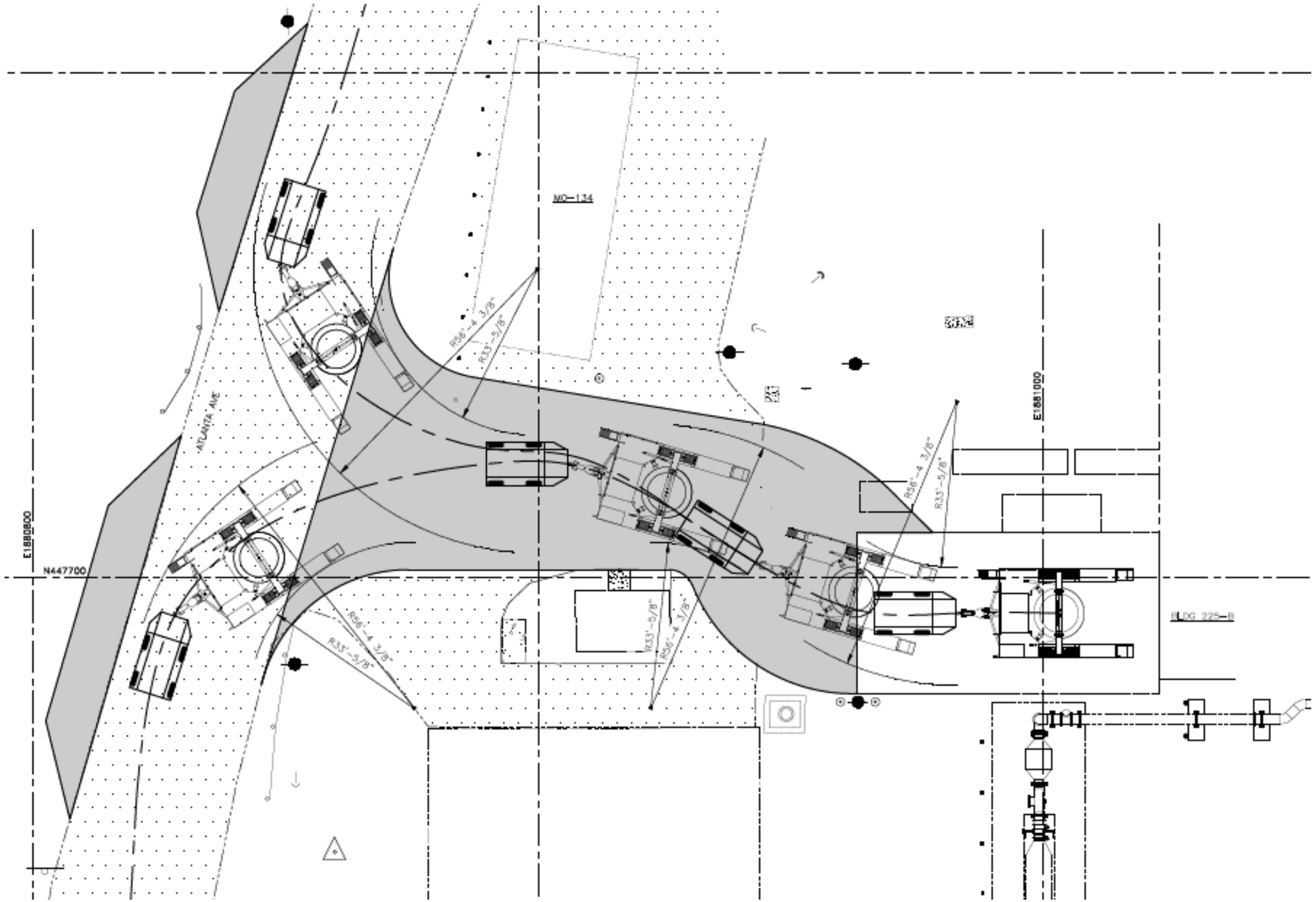


Figure B5. WESF Truck Port Operations Plan Phase 4 (Storage).

APPENDIX D

DESIGN BASIS INPUT MATRIX

Project W-135 CSA
Design Basis Input Matrix
8/8/2018

Item	Last Update	System/Area	Title	Detailed Description	Actionee	Date Required	Status and Notes
1	6/5/18	CSA	Security System Requirements	Provide final CSA security system requirements. Requirements shall address both technology (e.g., perimeter intrusion detection and assessment systems [PIDAS]) and Civil/MEP elements (e.g., fencing, gates, and lighting). These requirements will need to address the areas both during construction and when operational.	CHPRC	Prior to start of final design.	**Status: Closed**. **Final Design Input:** PIDAS not required (including no cameras). Normal fencing, truck/man gates, and lighting will be required on the perimeter of the CSA and the CSP (but no lighting is required at the CSP). In all cases, the fence is designed as 8-ft high chain link fence with outriggers and 3-strand barb wire, 10 ft on center anchor poles with top rail. There will be a single vehicular gate in each fence. There will be two personnel gates in each fence and these gates will have emergency crash bars. All gates shall have security lock capability. Ecology blocks on the north side can 'dogleg' around the CSA pad and meet up with the ecology blocks on the east side. Security require a simple swing barrier to close 7th Street at approximate location of current gate; gate design to be equal to or better than existing design.

2	5/29/18	CSA	Geotechnical Engineering Design Inputs	ARES requires site specific geotechnical engineering design inputs. This includes:
				
				• Allowable soil bearing pressure for a slab up to 3-ft thick, based on the following settlement criteria (provided to CHPRC on 06-Mar-18):
				  ○ Total settlement not greater than 1 inch.
				  ○ Differential settlement between CSP and Operations Pad not to exceed 0.25 inches.
				• Recommendations for obtaining a subsoil modulus of elasticity less than or equal to 30,000 psi with an in-place density greater than or equal to 100 lb/ft³ and less than or equal to 160 lb/ft³ at least 5 feet beyond the edge of the concrete pad and to a depth at least 10 feet as measured from the bottom surface *of the concrete pad.*
				• Suggested number of borings:
				  ○ One for CSP;
				  ○ One for Operating Pad;
				  ○ One for Haul Path Road access;
				  ○ One at WESF truck pad; and
				  ○ One at Haul Path next to WESF truck pad.
					CHPRC	Prior to start of final design.
						
						3/6/18: It was noted that the Geotech Report will not be issued until Mid-June.
							Status: Closed.
							
							Preliminary Input: ARES will proceed per S&Ws Preliminary Geotechnical Design Recommendations Report, to be issued as Rev. 0 (3/8/18).
							
							Note: CHPRC has contracted Ojeda Business Ventures with Shannon & Wilson to develop required geotechnical design inputs for civil/structural design. The ARES requirements have been provided to Ojeda. Preliminary input expected early February. Final recommendations will likely require additional geotechnical field investigation to confirm.
							
							3/13/18: Preliminary Geotechnical Recommendations Report, Revision 0, was provided to ARES.
							
							3/13/18: Jeff Martin and Chip Conselman had a telecon this afternoon with Clint Wilson and Bill Perkins at Shannon and Wilson.
							
							"We determined that it comes down to the fact that design of concrete structures using ACI 318 utilizes factored loads whereas typical soil criteria utilize allowable service load conditions (e.g., allowable bearing pressure). As our draft calculation uses a fully factored loading condition for design of the concrete, we will also determine the actual bearing pressure using unfactored loads and compare that to the unfactored allowable soil bearing pressure that Shannon and Wilson provides in their report. ARES predicts that the outcome of this method will be favorable and will not require additional modification to the Geotech information or recourse with Shannon and Wilson. As for settlements, based on their preliminary results, we don't see any issues. If further recourse regarding this issue is required, ARES and Shannon and Wilson will communicate directly with one another and will inform and copy you on the proceedings thereof."

Project W-135 CSA
Design Basis Input Matrix
8/8/2018

Item	Last Update	System/Area	Title	Detailed Description	Actionee	Date Required	Status and Notes
							4/17/18: Drilling contractor is scheduled to mobilize on 4/30/18. It is expected that results will be available by 5/15/18. 5/1/18: The borehole work is now scheduled for 5/14/18 and it is expected that draft results will be available 5/31/18. 5/22/18: CHPRC noted drilling is set to start 5/22/18. 6/13/18: All drilling has been completed. Date for final report TBD. 7/24/18: Report is still draft, but S&W sent a formal letter documenting all Geotech information that ARES will use as a reference/basis for civil design.
3	6/5/18	CSA and Truck Port Entrance Ramp	Radiological Contamination	Provide ARES with design inputs regarding the presence (or not) of radiological contamination within the footprint of CSA and SLF and, if contamination is present, also provide an assessment of how that contamination should be accounted for during detailed design. For example, if soil remediation is required, would that work form part of the CSA construction contract for which ARES will develop bid documents?	CHPRC	Prior to start of final design.	**Status: Closed.** **Final Design Input:** CHPRC instructed ARES to proceed based on following: - ARES to base design on assumption that the CSA site is free of contamination. - ARES to ensure that CSA construction footprint does not encroach on adjacent WIDS sites. - ARES to ensure that CSA works do not encroach on existing groundwater wells. A surface radiological survey of the CSA construction was performed on March 16, 2018; no contamination was identified. The W-135 Project consulted with CHPRC Environmental on January 31, 2018, and were informed that there is no known reason to anticipate contamination at depth. The CSA site is sufficiently distant from 200-IS-1 OU pipelines & pipeline components (e.g., diversion boxes) that is very unlikely for there to have been lateral subsurface migration of contamination from these sources into CSA construction footprint
4	6/5/18	CSA, Transfer Roadway	Utility Interferences	Identify known & suspected existing underground and overhead utilities that need protection and/or to be moved [temporary or permanent].	ARES and CHPRC	Prior to start of final design.	**Status: Closed.** **Design Input:** To date, CHPRC has provided ARES with: - Report for recent surface geophysics survey. - Subsurface utility drawings for the areas immediately adjacent to WESF.

Project W-135 CSA
Design Basis Input Matrix
8/8/2018

Item	Last Update	System/Area	Title	Detailed Description	Actionee	Date Required	Status and Notes
5	6/27/18	CSA	Utilities Availability	Identify availability of current electrical and water utilities near CSA site for MSCS Project needs	ARES and CHPRC	Prior to start of final design.	**Status: Closed.** **Final Design Input:** (i) Power – ARES has identified preferred tie-in location and anticipates adequate supply. KSR 368756 submitted to MSA EU 3/14/18. (For the CSA, permanent power needs are for site lighting, cask temperature monitoring system, motorized sliding gates (potentially) and convenience receptacles through the CSA.) (ii) FP Water – TBD. (CHPRC FP Engineer has still to meet with MSA FP to confirm exact requirement - # of hydrants & locations. Current *assumption* is tie in at CSB with 12-inch looped line running down 7th Street on CSA side with 2 hydrants.) 3/14/18: Riley Sutton met with Hanford Fire Marshall (ref.: e-mail, Dinse to DeVine, 3/14/18). The following was ascertained: **1. What does the size of the line need to be?** • "Distribution mains, either sanitary or raw water, that are being used to supply water for domestic and/or process water and will provide water for fire suppression systems (sprinklers and/or hydrants), shall be at least **12 inches in diameter**." **2. How many hydrants do we need for the CSA** • "A minimum of **two operational fire hydrants** shall be provided such that parts of the exterior of the building or buildings can be reached by **hose lays of not over 300 feet** for all Category 2 or 3 nuclear facilities, or where the MPFL exceeds $15 million." • The Fire Marshal concurred that we do not need more than two fire hydrants for the CSA. **3. Where do we tie in with the existing 200E raw water system?** • "Underground distribution systems for fire protection water supplies shall be of the **looped type arranged with two-way flow and sectional valving** to provide alternate flow paths from the source to any point in the distribution system for Category 1, 3, and 3 nuclear facilities and buildings or groups of buildings with Maximum Possible Fire Losses (MPFL) totaling over $15 million." • The position of the Fire Marshal, the RL AHJ, and CHPRC Fire Protection Engineering is that a **crosstie should be installed to connect the CSB raw water loop and the WESF raw water loop.** The two CSA fire hydrants would come off of this line. The crosstie also solves problems for CSB and WESF. WESF does not have a fire loop and is deficient, the crosstie would alleviate this. The Fire Marshal has no problem running the line on the **south side of 7th Street**, since you indicated this was preferable. 3/20/18: Provide tie-in location near WESF.

Project W-135 CSA
Design Basis Input Matrix
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Item	Last Update	System/Area	Title	Detailed Description	Actionee	Date Required	Status and Notes
							4/17/18: The tie-in location at CSB is acceptable as designed. The tie-in location at WESF (at the abandoned line south of WESF) is also acceptable as designed. The location of the fire hydrant near WESF still has to be worked out between MSA and ARES. 5/1/18: Need confirmation from MSA that the third hydrant near WESF is okay as designed. J. Martin to contact R. Sutton. 5/22/18: The design is still being worked on and will be issued to R. Sutton within 2 weeks. 6/13/18: Preliminary design drawing issued to Adam Moldovan 6/11/18. 6/20/18: Feedback has not been received yet from preliminary issue of FP design. 8/8/18: The final routing and tie-in locations of the fire line have been resolved and agreed to by MSA through the 90% design review process.
6	6/20/18	CSA	Temperature Monitoring System Requirements	Power requirements for the VCC Temperature Monitoring System, operating frequency and signal transmission requirements, including identification as to whether the system will be of wired or wireless design; any special housing requirements for the local and/or remote annunciation system 'TMS enclosure; Interface point for alarm and system monitoring at CSB and/or any other local or remote location.	CHPRC		**Status: Closed**. **Preliminary Design Input:** TBD. 3/13/18: NAC's draft TMS design provided to ARES 3/7/18; ARES provided comments on 3/9/18. Specific information ARES needs are: - Line of separation between GS and SS. - Is backup power required, and if so, for what amount of time? - Where should CSB annunciator be located? - What signals will be provided by TMS control panel? 4/10/18: CHPRC (D. Dinse) will provide direction. 4/17/18: CHPRC will meet with project personnel to provide ARES direction. 5/8/18: A meeting was held with VNSFS. The following items need to be answered in order for ARES to complete TMS design: 1. Manufacturer/model of TMS control panel enclosure. Approximate weight including internals for sizing SS anchors. (Hoffman enclosure A72H2518FS3PT and full panel A72P24F1. 325 lb per vendor data.) 2. Power requirements of TMS control panel. ARES has assumed one 120V 20A circuit is adequate. (1346VA @ 120V from Veolia.) 3. Communications output of TMS control panel for mimicking CSA ambient temp and TMS control panel alarm signals to CSB ops base. (Assumed two NO contacts for loss of power and high temp alarm.)

Project W-135 CSA
Design Basis Input Matrix
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Item	Last Update	System/Area	Title	Detailed Description	Actionee	Date Required	Status and Notes
							4. Connection of conduit/conductors from CSA pad to VCC RTDs. (Interface at VCC J-box connectors.) 5. Annunciator at CSB. (Loss of Power and High Temp Alarms per CHPRC.) 5/22/18: No response yet from NAC. 5/29/18: Items 1 thru 5 have been resolved. Need info on UPS and SEL. 6/5/18: All design inputs have been received (see inputs in parenthesis on items 1 through 5 above). There is no UPS. The final design direction regarding safety significant components is as follows: The following items tentatively are planned to be specified as SS: • VCC RTDs • RTD wiring • RTD connectors • RTD terminal blocks • Paperless chart recorder • TMS enclosure and subpanel Items that are GS include: • Electrical power • Local alarm beacon • Output alarm contact signal to CSB • Ambient temperature measuring RTDs 8/8/18: The classification of safety-significant components has been resolved with the issuance of CHPRC-03774, CSA Safety Equipment List.

Project W-135 CSA
Design Basis Input Matrix
8/8/2018

Item	Last Update	System/Area	Title	Detailed Description	Actionee	Date Required	Status and Notes
7	5/29/18	CSA	Radiological dose rates at CSA Outer Fence	ARES requires radiological dose rates at the outer CSA fence line from CHPRC to assess compliance with the 0.5 mrem/hr dose rate criterion and to assess related potential need for CSA design to include supplementary shielding at fence line.	CHPRC	Prior to start of final design.	**Status: Closed.** **Preliminary Design Input:** CHPRC instructed ARES to proceed with design based on assumption that outer fence line remains at 80m x 80m and that no supplemental shielding barrier will be required. **Note**: NAC's draft PD dose rate calculation anticipated by March 8th. CHPRC will evaluate and if results impact preliminary design input (below), ARES will be informed. 4/10/18: Need NAC dose rate. D. Dinse will write e-mail documenting dose rate. 4/17/18: D. Dinse provided ARES NAC Report No 30059-5004, Revision A, *MCSC CSS and Cask Array Shielding Evaluations*, which contains the preliminary dose rate calculation. This item will remain open until Revision 0 of that report is issued. 5/22/18: Need Rev 0 of this report to close item. 8/8/18: Calc 30059-5004 was completed (Rev 0) 7/3/18.
8	6/5/18	CSA	Fire Water Requirements	ARES requires CHPRC input on requirement for fire hydrants. Source: Statement of Work "Detailed Design for W-135 WESF Modifications and Capsule Storage Area", Rev. 2, Table A3.2, Item 6, and CHPRC-02623 "Capsule Storage Area (CSA) Functional Design Criteria (Project W-135)"	CHPRC	Prior to start of final design.	**Status: Closed.** **Design Input**: Fire hydrants need to be provided. There will most likely be three required alongside 7th Avenue. Relevant information associated with this item is contained in Item No. 5.
9	6/5/18	CSA and SLF	Crash Bar Requirements	Incorporate crash bars into the final design for the CSA. Source: Statement of Work "Detailed Design for W-135 WESF Modifications and Capsule Storage Area," Rev. 2, Table A3.2, Items 7 and 8.	ARES	Prior to start of final design.	**Status: Closed.** Crash bars are required on the main gates for the CSA perimeter fence and on the CSP fence.
10	1/23/18	CSA	Dangerous Waste Permitting	ARES requires design input from CHPRC regarding if Dangerous Waste Permit will require a building or other protective covering. Source: CHPRC-02623 "Capsule Storage Area (CSA) Functional Design Criteria (Project W-135)"	CHPRC	Prior to start of final design.	**Status: Closed.** Design Input: There is no Dangerous Waste Permit requirement.
11	6/5/18	CSA	Criteria for Size of CSP and Spacing of CSSs.	CHPRC to confirm the following <u>design input related to CSP sizing</u> cited in the CSS CDR: *In order to provide sufficient spacing between the CSSs for placement on the CSP using on-site transportation equipment, a minimum center-to-center distance of fifteen feet is required with an outside boundary of five feet on each side of the CSS. Based on these assumptions, the CSP shall be a square design with a minimum sixty-five feet on each side.* Source: CHPRC-03326, "Cask Storage System Conceptual Design Report (Project W-135)", Appendix C	CHPRC	Prior to start of final design.	**Status: Closed.** **Final Design Input:** The CSP shall be 95 ft. x 95 ft. which will allow sufficient spacing for 25 CSSs arranged in a 5 x 5 grid with 15 ft. center to center distance and outside clear perimeter of 10 ft.

Project W-135 CSA
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Item	Last Update	System/Area	Title	Detailed Description	Actionee	Date Required	Status and Notes
12	6/5/18	CSA	CSP Concrete Criteria.	CHPRC to confirm the following design inputs related to concrete cited in the CSS CDR: *A loaded VCC is shown in NAC drawing 30059-060 with an estimated loaded weight of 152,670 lbs. Previous CSP design criteria specified by NAC (based on a CSS that is much heavier) are suitable for this conceptual CSS CSP. These CSP criteria are:* • *Concrete pad compressive strength shall be less than or equal to 5,000 psi.* • *Concrete pad dry density shall be greater than or equal to 125 lb/ft³ and less than or equal to 160 lb/ft³.* • *The concrete pad shall have a thickness less than or equal to 36 inches.* Source: CHPRC-03326, "Cask Storage System Conceptual Design Report (Project W-135)", Appendix C	CHPRC ARES	Prior to start of final design.	**Status: Closed**. This item has been closed with the release of FDC Revision 2.
13	6/5/18	CSA	CSA Criteria.	CHPRC to confirm the following general CSA design inputs cited in the CSS CDR: *The CSA shall be designed with ample room for movement of on-site transportation equipment on or around the CSP and should be constructed in such manner that it is sloped away from the CSP so as to ensure proper drainage away from the CSP. Additionally, the CSA should be maintained clear of vegetation or other debris that could pose a risk to potentially blocking the CSS air vents or could provide for the accumulation of flammable material(s). Based on the spacing distances already discussed for the CSP and the current planned CSA dimension of 80 meters (262 feet) square, the available room for on-site transportation equipment accessibility on or around the CSP (90 feet) within the CSA is adequate (net free area = ~98 feet on all sides between the edge of the CSP and the CSA boundary).* Source: CHPRC-03326, "Cask Storage System Conceptual Design Report (Project W-135)", Appendix C	CHPRC ARES	Prior to start of final design.	**Status: Closed.** This item has been closed with the release of FDC Revision 2.
14	1/30/18	CSA	CSA Apron Criteria.	CHPRC to confirm the following design inputs related to CSA Apron cited in the CSS CDR: *Typically, a concrete apron is provided as a transition between the haul path and the edge of the CSP. If an apron feature is desired, it shall be sufficient in strength to accommodate the anticipated wheel loads of the on-site transportation equipment carrying a loaded system placed over subsoil with the same characteristics as the CSP. The apron should be constructed in such a manner as to ensure adequate drainage exists and does not present a condition that water flows onto the CSP from the apron. Concrete strength and density shall be the same as that used for the CSP with only the depth of the concrete placement being sized differently than the CSP. If the apron be required to additionally serve as potential extended waste storage area, it will need to be designed to the same requirements as the CSP.* Source: CHPRC-03326, "Cask Storage System Conceptual Design Report (Project W-135)", Appendix C	CHPRC	Prior to start of final design.	**Status: Closed** **Final Design Input:** Design input is confirmed by CHPRC with exception that all Pads within the CSA shall be the same thickness to allow for transfer, assembly, movement, and storage of any combination. The haul path ramp does not have to be 36" in depth, and can be either concrete or asphalt. **Note**: Input from CHPRC Engineering was to assume for CD that the operating apron could be utilized for future waste storage. Therefore, the CD specifies that the operating apron is constructed to the same 36" thickness, reinforcement and concrete specification as the CSP. If the CSP operating apron will not be used for future extended waste storage, its thickness could likely be reduced to 18", saving excavation and const. costs.

Project W-135 CSA
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Item	Last Update	System/Area	Title	Detailed Description	Actionee	Date Required	Status and Notes
15	6/5/18	Transfer Roadway	Transfer Roadway Criteria.	CHPRC to confirm the following design inputs related to transfer roadway cited in the CSS CDR: *The roadway (Haul Path) must be capable of sustaining the on-site transportation equipment during movement between the Truck Port and the CSP for placement (or staging) of CSSs on the CSP. The onsite transportation equipment proposed in the conceptual design is identified below:* • *TUG Industries Model #GT-50 Tow Tractor (Prime Mover)* • *Towed Wheeled Vertical Cask Transporter (VCT)* *Source: CHPRC-03326, "Cask Storage System Conceptual Design Report (Project W-135)", Appendix C* *The following requirements for the haul path are based on the performance and general characteristics of the Towed Wheeled VCT designed specifically to transport the CSS (VCC) between the WESF truck Port and the CSA. Meeting these requirements ensures that the VCT will be able to safely transport the CSS VCCs between the Truck Port and the CSA with minimal risk.* • *Grade along haul path must be less than or equal to 4%.* • *Side to side (traverse) slope of haul path must be less than or equal to 2%.* • *The haul path shall be capable of supporting a fully loaded VCT. Note that the VCT with a loaded CSS (VCC) weighs approximately 231,000 pounds. The load of the CSS and VCT is transmitted to the haul path through eight individual wheels with a maximum ground bearing pressure of 180 psi.* • *The front wheels of the VCT are steerable consisting of reinforced steel which are specially designed to resist flexing and are clad with Shore A Durometer 80 solid rubber. Due to the wheel rigidity and solid rubber durometer, a stable surface with a suitable subsurface to minimize cutting and rutting of the haul path is required.* • *While the GT-50 Tow Tractor is capable of generating approximately 35,000 - 48,000 pounds of tractive effort, tractive effort is limited by the tire friction of the haul path surface. The presence of loose surface materials/debris significantly reduces the tractive effort.* • *The haul path shall be sufficiently sized to allow free un-obstructed maneuvering of the Towed Wheeled VCT. Towed Wheeled VCT dimensions are as follows:* ✓ *VCT Track Width: 16' 7.5"* ✓ *VCT Track Length: 26' 8-5/16"* ✓ *VCT Overall Width: 17' 9"* ✓ *VCT Overall Height (maximum extension): 22' 7/8"* ✓ *VCT Length: 35' 7-5/8"* ✓ *VCT Turning Radius: 33' 5/8" (inside) 56' 4-3/8" (outside)* ✓ *Overall Length (includes length of GT-50): 54' 3-5/8"* CHPRC-03326, "Cask Storage System Conceptual Design Report (Project W-135)", Appendix C	CHPRC	Prior to start of final design.	**Status: Closed.** **Final Design Input:** CHPRC has confirmed the information cited in Detailed Description column. CHPRC Engineering will supply ARES with cut sheet information for the equipment as supplemental information. CHPRC provided wheel/axle load, 2/20/18 (email Dinse to DeVine).

Project W-135 CSA
Design Basis Input Matrix
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Item	Last Update	System/Area	Title	Detailed Description	Actionee	Date Required	Status and Notes
16	6/5/18	CSA, Transfer Roadway, and SLF	Construction Contractor Area	A laydown area needs to be defined for the construction contractor.	CHPRC	Prior to start of final design.	**Status: Closed.** The laydown area will be identified in CHPRC's Construction SOW/Division 1 Section.
17	1/23/18	CSA	CSA Seismic Design Criteria	Section 6.8.1 of CHPRC-02623, Draft Rev. 2, includes the following statement: "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 design basis for the 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 based on DOE-STD-1189-2008, Appendix A, specifically Table A-1, radiological criteria. The LS designations are derived using Section 5 and Appendix A of ANS 2.26." CHPRC should consider adding wording that states "Since the CSA has been classified as SDC-2, LS C, the structural design will be implemented using ASCE/SEI 7-2010 seismic design criteria as required in PRC-PRO-EN-097, Table 1." This will eliminate any confusion as to the use of ASCE/SEI 43-05.	CHPRC	Prior to start of final design.	**Status: Closed.** **Final Design Input:** CHPRC procedure PRC-PRO-EN-097 provides seismic design criteria base on SDC and LS designation. Since the CSA has been classified as SDC-2/LS C, the structural design will be implemented using ASCE/SEI 7-2010.
18	3/6/18	CSA	VCCs	What is the weight of an empty VCC?	CHPRC	1/23/18	**Status: Closed** **Final Design Input:** See NAC Document 30059-S-01 Rev. 1, Design Specification for the Cask Storage System, Table 4-1.
19	6/5/18	CSA	VCCs	What is the overall timeline for delivery of the VCCs, delivery of internals, placing of internals in VCCs, and filling the VCCs with capsules?	CHPRC	1/23/18	**Status: Closed** Design Input: Based off the current NAC schedule, the delivery of the VCCs is July of 2020, and the TSCs around the same time frame. Their preference is to store the TSCs out on site, rather than in Richland. Plan on assembly of the TSCs inserted into the VCCs on site, all parts would be on site around the July 2020 time frame and assembly time over the next 6 months after July, to fill with VCCs capsules one year later. This input is reflected in the Operation Analysis Report contained in Appendix F of the PDR. Reference FDC, Revision 3.

Project W-135 CSA
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Item	Last Update	System/Area	Title	Detailed Description	Actionee	Date Required	Status and Notes
20	6/5/18	CSA	VCCs	Will all 17 VCCs (empty) be delivered prior to start of placing internals in VCCs?	CHPRC	1/23/18	**Status: Closed.** Design Input: The current assumption is that the project will need to store and assemble up to 25 VCCs on site within the CSA. CHPRC noted that the final design will show a 5'x5' grid (room for 25 VCCs). The design will accommodate 25 VCCs. CHPRC (J. Pennock) provided a VCC orientation drawing to ARES on 5/1/18.
21	6/5/18	CSA	VCCs	How much space is required for storage of internals?	CHPRC	1/23/18	**Status: Closed.** Current preliminary design input: The TSC and internals all shipped together vertically on a standard size pallet weigh around 22,000 lbs., so there would be 25 TSC pallets. The lids would be shipped separately also on a standard size pallet weighing around 2,700 lbs. per lid. A pallet size of 8' x 8' is being used as a basis. This input is reflected in the Operation Analysis Report contained in Appendix F of the PDR.
22	6/5/18	CSA	VCCs	Can the VCC internals be stored on gravel?	CHPRC	1/23/18	**Status: Closed.** Yes, but they must be kept clean, and would require fencing with locked access. The best would be to store them at the CSA. There would be 25 that fit on the size of a standard pallet, weighing around 22,000 lbs, plus the pallet for the lids.
23	1/23/18	CSA	VCCs	Can ARES get a survey that includes the WIDS site located south-east of the proposed CSA?	CHPRC	1/23/18	**Status: Closed.** The information is located in the CDR (CHPRC-03328).
24	6/5/18	CSA	CSA Surface Water Management	Can CHPRC provide the current requirement for storm water deposit near the WIDS site?	CHPRC	1/23/18	**Status: Closed.** Design Input: CHPRC recommended to ARES to direct pad run-off to the west, towards CSB. ARES to assess suitability including proximity to WIDS sites in this area and also is recommended to research CSB surface water discharge points in this area (design interface). The runoff from the roadway (7th Avenue and the Haul Path road) is not subject to the 300' WIDS requirement.

Project W-135 CSA
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Item	Last Update	System/Area	Title	Detailed Description	Actionee	Date Required	Status and Notes
25	5/8/18	CSA	VCCs	The CSP design shall consider loading from the CSS drop and tip-over analysis. Need loading information from NAC so ARES can perform the required analysis. Reference CSA FDC Rev. 2, Section 4.1.2 (3rd paragraph).	CHPRC	2/8/18	**Status: Closed.** **Note**s: Request was made to NAC on January 25th. Final Design Input: The drop and tip-over analysis will be part of the slab sizing calculation. During preliminary design, ARES made a bounding assumption in order to move forward with this activity. 4/10/18: ARES will provide an email stating other design inputs needed from NAC. 4/17/18: ARES and Maurice Ades exchanged email information; this drop analysis calculation was further discussed in the 4/17/18 project meeting. ARES will provide further clarification on this issue for Maurice to forward on to NAC. 5/1/18: ARES still reviewing reference data with the goal not to do a FEA. 5/8/18: ARES has determined the calc can be done without performing a FEA. This is being worked. It is possible the pad could increase in thickness. 5/22/18: This calculation is being worked and will be submitted with the 90% design package on 6/20/18. 8/8/18: The issues associated with this item have been resolved via the 90% design review process.

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Design Basis Input Matrix
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Item	Last Update	System/Area	Title	Detailed Description	Actionee	Date Required	Status and Notes
26	5/8/18	CSA	VCCs	Need CSS temperature information from NAC so ARES can perform the required analysis per following excerpt from CSA FDC: "The heat transfer from CSS shall be totally passive, by natural convection, radiation and conduction, without any moving parts. The maximum temperature of adjacent concrete surfaces of the storage pad shall be in accordance with the guidelines and requirements of the ACI 318, B*uilding Code Requirements for Structural Concrete*, and ACI 349, *Code Requirements for Nuclear Safety-Related Concrete Structures*, as appropriate. The CSA contractor will be provided with thermal data for the CSS by the CSS contractor, and shall provide in the basis for the design of the CSA an analysis of maximum concrete temperatures and demonstrate how this complies with the system design life requirements."	CHPRC	2/8/18	**Status: Closed.** **Final Design Input:** See NAC Document 30059-S-01 Rev. 1, Design Specification for the Cask Storage, Section 4.2.2, VCC Concrete Temperature Limits. **Notes:** The thermal analysis will be part of the slab sizing calculation. It was discussed that ARES will make a bounding assumption (based on what the Code allows) in order to move forward with this activity. CHPRC noted that the calculation needs to take into consideration that the bottom of the cask will be 300°F. 4/10/18: CHPRC noted that ARES will need to look at this for 400°. 5/8/18: FDC, Revision 3, reflects 400°. This calculation is being worked. 5/22/18: Once FDC Rev 3 is approved, this item can be closed. 8/8/18: FDC Rev 3 was released July 2018.
27	3/6/18	CSA		Provide dimensions of "bounding size" delivery truck.	CHPRC	2/8/18	**Status: Closed.** Information provided by D. Dinse to ARES 3/2/18.

APPENDIX E

HUMAN FACTORS ENGINEERING REPORT

PROJECT W-135
CAPSULE STORAGE AREA
HUMAN FACTORS ENGINEERING REPORT

prepared for

CH2M HILL PLATEAU REMEDIATION COMPANY

Subcontract No. 64824
Report No. 046414.17.01-008
Revision 0

August 2018

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PROJECT W-135
CAPSULE STORAGE AREA
HUMAN FACTORS ENGINEERING REPORT

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August 2018

Prepared by: Bruce D. Groth — 8/10/2018
Bruce D. Groth — Date

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Denis P. DeVine — Date

REVISION DESCRIPTION

Rev.	Reason for Revision	Change Description	Affected Pages (Page/Sec./Para.)	Date
0	Initial Issue.	N/A	All pages.	08/10/2018

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Appendices

Appendix A
Detailed Design Considerations for Human Factors Engineering Checklist

Appendix B
NUREG-0700 Checklist, Rev. 2

Appendix C
TMS Coordination Meeting Draft Meeting Minutes

Acronyms

ALARA	As Low as Reasonably Achievable
CE&I	Control, Electrical, and Instrumentation
CSA	Capsule Storage Area
CSP	Capsule Storage Pad
CSS	Cask Storage System
DOE	U.S. Department of Energy
I&C	Instrumentation and Control
IEEE	Institute of Electrical and Electronics Engineers
IES	Illuminating Engineering Society
MCSC	Management of Cesium and Strontium Capsule
NAC	NAC International
NUREG	U.S. Nuclear Regulatory Commission Regulation
PPE	Personal Protective Equipment
TMS	Temperature Monitoring System
VCC	Vertical Concrete Cask
VCT	Vertical Cask Transporter
WESF	Waste Encapsulation Storage Facility

1.0 INTRODUCTION AND BACKGROUND

The Management of Cesium and Strontium Capsules (MCSC) Project (W-135) will fill the capability gap for interim storage of cesium and strontium capsules currently stored underwater at the Waste Encapsulation and Storage Facility (WESF). The scope of Project W-135 is consistent with DOE/RL-2012-47, *Mission Need Statement for the Management of the Cesium and Strontium Capsules*.

The project will provide the capabilities necessary to transfer the capsules from the WESF pool cell to a Cask Storage System (CSS) which will be located in a new Capsule Storage Area (CSA). The CSS will safely and compliantly store the 1,936 capsules until a capsule disposal option is available in the future.

This report addresses the CSA portion of Project W-135, which consists of the following key elements:

- Design and construction of the CSA, including the Capsule Storage Pad (CSP) and other sub-systems to support interim storage of the capsules; and
- Design and construction of transfer roadway and haul path facility access improvements from the WESF to the CSA, as necessary to support transfer of the capsules utilizing the CSS supplied Vertical Cask Transporter (VCT) and tug.

2.0 PURPOSE AND SCOPE

The purpose of this report is to document a human factors evaluation of the CSA portion of Project W-135 as required by CHPRC-02623, *Capsule Storage Area (CSA) Functional Design Criteria (Project W-135)*. Section 6.3 of CHPRC-02623 states that:

> "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 the human versus the machine shall be determined by analyses of system functions required, impact of error or no action on safety, and a comparison of human capabilities and equipment capabilities for the separate system functions.
>
> "Systems, subsystems, and equipment shall consider the human engineering guidelines of DOE-HDBK-1140, *Human Factors/Ergonomics Handbook for the Design for Ease of Maintenance*, U.S. Nuclear Regulatory Commission Regulation (NUREG)-0700, and Institute of Electrical and Electronics Engineers (IEEE) Standard 1023, *IEEE Recommended Practice for the Application of Human Factors Engineering to Systems, Equipment, and Facilities of Nuclear Power Generating Stations and Other Nuclear Facilities.*
>
> "A human factors evaluation shall be performed and documented on the completed design."

A checklist based on NUREG-0700 was used to review the design. This checklist is more comprehensive than IEEE-1023-2004 and covers similar material. DOE-HDBK-1140 was canceled by the U.S. Department of Energy in January of 2017, but aspects of it are considered in the design for maintainability. Another human factors checklist from the Hanford Tank Farms was utilized as well, but not required by CHPRC-02623. This checklist is from TFC-ENG-STD-01, *Human Factors*, and was utilized as most appropriate to the level of complexity in the design and operations of the CSA which is a passive storage area with only active monitoring systems and no planned cask movements following initial emplacement.

3.0 DESIGN DESCRIPTION

As stated previously, the CSA portion of Project W-135 consists of design and construction of the CSA and the transfer roadway and haul path facility access improvements from WESF to the CSA, as necessary to support transfer of the capsules utilizing the CSS supplied VCT and tug.

3.1 Capsule Storage Area

The designated CSA is the storage site location selected for interim storage of the capsules and consists of several structures, systems, and components (SSCs), including the CSP and other sub-systems to support interim storage of the capsules until a disposal pathway becomes available. The CSA consists of:

- The CSP – A concrete monolith designed and sized to support the fully loaded Vertical Concrete Casks (VCCs) for the duration of interim storage.
- The Operating Pad and CSA Yard – The Operating Pad is a concrete monolith adjacent to the CSP. The Operating Pad provides a stable operating area for the maneuvering of the VCCs into designated positions utilizing a combination of a crane and the VCT and tug system previously utilized at the West Valley Demonstration Project's High-Level Waste Canister Relocation Project for similar purpose. The CSA Yard is the balance of the designated CSA open space that will be cleared, grubbed, and graveled with the gravel being compacted and leveled grade to match with the CSP and Operating Pad.
- The Security/Property Protection Sub-systems – These CSA sub-systems consist of fencing, vehicular and personnel access gates, pole-mounted flood lighting, and any other associated equipment as may be required and necessary based upon security assessment, hazard analysis, safety analysis, and housed SSCs' quality level designations.
- The Temperature Monitoring System (TMS) and Control, Electrical, and Instrumentation (CE&I) interfaces and support equipment – These CSA sub-systems consist of the CE&I interface to the TMS and the TMS protective structure.

3.2 Transfer Roadway and Facility Access Haul Path Improvements

Transfer roadway and facility access haul path improvements consist of improvements and modifications to Atlanta Avenue and 7th Street from WESF to the CSA, as well as roadway

improvements from the truck loading area at WESF to Atlanta Avenue, necessary to support transfer of the capsules in the loaded VCCs utilizing the VCT and tug. This scope also includes extending site fire water lines to provide fire protection to the CSA.

3.3 Applicable Drawings Reviewed

The drawings listed in Table 3-1 were reviewed as part of this human factors evaluation.

Table 3-1. Reference Drawing List.

Drawing	Title
Drawing List	
H-2-837589-1	*Capsule Storage Area Drawing List/Title Sheet*
Civil/Structural	
H-2-837590-1	*Capsule Storage Area Abbreviations, Legend, & General Notes*
H-2-837591-1	*Capsule Storage Area Civil Overall Site Plan*
H-2-837592-1	*Capsule Storage Area Civil Grading Plan*
H-2-837593-1	*Capsule Storage Area Civil Enlarged Plan*
H-2-837594-1-2	*Capsule Storage Area Civil Fire Water Plan & Profile*
H-2-837596-1	*Capsule Storage Area Civil Truck Port Enlarged Plan Street Enlarged Plan*
H-2-837597-1	*Capsule Storage Area Civil 7th Street Enlarged Plan*
H-2-837598-1-3	*Capsule Storage Area Civil Fire Water Details*
H-2-837598-4	*Capsule Storage Area Civil Sections & Details*
H-2-837598-5	*Capsule Storage Area Civil Pad Marking Details*
H-2-837598-6	*Capsule Storage Area Civil Security Fence Details*
H-2-837599-1	*Capsule Storage Area Civil Electrical Enclosure Pad*
Electrical	
H-2-837600-1	*Capsule Storage Area Electrical One-Line Diag and Panel Schedule*
H-2-837601-1	*Capsule Storage Area Electrical CSA Enlarged Plan*
H-2-837602-1	*Capsule Storage Area Instrumentation CSP Enlarged Plan*
H-2-837603-1	*Capsule Storage Area Electrical CSB Enlarged Plan*
H-2-837604-1	*Capsule Storage Area Electrical Truck Port Enlarged Plan*
H-2-837605-1	*Capsule Storage Area Electrical Power & TMS Assembly*
H-2-837606-1	*Capsule Storage Area Electrical Details*
H-2-837607-1-2	*Capsule Storage Area Instrumentation TMS TBX Rack Assembly*
H-2-837608-1-3	*Capsule Storage Area Electrical Wire Run & CND Sched*
H-2-837609-1-2	*Capsule Storage Area Instrumentation TMS annunciator Assembly*
H-2-837609-3	*Capsule Storage Area Instrumentation TMS Annunciator Diagrams*
H-2-837610-1	*Capsule Storage Area Electrical 1PH XFMR Pole Assembly*
H-2-837610-2	*Capsule Storage Area Electrical Lighting Pole Assembly*
H-2-837610-3	*Capsule Storage Area Electrical Pole Elevations*
H-2-837610-4	*Capsule Storage Area Electrical Downguy/Anchor Assembly*

4.0 GENERAL HUMAN FACTORS CRITERIA AND CONSIDERATIONS

The first and more general human factors checklist used is contained in Appendix A. Human factors aspects of the CSA that it addresses primarily includes minimizing exposure to radiation and chemicals, and general criteria associated with instrumentation and accessibility to this equipment. Tripping, sharp edges, and other potential hazards are also addressed. Details on these human factor considerations in the CSA design are described in more detail in the subsections that follow.

4.1 Radiation Exposure

Dose rates on the CSA CSP and at 40m from the CSP center have been analyzed in NAC Calculation No. 30059-5004, *MCSC CSS and Cask Array Shielding Calculations*. Dose rates on the CSP are less than 3.6 mrem/hr and less than 0.5 mrem/hr 40m from the center of the CSP. The fence line at the CSA boundary is a minimum of 40m (130 ft) from the center of the CSP. All shielding is provided by the VCC which is outside the scope of the CSA project. All lighting and TMS equipment that is permanent is located outside of this fence line. For emplacement of a VCC, TMS wiring is pulled from the hand hold off the pad to the existing conduit where the VCC will be located. A small piece of rigid conduit is added, along with a piece of flexible conduit, to the junction box located on the VCC.

4.2 Lighting

The following design criteria are applicable to the design of the CSA.

1. CHPRC-02623, Section 4.1.4 states that lighting around the perimeter of the storage location shall be provided with an illumination level of not less than that recommended by Illuminating Engineering Society (IES) 2013 (sic), *The Lighting Handbook*. Lighting shall be replaceable without the need to enter the inner fenced area.

2. The IES 2013 (sic), *The Lighting Handbook* recommends per section 30.2.3, *Lighting for Manufacturing*, page 30.61, under Storage Yards, that the average maintained illuminance target shall be 1.0 foot-candles.

3. CHPRC-02623, Section 6.7 states that sufficient lighting and accessibility shall be provided for the CSSs on the CSP to enable their visual inspection on all sides for security purposes from a distance of 250 ft, and no less than 0.2 foot-candles.

The lighting was designed to meet these criteria. The final lighting design is shown on drawings H-2-837604, Sheet 1, *Capsule Storage Area Electrical Enlarged Plan*, and H-2-837610, Sheet 2, *Capsule Storage Area Electrical Lighting Pole Assembly*. Calculation CHPRC-02535, *W-135 Capsule Storage Area Lighting Calculation*, demonstrates that the illumination criteria are met and that the minimum illumination from the VCCs to the outside edge of the CSP is 1.2 foot-candles.

There are additional criteria for lighting of operating and control spaces in NUREG-0700, but these criteria are not applicable to the design of a normally unoccupied storage area.

4.3 Instrumentation and Control

In addition to the Appendix A checklist, a checklist for the guidance contained in NUREG-0700 was developed and is contained in Appendix B for the assessment of the Instrumentation and Control (I&C) system. The vast majority of NUREG-0700 is not applicable to the design of the CSA as it was primarily meant for application to the complex controls and heightened operational awareness required for the control of nuclear power plants. Thus, most the criteria are related to visual display of operating information on display panels. However, there were some pertinent areas that were addressed by the design of the CSA TMS.

- The TMS alarm annunciator panel has a visual and audio alert that are both active if alarmed until acknowledged. When acknowledged the audio alert is silenced and the light stays on until cleared. The annunciator is located in the Shift Office at the nearby Canister Storage Building which is manned Monday to Friday, 6:00 a.m. to 4:30 p.m. It is a dual red-light indicator panel for any temperature alarm and loss of power at the CSA. The indicator panel has redundant LED lights that are designed to last the life of the annunciator.

- The TMS alarm annunciator is not a single-failure proof design in that alarm indication could be lost if the annunciator lost all power. However, this is not a project requirement and temperatures could be monitored locally if necessary until the failure could be corrected. This did result in the NUREG-0700 checklist item 4.4.1-1 being checked as "No."

- Because the annunciator must be tested using a manually initiated test to identify alarm failures NUREG-0700 checklist item 4.4.3-3 was checked as "No."

- Because the annunciator provides no indication of a fuse or circuit breaker opening NUREG-0700 checklist item 13.4-2 was checked as "No."

4.4 Other Hazards to Personnel

One potential tripping hazard has been identified and mitigated. Conduit at each VCC storage location must be installed to connect the TMS to each VCC. This requires that the conduit be stubbed up from the concrete pad prior to VCC emplacement. This was mitigated by installed a flexible Stub-EASE®[1] at each location with the conduit terminated below grade. When ready to install a VCC at that location, the Stub-EASE is then removed and short piece of conduit installed to bring in above grade. The remaining concrete opening is filled with grout and troweled to slope away from the conduit (reference drawing H-2-837606, Detail 1).

4.5 Heat Stress

Preliminary thermal analyses of the VCCs have indicated a maximum external temperature of 170°F at a height of 7 ft., with temperatures decreasing below this height (per the draft TMS Coordination Meeting Minutes provided in Appendix C). This temperature could be a concern on warm days when trying to connect the RTDs for the VCCs to the TMS. If necessary, the actions of PRC-PRO-SH-121, *Heat Stress*

[1] Stub-EASE is a registered trademark of CSUE Technologies, Chicago, Illinois.

Control, shall be implemented to monitor worker heat stress. Other actions that can be taken to reduce worker heat exposure include:

- Performing this activity at night;
- Erecting temporary heat shields between the VCCs and workers; and
- Erecting temporary shade if the activity must be performed in daylight.

5.0 REFERENCES

Refer to Table 3-1 for a list of drawings utilized in the development of this report.

CHPRC-02535, 2018, *W-135 Capsule Storage Area Lighting Calculation*, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington.

CHPRC-02623, 2018, *Capsule Storage Area (CSA) Functional Design Criteria (Project W-135)*, Rev. 2, CH2M HILL Plateau Remediation Company, Richland, Washington.

DOE-HDBK-1140-2001, 2001, *Human Factors/Ergonomics Handbook for the Design for Ease of Maintenance*, canceled January 13, 2017, U.S. Department of Energy, Washington, D.C.

DOE/RL-2012-47, *Mission Need Statement for the Management of the Cesium and Strontium Capsules*, Rev. 3, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

IEEE-1023-2004, 2004, *IEEE Recommended Practice for the Application of Human Factors Engineering to Systems, Equipment, and Facilities of Nuclear Power Generating Stations and Other Nuclear Facilities*, Institute of Electrical and Electronics Engineers, New York, New York.

IES, 2011, *The Lighting Handbook, Tenth Edition: Reference and Application*, Illuminating Engineering Society, New York, New York.

NAC Calculation No. 30059-5004, *MCSC CSS and Cask Array Shielding Calculations*, Rev. A, NAC International, Norcross, Georgia.

NUREG-0700, 2002, *Human-System Interface Design Review Guidelines*, Rev. 2, Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission, Washington, D.C.

PRC-PRO-SH-121, *Heat Stress Control*, Revision 2, Change 1, CH2M HILL Plateau Remediation Company, Richland, Washington.

TFC-ENG-STD-01, 2016, *Human Factors in Design*, Rev. A-7, Washington River Protection Solutions, LLC, Richland, Washington.

APPENDIX A

DETAILED DESIGN CONSIDERATIONS FOR HUMAN FACTORS ENGINEERING CHECKLIST

Detailed Design Considerations for Human Factors Engineering Checklist

Item No.	Issues	Were these requirements met?			Remarks
		Yes	No	N/A	
1	Can the equipment be readily assembled and disassembled as designed?	☒	☐	☐	The systems, structures, and components of the CSA can be readily constructed or assembled as designed. Heat stress is addressed in Section 4.5 of this report.
2	Are assembly clearances adequate?	☒	☐	☐	Clearance around the temperature monitoring system (TMS) and associated cabinets are adequate. All fence clearances and clearances around each Vertical Concrete Cask (VCC) are also adequate.
3	Has the design appropriately considered maintenance, operations, and reliability, including maintenance procedures and techniques, unique maintenance requirements, and frequencies?	☒	☐	☐	There is little maintenance associated with the CSA. The TMS will require routine calibration checks, light replacement, and checks around each VCC on a routine basis.
4	Can the design and its parts be easily inspected for conformance to engineering specifications and to support in-service inspection?	☒	☐	☐	The design of the CSA allows for easy access and inspection. Where possible, equipment has been located outside the fence line where radiation dose rates are less than 0.5 mrem/hr.
5	Have personnel radiation protection requirements/As Low as Reasonably Achievable (ALARA) been considered and properly addressed?	☒	☐	☐	Dose rates on the CSA CSP and at 40m from the CSP center have been analyzed in NAC Calculation No. 30059-5004, *MCSC CSS and Cask Array Shielding Calculations*. Dose rates on the CSP are <3.6 mrem/hr and <0.5 mrem/hr 40m from the CSP. The fence line at the CSA boundary is a minimum of 40m (130 ft) from the center of the CSP.
6	Are physical design features the primary methods used to maintain exposures ALARA (e.g. confinements, ventilation, remote handling, and shielding)?	☒	☐	☐	Yes. The main feature of the CSA itself is the distance from the CSP to the CSA boundary. The flood lights and electrical equipment are located outside the CSA boundary to reduce exposure from maintenance. The Cs/Sr capsules are in a shielded cask, but that is outside the scope of this analysis.

Detailed Design Considerations for Human Factors Engineering Checklist

Item No.	Issues	Were these requirements met?			Remarks
		Yes	No	N/A	
7	Are optimization methods used (ALARA decision-making methods) to assure that occupational exposure is maintained ALARA?	☒	☐	☐	Design/method of connecting the TMS wiring to the VCC was selected to minimize worker time near the VCC in performing this operation. The design is such that wire is pulled from the last hand hole out to the VCC location prior to emplacing the cask. There is an existing junction box on the VCC and this is where final wire ties are made through a short piece of flex conduit.
8	Does the design avoid, under normal conditions, releases of airborne radioactive material to the workplace atmosphere?	☐	☐	☒	Consideration for cask, not for CSA.
9	Does the design control, in any situation, the inhalation of radioactive material by workers to levels that are ALARA?	☐	☐	☒	Consideration for cask, not for CSA.
10	Does the design avoid, under normal conditions, releases of chemical vapors, aerosols, or solids to the workplace atmosphere?	☒	☐	☐	No chemicals used in CSA design. No chemicals loaded in cask.
11	Does the design control, in any situation, the inhalation of chemical vapors, aerosols, or solids by workers to levels that are ALARA?	☒	☐	☐	No chemicals used in CSA design. No chemicals loaded in cask.
12	Are equipment, controls, and traffic patterns located for accessibility and to minimize chemical and radiological exposure to personnel during all situations, including operations and maintenance?	☒	☐	☐	Lights, electrical supply, and temperature monitoring are all located outside the CSA boundary.
13	Are doorways and labyrinths wide enough to permit personnel, component, and equipment passage?	☒	☐	☐	Personnel gates are adequate for routine entries into the CSA. Main gates are very large to accommodate cask transporter and could be used for large equipment if ever needed.

Detailed Design Considerations for Human Factors Engineering Checklist

Item No.	Issues	Were these requirements met?			Remarks
		Yes	No	N/A	
14	Are adequate control devices used to reduce occupational exposures, including shielding, hoods, glove boxes, containments, interlocks, barricades, shielded cells, decontamination features, and remote operations	☒	☐	☐	Dose at the CSA is primarily limited by minimizing time inside the fence for any activities and limiting the dose rate at the fence to less than 0.5 mrem/hr.
15	Are areas of the facility that exhibit high occupancy, or are presently uncontrolled, adequately protected from new or increased radiation sources?	☐	☐	☒	There are no high occupancy areas associated with the CSA. There are no uncontrolled areas where dose rates exceed 0.5 mrem/hr.
16	Is maximum distance provided between serviceable components and any substantial radiation sources in the area?	☒	☐	☐	Most serviceable components are outside the CSA fence in an area where dose rates are <0.5 mrem/hr. In the unlikely event that items need to be serviced on the VCC (such as the TMS), the dose rates are manageable at less than 3.6 mrem/hr.
17	Are permanent platforms, walkways, stairs, or ladders provided to improve accessibility?	☐	☐	☒	No permanent platforms or stairs are required. The VCCs are located on a grade level concrete pad.
18	Are serviceable components capable of being isolated and drained?	☐	☐	☒	There is no need to isolate and drain any equipment.
19	Is there adequate provision for rapid removal of equipment?	☐	☐	☒	There is no need for rapid removal of any equipment.
20	Can surveillance be performed from outside a high radiation area through the use of TV camera, viewing port, or remote read-out?	☐	☐	☒	There are no high radiation areas within the CSA.
21	Does the design consider the use of built-in rigging to facilitate component handling?	☐	☐	☒	No built-in rigging required.
22	Does the design facilitate flushing and decontamination of components?	☐	☐	☒	All external decontamination of the VCC is done before it is sent to the CSA.
23	Are components selected with consideration for long service life, ease of removal, and frequency of maintenance?	☒	☐	☐	CSA has a design life of 100 years. Minor maintenance will be required on lights, electrical, and temperature monitoring system.

Detailed Design Considerations for Human Factors Engineering Checklist

Item No.	Issues	Were these requirements met?			Remarks
		Yes	No	N/A	
24	Are serviceable components easily accessible with adequate workspace, lay-down areas, and lighting?	☒	☐	☐	The location of the TMS cabinet is the only location where routine maintenance is performed and has adequate lighting. The entire area within the fence has security lighting that meets the requirements of IES 2013, *The Lighting Handbook*. Reference calculation CHPRC-02535, *W-135 Capsule Storage Area Lighting Calculation.*
25	Are equipment cover plates hinged or closed with captive quick-opening fasteners to facilitate routine personnel access or maintenance access?	☒	☐	☐	Cabinet covers are hinged. Routine maintenance will only be annual once all VCCs are emplaced.
26	Does the design adequately consider life expectancy and reliability in selecting and locating equipment, to minimize the need for personnel access in the area.	☒	☐	☐	The design life of 100 years is adequately addressed. If instrumentation must be replaced, it can be done so in a reasonably straight-forward replacement with minimal exposure of personnel.
27	Are electrical, mechanical, or hydraulic quick release mechanisms used, where possible?	☐	☐	☒	No quick release mechanisms are required for the CSA.
28	Does the design adequately consider remote operators or robotics for use in high radiation areas?	☐	☐	☒	There are no high radiation areas within the CSA.
29	Are entrances and penetrations adequately shielded (e.g., labyrinths or shadow shields).	☐	☐	☒	No labyrinth shielding required for the CSA. Distance is used to limit dose rate to less than 0.5 mrem/hr outside the fence.
30	Is permanent shielding employed, to the degree feasible, to avoid the need for temporary shielding or that provisions are made to allow temporary shielding during maintenance activities?	☐	☐	☒	No permanent shielding other than the VCC itself is necessary. If needed, temporary shielding could be used around a VCC.
31	Is shielding placed between serviceable components and any substantial radiation source in the area?	☐	☐	☒	No permanent shielding other than the VCC itself is necessary. If needed, temporary shielding could be used around a VCC.
32	Is ventilation designed to control airborne radioactivity and chemical vapors?	☐	☐	☒	No ventilation associated with the CSA.

Detailed Design Considerations for Human Factors Engineering Checklist

Item No.	Issues	Were these requirements met?			Remarks
		Yes	No	N/A	
33	Are pointed or other sharp projections avoided?	☒	☐	☐	All bollards, fire hydrants, and light poles are outside the CSA. Within the CSA, for unused TMS conduit, a StubEase is used to mark the location and keep debris out until final installation of the VCC. The StubEase can be run over by vehicles and is soft and flexible so as not to present a puncture hazard.
34	Are covered pump seals used to contain contaminated liquids?	☐	☐	☒	No pumps associated with the CSA.
35	Are canned pumps or pumps with mechanical seals instead of standard packing glands used?	☐	☐	☒	No pumps associated with the CSA.
36	Does the design of piping, tanks, and pumps facilitate draining, cleaning, flushing and decontamination?	☐	☐	☒	No piping, tanks, or pumps associated with the CSA.
37	Are vents and relief tail pipes routed away from manned work locations to drains?	☐	☐	☒	No vents or reliefs associated with the CSA.
38	Are remotely operated valves used, where needed?	☐	☐	☒	No valves associated with the CSA.
39	Are manual valve operators used only for infrequently operated valves?	☐	☐	☒	No valves associated with the CSA.
40	Are instrument read-outs and control points located in the lowest radiation area feasible?	☒	☐	☐	Electrical equipment and TMS readout is located outside the CSA.
41	Are instruments and controls grouped functionally to minimize time spent in the area?	☒	☐	☐	There is no other I&C than the TMS.
42	Are instruments selected for long service life and low maintenance requirements? Is remote calibration provided for?	☒	☐	☐	Calibration can be performed from the TMS panel which is located in an area where the dose rate is less than 0.5 mrem/hr.
43	Do instruments that use radioactive or contaminated working fluid contain a minimum quantity of working fluid?	☐	☐	☒	There are no instruments that use radioactive or contaminated working fluid.
44	Is the flow of air from areas of lesser contamination to areas of greater contamination?	☐	☐	☒	The CSA is an outdoor storage pad.

Detailed Design Considerations for Human Factors Engineering Checklist

Item No.	Issues	Were these requirements met?			Remarks
		Yes	No	N/A	
45	Are filter banks readily accessible for maintenance?	☐	☐	☒	There are no filter banks associated with the CSA.
46	Are filter banks separated or shielded from each other to permit working on one with the other operating?	☐	☐	☒	There are no filter banks associated with the CSA.
47	Does the ventilation system (exclusive of filters) minimize potential radioactivity build-up and accumulation of chemical vapors?	☐	☐	☒	There is no ventilation system associated with the CSA.
48	Will the system provide the required level of protection from airborne contamination, giving particular attention to patterns of air flow and to the locations of air inlets, penetrations, and exhausts, to ensure releases of radioactive or hazardous chemical material to the workplace atmosphere are avoided under normal operating conditions and that inhalation of such materials by workers are controlled to the extent reasonably achievable?	☒	☐	☐	The VCC (outside the scope of the CSA) provided the primary confinement of hazardous materials. However, the CSA fence line is used to limit radiation exposure to personnel.
49	Are multiple filters or demineralizers housed in separate cubicles to permit maintenance with the system operating?	☐	☐	☒	There are no filters or demineralizers associated with the CSA.
50	Are filters provided with remote or shielded methods of filter removal?	☐	☐	☒	There are no filters associated with the CSA.
51	Are lifting lugs provided on equipment?	☐	☐	☒	No equipment associated with the CSA is large enough to require lifting lugs. The TMS cabinet is being provided by the VCC contractor.

Detailed Design Considerations for Human Factors Engineering Checklist

Item No.	Issues	Were these requirements met?			Remarks
		Yes	No	N/A	
52	Are displays, indicators, switches and actuators: • Arranged and grouped to ensure status and conditions are easily discernible? • Arranged to ensure standard conventions of order (e.g., "A" before or above "B"), direction and rotation (e. g. clockwise or counterclockwise)? • Placed at angles and heights that permit comfortable viewing? • Properly illuminated and easily visible in all expected conditions? • Clearly and unambiguously labeled as to function? • Easily operated when wearing required PPE?	☒	☐	☐	The TMS alarm annunciator is a very simple design with only a single high temperature alarm.
53	Are lamp test switches/pushbuttons employed, when appropriate?	☒	☐	☐	On the alarm annunciator.
54	Is color-coding of alarm and status indicators consistent with existing operational practices?	☒	☐	☐	The high temperature alarm is coded red.
55	Has the design appropriately considered the use of "latching" of status and alarm conditions to allow post event analysis?	☒	☐	☐	The visual and audio alert on the annunciator is active if alarmed until acknowledged. When acknowledged, the audio alert is silenced and the light stays on until cleared.
56	Have key-locked or protected switches been employed where actuation could result in undesirable or unsafe conditions?	☐	☐	☒	No key-locked or protected switches are required. TMS is for monitoring only.
57	Are labels and markings: • Provided for all items that must be viewed read or operated? • Clearly viewable and permanently marked? • Located so that they are correctly associated with the apparatus?	☒	☐	☐	TMS alarms and wiring/terminations are labeled appropriately.
58	Are similar names for different controls avoided?	☐	☐	☒	There is only the TMS.
59	Are process parameters displayed in commonly used engineering units?	☒	☐	☐	Only process parameters are the TMS.

Detailed Design Considerations for Human Factors Engineering Checklist

Item No.	Issues	Were these requirements met?			Remarks
		Yes	No	N/A	
60	Are audible warning signals of such intensity as to not cause discomfort? (Less than 115 db at the ear of the listener.)	☒	☐	☐	Audible alarm is limited to 80 db.
61	Have communication requirements for operating and maintenance personnel been considered?	☐	☐	☒	Existing operator radios to be used if needed. Outside the scope of this project.
62	Are valve positions clearly and unambiguously indicated?	☐	☐	☒	No valves associated with the CSA.
63	Are items requiring periodic inspection or replacement viewable and accessible?	☒	☐	☐	TMS panel is readily accessible.
64	Is adequate space provided for personnel to perform normal operations and maintenance activities?	☒	☐	☐	TMS panel is readily accessible.
65	Have adequate clearances been provided to open all doors including equipment cabinets and enclosures?	☒	☐	☐	There is over 3 feet of clearance in front of the TMS panel
66	Have captive fasteners been used where dropping or losing such items could cause damage to equipment or create difficult or hazardous removal and where frequent removal is required?	☐	☐	☒	No locations where dropping is a concern.
67	Are the shelves and cabinets on the floor properly secured?	☒	☐	☐	All electrical and instrument cabinets are mounted on anchored struts.

APPENDIX B

NUREG-0700 CHECKLIST, REV. 2

Rev. A **Date:** 6/11/18

ARES Project No. 046414.17.01 **Project Title:** Detailed Design for W-135 Capsule Storage Area

Completed By: Bruce Groth (Print Name) **Dated:** 6/11/18 **Company:** ARES

Guideline #	Review Criteria	Yes	No	N/A
1	**INFORMATION DISPLAY**			
1.1	**General Display Guidelines**			
1.1-1	**Appropriate Display Format**			
	The display presentation format, e.g., table, graph, or flowchart, should be consistent with tasks that the user will be performing with the displayed information (see Table 1.1).			X
1.1-2	**Display Conventions**			
	Consistent interface design conventions should be evident for all display features (such as labels).	X		
1.1-3	**Display Information Consistent with User Conventions**			
	Information should be displayed consistently according to standards and conventions familiar to users.	X		
1.1-4	**Display Information Consistent with Control Requirements**			
	Displays should be consistent in word choice, format, and basic style with requirements for data and control entry.			X
1.1-5	**Correspondence Mapping**			
	There should be an explicit mapping between the characteristics and functions of the system to be represented and the features of the display representation, i.e., changes in the appearance of the display form should have a one-to-one relation with the plant states it represents. These changes should result from explicit rules relating the physical form of the display and its meaning to the plant state represented.			X
1.1-6	**Levels of Abstraction**			
	Displays should provide information at the levels of abstraction necessary to meet the operators' requirements relative to their task goals.			X
1.1-7	**Coherence Mapping**			
	The characteristics and features of the display used to represent the process should be readily perceived and interpreted by the operator.			X
1.1-8	**Understandability of Higher-Level Information**			
	The methods by which lower-level data are analyzed to produce higher-level information and graphical elements should be understandable to users.			X
1.1-9	**User Verification of Higher-Level Information**			
	Operators should have access to the rules or computations that link process parameters and graphical features, and to an explanation of how the information system produces higher-level information.			X

Guideline #	Review Criteria	Yes	No	N/A
1.1-10	**Alert to Higher Level Displays**			
	While viewing secondary (lower-level) displays, a perceptual (audible or visual) cue should be provided by the system to alert the user to return to the primary (higher-level) display if significant information in that display requires user attention.			X
1.1-11	**Display of Goal Status**			
	The information system should provide for global situation awareness (i.e., an overview of the status of all the operator's goals at all times) as well as supplying details about the current specific goal.			X
1.1-12	**Display of Information to Support Planning**			
	The human-system interface (HSI) should present information to support users in planning for and coordinating concurrent tasks.			X
1.1-13	**Display of Future Status**			
	The information system should support the user's ability to project future states of the system when this is required to safely operate the plant.			X
1.1-14	**Status at a Glance**			
	Information display systems should allow users to immediately assess overall plant status and detect conditions that require attention without performing interface management tasks.	X		
1.1-15	**Actual System/Equipment Status**			
	Indications of the actual status of plant systems and equipment, as opposed to demand status, should be provided when required by the task.			X
1.1-16	**Display of Parameters and Variables Important to Safety**			
	Plant parameters and variables important to safety should be displayed in a way that is convenient and readily accessible.	X		
1.1-17	**Normal Value Reference Index**			
	Displays should contain reference(s) to the values of normal operating condition(s).			
1.1-18	**Critical Value Reference Index**			
	A reference index should be included in a display when the user must compare displayed information with some critical value.			X
1.1-19	**Limit Marks for Critical Variables**			
	Limit marks should be used to indicate operational limits for critical plants parameters.			X
1.1-20	**Choice of Status Setpoints**			
	Setpoints used to indicate a change in status should be chosen to provide users with sufficient time to respond appropriately.			X
1.1-21	**Analytical Redundancy**			
	Analytical redundancy should be considered to help ensure the appropriateness of displayed values.			X
1.1-22	**Indication of Proper Display Operation**			
	A display feature should be provided to indicate to the user that the system is operating properly (or that a system failure has occurred).			X

Guideline #	Review Criteria	Yes	No	N/A
1.1-23	**Indication of Display Failure**			
	Information system failures (due to sensors, instruments, and components) should result in distinct display changes, which directly indicate that depicted plant conditions are invalid.			X
1.1-24	**Annotating Displays With Time Data**			
	When task performance requires or implies the need to assess currency of information within a display, the information should be annotated with time information.			X
1.1-25	**Freezing Rapidly Changing Information**			
	When task requirements dictate that current information changes be continuously viewed and the display is changing so rapidly that the information is difficult to read, the user should have the capability of simultaneously viewing the information in a supplemental 'snapshot' display (i.e., a display frozen to enhance readability) along with the continuous display.			X
1.1-26	**Freeze Feedback**			
	If a display has a freeze capability, the display should have an obvious reminder that it is in the freeze mode.			X
1.1-27	**Navigational Links to Related Information**			
	Navigational links to and from high-level and lower-levels of information and to reference and supporting information should be provided when needed for operators' tasks.			X
1.1-28	**Grouping of Related Information**			
	Related information should be organized into groups.			X
1.1-29	**Spatial Proximity for Related Information**			
	Information that must be compared or mentally integrated should be presented in the close spatial proximity.			X
1.1-30	**Chromatic Proximity for Related Information**			
	If information must be mentally integrated, similar color codes should be used for the information items.			X
1.1-31	**Similar Physical Dimensions for Related Information**			
	Information that must be compared or mentally integrated should use similar physical dimensions to convey meaning.			X
1.1-32	**Similar Presentation Formats for Related Information**			
	Information that must be compared or mentally integrated should be presented using similar presentation formats (e.g., analog versus digital).			X
1.1-33	**Display Information in Directly Usable Form**			
	Information should be displayed to users in directly usable form consistent with the task requirements.			X
1.1-34	**Indication of Transformations Needed**			
	Scale multiplication factors (i.e., powers of 10), if used, should be clearly indicated on the display.			X

Guideline #	Review Criteria	Yes	No	N/A
1.1-35	**Annotating Graphic Displays With Numeric Values**			
	When precise reading of a graphic display is required, the display should be annotated with actual data values to supplement their graphic representation.			X
1.1-36	**Readability Conditions**			
	Important display elements and codes should be identifiable and readable from the maximum viewing distance and under minimal ambient lighting conditions.			X
1.1-37	**Sensitivity**			
	Display dynamic sensitivity should be selected to minimize the display of normal random variations in equipment performance.			X
1.1-38	**Numeral and Letter Styles**			
	Numeral and letter styles should be simple and consistent.			X
1.1-39	**Display Flexibility**			
	Users should be able to control the amount, format, and complexity of displayed data to meet task requirements.			X
1.1-40	**Range of Conditions Displayed**			
	The display system should correctly display information about the plant's safety status including severe accident symptoms.			X
1.1-41	**Distinctive Coding of Critical Information**			
	Distinctive means of coding/highlighting should be used when a user's attention must be directed to changes in the state of the system, critical or off-normal data, and hazardous conditions.			X
1.1-42	**Salience Levels**			
	The salience of graphic features should reflect the importance of the information.			X
1.1-43	**Readability of Coded Information**			
	Coding should not interfere with the readability of displayed information.			X
1.1-44	**Highlighting Text Displays**			
	When critical text merits emphasis to set it apart from other text, that text should be highlighted by bolding/brightening or color coding or by some auxiliary annotation.			X
1.1-45	**Graphic Display Enhancement With Text**			
	When a graphic display contains some outstanding or discrepant feature that merits attention by a user, supplementary text should be displayed to emphasize that feature.			X
1.1-46	**Coding Display Items Requiring Rapid Discrimination**			
	Coding should be provided when a user must distinguish rapidly among different categories of displayed data.			X
1.1-47	**Meaningful Codes**			
	Meaningful or familiar codes should be used, rather than arbitrary codes.			X
1.1-48	**Consistent Coding Across Displays**			
	Consistent meanings should be assigned to codes, from one display to another.			X

Guideline #	Review Criteria	Yes	No	N/A
1.1-49	**Coding and Transmission Time**			
	Coding should not increase transmission time.			X
1.1-50	**On-Line Dictionary of Display Element Definitions**			
	The user should have access to a dictionary that contains definitions for all display element conventions through the display or an on-line help system.			X
1.1-51	**Physical Overlays**			
	Overlays should not distract or interfere with the observation or interpretation of displayed information.			X
1.1-52	**Hardcopy of VDU Displays**			
	Users should be able to obtain an accurate and complete hardcopy of any VDU display.			X
1.1-53	**Display Area**			
	Sufficient viewing area should be provided to display all important information so that repetitive transitions between displays are not required.			X
1.1-54	**Predefined Displays**			
	Predefined information groupings should be available.			X
1.1-55	**Indicating Locations for Important Information**			
	The system should support the user in identifying displays and indicators that should be monitored during upset conditions.			X
1.2	**Display Formats**			
1.2.1	**Continuous Text Displays**			
1.2.1-1	**Standard Text Format**			
	A standard text display format should be used from one display to another.			X
1.2.1-2	**Consistency Between VDU-Based Text and Printed Text**			
	VDU displays of textual data, messages, or instructions should generally follow design conventions for printed text.			X
1.2.1-3	**Sentences Begin with Main Topic**			
	The main topic of each sentence should be located near the beginning of the sentence.			X
1.2.1-4	**Clarity of Wording**			
	Text displays should be worded simply and clearly.			X
1.2.1-5	**Distinct Wording**			
	Distinct words rather than contractions or combined forms should be used, especially in phrases involving negation.			X
1.2.1-6	**Concise Wording**			
	The text should be worded concisely to aid comprehension.			X
1.2.1-7	**Abbreviations Defined in Text**			
	When words in text displays are abbreviated, each abbreviation (or acronym) should be defined in parentheses following its first appearance.			X
1.2.1-8	**Affirmative Sentences**			
	Affirmative statements rather than negative statements should be used.			X

Guideline #	Review Criteria	Yes	No	N/A
1.2.1-9	**Active Voice**			
	Sentences should be composed in the active rather than the passive voice.			X
1.2.1-10	**Temporal Sequence**			
	When a sentence describes a sequence of events, it should be phrased with a corresponding word order.			X
1.2.1-11	**Minimum Number of Displayed Lines**			
	When a user must read continuous text on line, at least four lines of text should be displayed at one time.			X
1.2.1-12	**Line Length**			
	Continuous text should be displayed in wide columns, containing at least 50 characters per line.			X
1.2.1-13	**Minimal Hyphenation**			
	In display of textual material, words should be kept intact, with minimal breaking by hyphenation between lines.			X
1.2.1-14	**Conventional Punctuation**			
	Conventional punctuation should be used in textual display.			X
1.2.1-15	**Inter-Word Spacing**			
	Consistent spacing between the words of displayed text should be maintained, with left justification of lines and ragged right margins. A minimum of one character width (capital N for proportional spacing) should be used between words.			X
1.2.1-16	**Inter-Line Spacing**			
	A minimum of two stroke widths or 15 percent of character height, whichever is greater, should be used for spacing between lines of text.			X
1.2.1-17	**Inter-Paragraph Spacing**			
	Displayed paragraphs of text should be separated by at least one blank line.			X
1.2.1-18	**Combining Text with Other Data**			
	Text should be formatted in a few wide lines rather than in narrow columns of many short lines when space is limited owing to the display of graphics or other data.			X
1.2.1-19	**Placing Figures Near Their Citations**			
	When tables and/or graphics are combined with text, each figure should be placed near its first citation in the text, preferably in the same display frame.			X
1.2.1-20	**Underlining for Emphasis**			
	When a line is placed under an item to mark or emphasize it, the line should not impair the legibility of the item, e.g., by obscuring the descenders.			X
1.2.1-21	**Font Coding**			
	Within a text file or table, the use of a different font style should be preferred over the use of a different size for highlighting information.			X

Guideline #	Review Criteria	Yes	No	N/A
1.2.1-22	**Attention Symbols in Alphanumeric Displays**			
	When a special symbol, such as an asterisk, is used to draw attention to a selected item in alphanumeric displays, the symbol should be separated from the beginning of the word by a space.			X
1.2.1-23	**Hardcopy for Lengthy Text Displays**			
	When a user must read lengthy textual material, that text should be available in printed form.			X
1.2.2	**Tables and Lists**			
1.2.2-1	**Logical Organization**			
	Information should be organized in some recognizable logical order to facilitate scanning and assimilation.			X
1.2.2-2	**Table Layout by Row and Column**			
	A table should be constructed so that row and column labels represent the information a user has prior to consulting the table.			X
1.2.2-3	**Row and Column Labels**			
	Each row and column should be uniquely and informatively labeled and should be visually distinct from data entries.			X
1.2.2-4	**Labeling Units of Measurement**			
	Labels should include the unit of measure for the data in the table; units of measurement should be part of row or column labels.			X
1.2.2-5	**Consistent Spacing Within Tables**			
	Consistent column and row spacing should be maintained within a table, and from one table to another. Similarly, spacing between rows should be consistent within a table and between related tables.			X
1.2.2-6	**Minimum Column Spacing**			
	The spacing between columns should be greater than any internal spaces that might be displayed within a tabulated data item.			X
1.2.2-7	**Row Separation**			
	In dense tables with many rows, a blank line, dots, or some other distinctive feature (to aid horizontal scanning) should be inserted after a group of rows at regular intervals.			X
1.2.2-8	**Consistent Character Appearance**			
	The font and size of alphanumeric characters should be consistent within a table and between related tables.			X
1.2.2-9	**Justification of Alphabetic Data**			
	Columns of alphabetic data should be displayed with left justification to permit rapid scanning.			X
1.2.2-10	**Justification of Numeric Data**			
	Columns of numeric data should be justified with respect to a fixed decimal point; if there is no decimal point, then numbers should be right-justified.			X
1.2.2-11	**Arabic Numerals for Numbered List Items**			
	Arabic rather than Roman numerals should be used when listed items are numbered.			X

Guideline #	Review Criteria	Yes	No	N/A
1.2.2-12	**Numbered Items Start with '1'**			
	Item numbers should begin with one rather than zero.			X
1.2.2-13	**Continuous Numbering in Multipage Lists**			
	When a list of numbered items exceeds one display page, the items should be numbered continuously in relation to the first item on the first page.			X
1.2.2-14	**Repeated Elements in Hierarchic Numbering**			
	Complete numbers should be displayed for hierarchic lists with compound numbers, i.e., repeated elements should not be omitted.			X
1.2.2-15	**Single-Column List Format**			
	Lists should be formatted so that each item starts on a new line.			X
1.2.2-16	**Marking Multiline Items in a List**			
	When a single item in a list continues for more than one line, items should be marked in some way so that the continuation of an item is obvious.			X
1.2.2-17	**Vertical List Extension Beyond One Page**			
	Where lists extend over more than one display page, the last line of one page should be the first line on the succeeding page.			X
1.2.2-18	**Hierarchic Structure for Long Lists**			
	For a long list, extending more than one displayed page, a hierarchic structure should be used to permit its logical partitioning into related shorter lists.			X
1.2.2-19	**Vertical Ordering in Multiple Columns**			
	If a list is displayed in multiple columns, the items should be ordered vertically within each column rather than horizontally within rows and across columns.			X
1.2.2-20	**Annotating Display of Continued Data**			
	When lists or tables are of variable length and may extend beyond the limits of one display page, the user should be informed when data are continued on another page and when data are concluded on the present page.			X
1.2.3	**Data Forms and Fields**			
1.2.3-1	**Comparing Data Fields**			
	Data fields to be compared on a character-by-character basis should be positioned one above the other.			X
1.2.3-2	**Consistent Format Across Displays**			
	The ordering and layout of corresponding data fields across displays should be consistent from one display to another.			X
1.2.3-3	**Consistency of VDU and Hardcopy Formats**			
	The format of a VDU data form should be similar to that of commonly used hardcopy source documents.			X
1.2.3-4	**Form Compatible for Data Entry and Display**			
	When forms are used for data entry as well as for data display, the formats of these forms should be compatible.			X

Guideline #	Review Criteria	Yes	No	N/A
1.2.3-5	**Visually Distinct Labels and Data Entry Areas**			
	Clear visual definition of data fields should be provided so that the data are distinct from labels and other display features.			X
1.2.3-6	**Separation of Field Label and Data Entry Area**			
	The label and the data entry area should be separated by at least one character space.			X
1.2.3-7	**Data Field Separation**			
	At least three spaces should appear between the longest data field in one column and the rightmost label in an adjacent column.			X
1.2.3-8	**Justification: Data Field Labels of Equal Length**			
	When label sizes are relatively equal, both labels and data fields should be left justified. One space should be left between the longest label and the data field column.			X
1.2.3-9	**Justification: Data Field Labels of Unequal Length**			
	When label sizes vary greatly, labels should be right justified and the data fields should be left justified. One space should be left between each label and the data field.			X
1.2.3-10	**Protected Labels**			
	Field labels should be protected from keyed entry by having the cursor skip over them automatically when a user is spacing or tabbing.			X
1.2.3-11	**Highlight Active Data Entry Field**			
	The current field to be entered should be highlighted.			X
1.2.3-12	**Data Entry Cues**			
	If appropriate, labels should be used to help cue the user as to the expected data entry.			X
1.2.3-13	**Label Punctuation as Entry Cue**			
	The label for each entry field should end with a special symbol, signifying that an entry may be made.			X
1.2.3-14	**Data Form Entry Error**			
	Data entered that does not match the predefined format of the data form should be highlighted and signaled to the user.			X
1.2.3-15	**Distinguishing Blanks from Nulls**			
	Blanks (keyed spaces) should be distinguished from nulls (no entry at all) in the display of data forms, where it can aid task performance.			X
1.2.3-16	**Labeling Groups of Data Fields**			
	A field group heading should be centered above the labels to which it applies.			X
1.2.3-17	**Data Field Group Separation**			
	At least five spaces should appear between groups of data fields.			X
1.2.3-18	**Headings and Label Indentation**			
	When headings are located on the line above related screen fields, the labels should be indented a minimum of five spaces from the start of the heading.			X

Guideline #	Review Criteria	Yes	No	N/A
1.2.3-19	**Heading Proximity to Subordinate Labels**			
	When headings are placed adjacent to the related fields, they should be located to the left of the topmost row of related fields. The column of labels should be separated from the longest heading by a minimum of three blank spaces.			X
1.2.3-21	**Minimizing the Number of Pages for a Data Form**			
	The number of pages in a data form required to complete a transaction should be minimized to reduce the amount of navigation.			X
1.2.3-22	**Cursor Positioning**			
	The cursor should be positioned at the first character location of the first data entry field upon initial presentation of a data entry form.			X
1.2.3-23	**Movement Between Entry Fields**			
	The user should be able to move from one entry field to the next using a simple action that requires minimal focused attention.			X
1.2.4	**Bar Charts and Histograms**			
1.2.4-1	**Labeling Single Bars**			
	Each bar on the display should have a unique identification label.			X
1.2.4-2	**Labeling Paired Bars**			
	When bars are displayed in pairs, they should be labeled as a unit, with individual distinguishing labels for each bar.			X
1.2.4-3	**Bar Spacing**			
	When data must be compared, bars should be adjacent to one another and spaced such that a direct visual comparison can be made without eye movement.			X
1.2.4-4	**Consistent Orientation of Bars**			
	In a related series of bar charts, a consistent orientation of the bars (vertical or horizontal) should be adopted.			X
1.2.4-5	**Highlighting**			
	If one bar represents data of particular significance, then that bar should be highlighted.			X
1.2.4-6	**Zero Reference on Deviation Bar Charts**			
	The zero reference should be the center of the deviation bar chart.			X
1.2.4-7	**Normal Range on Deviation Bar Charts**			
	On a deviation bar chart, the range of normal conditions for positive or negative deviations should represent no more than 10 percent of the total range.			X
1.2.4-8	**Indication of Magnitude on Deviation Bar Charts**			
	The magnitude of each variable should be displayed when a deviation bar display is used as a main display format for safety function parameters.			X
1.2.4-9	**Coding Segmented Bar Charts**			
	Segmented bars, in which differently coded segments are shown cumulatively within a bar, should be used when both the total measures and the portions represented by the segments are of interest.			X

Guideline #	Review Criteria	Yes	No	N/A
1.2.4-10	**Ordering Data in Segmented Bars**			
	The data categories should be ordered within each bar in the same sequence, with the least variable categories displayed at the bottom and the most variable at the top.			X
1.2.5	**Graphs**			
1.2.5-1	**Interpreting Graphs**			
	Graphs should convey enough information to allow the user to interpret the data without referring to additional sources.			X
1.2.5-2	**Labeling Curves**			
	When multiple curves are included in a single graph, each curve should be identified directly by an adjacent label, rather than by a separate legend.			X
1.2.5-3	**Legend Ordering**			
	If a legend must be displayed, the codes in the legend should be ordered to match the spatial order of their corresponding curves in the graph itself.			X
1.2.5-4	**Coding to Distinguish Curves**			
	Coding should be used when multiple functions are displayed in a single graph.			X
1.2.5-5	**Consistent Line Coding**			
	Line coding should be used consistently across graphs.			X
1.2.5-6	**Highlighting Significant Curves**			
	In displays of multiple curves, if one curve represents data of particular significance, then that curve should be highlighted.			X
1.2.5-7	**Trending Time Intervals**			
	Trend displays should be capable of showing data collected during time intervals of different lengths.			X
1.2.5-8	**Multiple Trend Lines**			
	When the user must compare data represented by separate curves, the curves should be displayed in one combined graph.			X
1.2.5-9	**Stability of Trend Data**			
	Trend rates should not fluctuate as a result of minor fluctuations in data or oscillatory behavior that may be superimposed on a well-defined trend.			X
1.2.5-10	**Indication of Non-Representative Trend Data**			
	When a simple quantitative rate-of-change value is used, an indication should be provided to inform the user when, as a result of minor fluctuations or oscillations, the rate value does not accurately represent the trend.			X
1.2.5-11	**Display of Projected Values**			
	Curves representing planned, projected, or extrapolated data should be distinctive from curves representing actual data.			X

Guideline #	Review Criteria	Yes	No	N/A
1.2.5-12	**Curve Averaging**			
	Combining several individual curves into a single average curve should only be done when users do not need to know the pattern of individual curves or when curves differ on the basis of minor irregularities.			X
1.2.5-13	**Repeating Display of Cyclic Data**			
	Where curves represent cyclic data, the graph should be extended to repeat uncompleted portions of the displayed cycle.			X
1.2.5-14	**Target Area Definition**			
	The target area, preferred combination of X- and Y-axis values, should be graphically defined.			X
1.2.5-15	**Minimize Clutter**			
	Old data points should be removed after some fixed period of time.			X
1.2.5-16	**Linear Profile Pattern Recognition**			
	The graph should form recognizable geometric patterns for specific abnormal conditions.			X
1.2.5-17	**Coding Linear Profile Charts**			
	The area below the profile line should be shaded to provide a more distinguishable profile.			X
1.2.5-18	**Labeling Linear Profile Charts**			
	Labels should be provided along the bottom to identify each parameter.			X
1.2.5-19	**Depicting Bands in Segmented Curve Graphs**			
	All segments in a segmented curve graph should be related to the total value.			X
1.2.5-20	**Ordering Data in Segmented Curve Graphs**			
	The data categories in a segmented curve graph should be ordered so that the least variable curves are displayed at the bottom and the most variable at the top.			X
1.2.5-21	**Coding Segmented Curve Graphs**			
	The different bands of segmented curve graphs should be made visually distinctive by coding, such as by the texturing or shading of bands.			X
1.2.5-22	**Labeling Segmented Curve Graphs**			
	Where space permits, the different bands of segmented curve graphs should be labeled directly within the textured or shaded bands.			X
1.2.5-23	**Highlighting Scatterplots**			
	If some plotted points represent data of particular significance, they should be highlighted to make them visually distinctive from others.			X
1.2.5-24	**Grouping Scatterplots to Show Multiple Relations**			
	When relations among several variables must be examined, an ordered group (matrix) of scatterplots should be displayed, each showing the relation between just two variables.			X

Guideline #	Review Criteria	Yes	No	N/A
1.2.5-25	**Interactive Analysis of Grouped Scatterplots**			
	When scatterplots are grouped in a single display to show relations among several variables, an interactive aid should be provided for analysis so that if a user selects a set of data in one plot then the corresponding data points in other plots will be highlighted.			X
1.2.6	**Pie Charts**			
1.2.6-1	**Partitioning**			
	Partitioning should be limited to five segments or less.			X
1.2.6-2	**Labeling Pie Charts**			
	Pie chart segments should be labeled directly rather than by a separate legend. If a segment is too small to contain the label, the label should be placed outside the segment with a line from it to the segment.			X
1.2.6-3	**Numeric Annotation of Labels**			
	If the task requires precise values, numbers should be added to pie chart segment labels to indicate the percentage and/or absolute values.			X
1.2.6-4	**Highlighting**			
	If a particular segment of a pie chart requires emphasis, it should be highlighted by special hatching or displaced slightly from the remainder of the pie.			X
1.2.7	**Flowcharts**			
1.2.7-1	**Logical Ordering of Decision Options**			
	The available decision options should be displayed in logical order.			X
1.2.7-2	**Single Decision at Each Step**			
	Only a single decision should be required at each step.			X
1.2.7-3	**Consistent Ordering of Decision Options**			
	When a flowchart is designed so that a user must make decisions at various steps, the available options should be displayed in some consistent order from step to step.			X
1.2.7-4	**Availability of Supplemental Information**			
	While flowcharts should display only the data immediately required by the user, more detailed data should be available by means of a simple action.			X
1.2.7-5	**Conventional Path Orientation**			
	Flowcharts should be designed so that the path of the logical sequence is consistent with familiar orientation conventions.			X
1.2.7-6	**Flowchart Symbol Set**			
	There should be a standard set of flowchart symbols.			X
1.2.8	**Mimics and Diagrams**			
1.2.8-1	**Level of Detail**			
	Mimics and diagrams should contain the minimum amount of detail required to yield a meaningful pictorial representation.			X
1.2.8-2	**Component Identification**			
	Plant components represented on mimic lines should be identified.			X

Guideline #	Review Criteria	Yes	No	N/A
1.2.8-3	**Line Points of Origin**			
	All flow path line origin points should be labeled or begin at labeled components.			X
1.2.8-4	**Line Termination Points**			
	All flow path line destination or terminal points should be labeled or end at labeled components.			X
1.2.8-5	**Directional Arrowheads**			
	Flow directions should be clearly indicated by distinctive arrowheads.			X
1.2.8-6	**Line Coding**			
	Flow paths should be coded (e.g., by color and/or width) to indicate important information.			X
1.2.8-7	**Overlapping Lines**			
	Overlapping of flow path lines should be avoided.			X
1.2.8-8	**Symbol-Data Integration**			
	Where symbols are used to represent equipment components and process flow or signal paths, numerical data should be presented reflecting inputs and outputs associated with equipment.			X
1.2.8-9	**Aids for Evaluation**			
	When users must evaluate information in detail, computer aids for calculation and visual analysis should be provided.			X
1.2.9	**Maps**			
1.2.9-1	**Feature Identification**			
	Significant features of a map should be labeled directly on the display unless cluttering or obscuring of other information would result.			X
1.2.9-2	**Consistent Orientation**			
	When several different maps will be displayed, a consistent orientation should be used so that the top of each map will always represent the same direction.			X
1.2.9-3	**User Selectable Orientation**			
	The user should be able to select different orientations and reference points.			X
1.2.9-4	**Panning Map Displays**			
	When a map exceeds the capacity of a single display frame, users should be able to pan the display over the mapped data in order to examine different areas of current interest.			X
1.2.9-5	**Area Coding**			
	Codes, such as texture patterns, color, or tonal variations, should be used when different areas of a map must be defined, or when geographic distribution of a particular variable must be indicated.			X
1.2.9-6	**Color Tonal Codes**			
	Tonal codes (different shades of one color) rather than spectral codes (different colors) should be used when users must make relative judgments for different colored areas of a display.			X

Guideline #	Review Criteria	Yes	No	N/A
1.2.9-7	**Ordered Coding**			
	Where different areas of a map are coded by texture patterns or tonal variation, the darkest or lightest shades correspond to the extreme values of the coded variable.			X
1.2.9-8	**Mapping Nongeographic Data**			
	In applications where the geographic distribution of nongeographic data must be displayed, other graphic elements should be added to a map for that purpose.			X
1.2.9-9	**Highlighting Data Change**			
	When changes in mapped data are significant for a user's task, auxiliary graphic elements should be included to highlight those changes.			X
1.2.9-10	**Aids for Analyzing Maps**			
	When the use of mapped data may be complex, computer aids should be provided for data analysis.			X
1.2.9-11	**Map and Label Orientation**			
	If the map orientation can be changed, the map labels and symbols should remain oriented to the user's position.			X
1.2.9-12	**Map Decluttering**			
	The user should be able to rapidly remove non-critical information from a map or map overlay display.			X
1.2.10	**Integral and Configural Formats**			
1.2.10-1	**Appropriate Use of Integral Displays**			
	Integral formats should be used to communicate high-level, status-at-a-glance information where users may not need information on individual parameters to interpret the display.			X
1.2.10-2	**Appropriate Use of Configural Displays**			
	Configural formats should be used when operators must rapidly transition between high-level functional information and specific parameter values.			X
1.2.10-3	**Reference Aids for Object Displays**			
	A perceptually distinct reference aid should be provided in an object display to support operators in recognizing abnormalities in the object's characteristics.			X
1.2.10-4	**Representation of Emergent Features**			
	The display elements should be organized so that the emergent features that arise from their interaction correspond to meaningful information about the process or system, e.g., when the aspect of the system represented by the emergent is disturbed, the disturbance is visible in the emergent feature.			X
1.2.10-5	**Levels of Emerging Features**			
	The emergent features or patterns within the display should be nested (from global to local) in a way that reflects the hierarchical structure of the process.			X

Guideline #	Review Criteria	Yes	No	N/A
1.2.10-6	**Salience of Emerging Features**			
	Each emergent feature should be clearly distinguishable for other emergent features and from information on individual parameters.			X
1.2.10-7	**Reference Aids for Configural Displays**			
	A perceptually distinct reference aid should be provided in a configural display to support operators in recognizing abnormalities in emergent features.			X
1.2.10-8	**Representation of Individual Parameters**			
	Each relevant process parameter should be represented by a perceptually distinct element within the display.			X
1.2.10-9	**Use of Lower-Level Information**			
	The display should support the user in performing tasks requiring lower-level information.			X
1.2.10-10	**Complexity**			
	The emergent features and their interactions should not be so complex as to be susceptible to misinterpretation.			X
1.2.11	**Graphic Instrument Panels**			
1.2.11-1	**Display Range Coding**			
	Zones indicating operating ranges should be color coded by edge lines or wedges for circular scales.			X
1.2.11-2	**Location of Zero**			
	When check-reading positive and negative values on rotary meters (circular displays), the zero or null position should be at 12 o'clock or 9 o'clock.			X
1.2.11-3	**Pointer Orientation**			
	The pointer on fixed scales should extend from the right of vertical scales and from the bottom of horizontal scales.			X
1.2.11-4	**Pointer Obscurement**			
	The pointer on fixed scales should extend to but not obscure the shortest graduation marks.			X
1.2.11-5	**Tick Mark Separation**			
	Tick marks should be separated by at least 0.07 inches (1.75 millimeters) for a viewing distance of 28 inches (71 centimeters) under low illumination.			X
1.2.11-6	**Number of Tick Marks**			
	Scales should not be cluttered with more marks than necessary for precision.			X
1.2	**Display Formats**			
1.2.12	**Speech Displays**			
1.2.12-1	**Limits on Speech Messages**			
	Speech should be limited to provide only a few messages.			X
1.2.12-2	**Message Repeat Capability**			
	The user should be able to have speech messages repeated.			X

Guideline #	Review Criteria	Yes	No	N/A
1.2.12-3	**Simple Spoken Messages**			
	Messages should be short and simple.			X
1.2.12-4	**Type of Voice**			
	A distinctive and mature voice should be used.			X
1.2.12-5	**Delivery Style**			
	Spoken messages should be presented in a formal, impersonal manner.			X
1.2.12-6	**Word Selection**			
	Words in a speech message should be concise, intelligible, and appropriate for the information presented.			X
1.2.12-7	**Speech Message Priority**			
	A speech message priority system should be established such that more critical messages override the presentation of messages having lower priority.			X
1.2.12-8	**Distinctive Spoken Warnings**			
	If speech is used to provide warnings as well as other forms of user guidance, spoken warnings should be easily distinguishable from routine messages.			X
1.2.12-9	**Intensity of Speech Presentation**			
	Speech signal intensity should be clearly audible for the expected ambient noise environment.			X
1.3	**Display Elements**			
1.3.1	**Alphanumeric Characters**			
1.3.1-1	**Conventional Use of Mixed Case**			
	Text to be read (except labels) should be presented using upper and lower case characters.			X
1.3.1-2	**Font Style**			
	A clearly legible font should be utilized. Fonts should have true ascenders and descenders, uniform stroke width, and uniform aspect ratio.			X
1.3.1-3	**Distinguishability of Characters**			
	For a given font, it should be possible to clearly distinguish between the following characters: X and K, T and Y, I and L, I and 1, O and Q, O and 0, S and 5, and U and V.			X
1.3.1-4	**Character Size for Text Readability**			
	The height of characters in displayed text or labels should be at least 16 minutes of arc and the maximum character height should be 24 minutes of arc.			X
1.3.1-5	**Character Height-to-Width Ratio**			
	For fixed (as opposed to proportionally spaced) presentations, the height-to-width ratio should be between 1:0.7 to 1:0.9.			X
1.3.1-6	**VDU Character Format**			
	A 4x5 (width-to-height) character matrix should be the minimum matrix used for superscripts and for numerators and denominators of fractions that are to be displayed in a single character position.			X

Guideline #	Review Criteria	Yes	No	N/A
1.3.1-7	**Inter-Character Spacing**			
	Horizontal separation between characters or symbols should be between 10 and 65 percent of character or symbol height.			X
1.3.2	**Abbreviations and Acronyms**			
1.3.2-1	**Avoiding Abbreviations**			
	Abbreviations should be avoided (except when terms are commonly referred to by their initialisms, e.g., SPDS).	X		
1.3.2-2	**Abbreviation Rule**			
	When defining abbreviations that are not common to the user population, a simple rule should be used that users understand and recognize.	X		
1.3.2-3	**Distinctive Abbreviations**			
	Abbreviations should be distinctive so that abbreviations for different words are distinguishable.	X		
1.3.2-4	**Punctuation of Abbreviations**			
	Abbreviations and acronyms should not include punctuation.	X		
1.3.2-5	**Easily Remembered Arbitrary Codes**			
	When arbitrary codes must be remembered by the user, characters should be grouped in blocks of three to five characters, separated by a minimum of one blank space or other separating character such as a hyphen or slash.			X
1.3.2-6	**Avoid O and I in Arbitrary Codes**			
	The use of the letters O and I in a non-meaningful code should be avoided since they are easily confused with the numbers 0 (zero) and 1 (one), respectively.			X
1.3.2-7	**Combining Letters and Numbers in Arbitrary Codes**			
	When codes combine both letters and numbers, letters should be grouped together and numbers grouped together rather than interspersing letters with numbers.			X
1.3.3	**Labels**			
1.3.3-1	**Group Labels**			
	Each individual aspect of a display (e.g., data group, field, or message) should contain a distinct, unique, and descriptive label.			X
1.3.3-2	**Meaningfulness of Labels**			
	Labels should be meaningful words or accepted technical terms.			X
1.3.3-3	**Label Formats**			
	Label formats should be consistent across and within displays.			X
1.3.3-4	**Consistent Wording of Labels**			
	Labels should be worded consistently, so that the same item is given the same label whenever it appears.			X
1.3.3-5	**Distinctive Labels**			
	Labels should be uniquely and consistently highlighted, capitalized, or otherwise emphasized to differentiate them from other screen structures and data.			X

Guideline #	Review Criteria	Yes	No	N/A
1.3.3-6	**Label Separation**			
	Labels should be separated from one another by at least two standard character spaces.			X
1.3.3-7	**Normal Orientation for Labels**			
	The annotation of graphic displays, including labels for the axes of graphs, should be displayed in a normal orientation for reading text.			X
1.3.3-8	**Label Content for User Options**			
	When presenting a list of user options, labels should reflect the question or decision being posed to the user.			X
1.3.3-9	**Labels for Graphical Objects**			
	The label for a specific graphical object (e.g., an icon) should be placed in close proximity to the object.			X
1.3.4	**Icons and Symbols**			
1.3.4-1	**Appropriate Use of Icons**			
	The primary use of icons in graphic displays should be to represent actual objects or actions.			X
1.3.4-2	**Iconic Representation**			
	Icons should be designed to look like the objects, processes, or operations they represent, by use of literal, functional, or operational representations.			X
1.3.4-3	**Simple Design**			
	Icons should be simple, closed figures when possible.			X
1.3.4-4	**Use of Abstract Symbology**			
	Abstract symbols should conform to user conventions or to common electrical and mechanical symbol conventions when user conventions do not exist.			X
1.3.4-5	**Distinguishability**			
	Each icon and symbol should represent a single object or action, and should be easily discriminable from all other icons and symbols.			X
1.3.4-6	**Consistent Use of Special Symbols**			
	Special symbols to signal critical conditions should be used exclusively for that purpose.			X
1.3.4-7	**Upright Orientation**			
	Icons and symbols should always be oriented 'upright.'			X
1.3.4-8	**No Alternating Words and Symbols**			
	Words and symbols should not be used alternately.			X
1.3.4-9	**Size**			
	Icons and symbols should be large enough for the user to perceive the representation and discriminate it from other icons and symbols.			X
1.3.4-10	**Highlighting**			
	An icon or symbol should be highlighted when the user has selected it.			X
1.3.4-11	**Labeling Icons**			
	Icons should be accompanied by a text label.			X

Guideline #	Review Criteria	Yes	No	N/A
1.3.4-12	**Labels for Control Option Icons**			
	If icons are used to represent control action options, a label indicating the action should be associated with the icon.			X
1.3.5	**Numeric Data**			
1.3.5-1	**Number System**			
	Numeric values should ordinarily be displayed in the decimal number system.			X
1.3.5-2	**Leading Zeros**			
	Leading zeros in numeric entries for whole numbers should be suppressed.			X
1.3.5-3	**Maintaining Significant Digits**			
	A number should be displayed at the number of significant digits required by users to perform their tasks.			X
1.3.5-4	**Display Range**			
	Numeric displays should accommodate the variable's full range.			X
1.3.5-5	**Rate of Display Change**			
	Digital displays should change slowly enough to be readable.			X
1.3.5-6	**Direction of Change in Digital Display**			
	If users must rapidly discern directional change, digital displays should be provided with arrows to indicate the direction of change.			X
1.3.5-7	**Direct Display of Differences**			
	If users must evaluate the difference between two sets of data, the difference should be presented on the display.			X
1.3.5-8	**Orientation of Numbers**			
	All numbers should be oriented upright.			X
1.3.6	**Scales, Axes, and Grids**			
1.3.6-1	**Orientation of Scales**			
	Numbers on a scale should increase clockwise, left to right, or bottom to top.			X
1.3.6-2	**Scale Intervals**			
	Nine should be the maximum number of tick marks between numbers.			X
1.3.6-4	**Circular Scales**			
	For one-revolution circular scales, zero should be at 7 o'clock and the maximum value should be at 5 o'clock.			X
1.3.6-5	**Axis Labels**			
	Axes should be clearly labeled with a description of what parameter is represented by the axis.			X
1.3.6-6	**Identification of Units of Measurement**			
	The units of measurement represented by the scale should be included in the axis label.			X
1.3.6-7	**Scaling Conventions**			
	Conventional scaling practice should be followed, in which the horizontal X-axis is used to plot time or the postulated cause of an event, and the vertical Y-axis is used to plot the effect.			X

Guideline #	Review Criteria	Yes	No	N/A
1.3.6-8	**Consistent Scaling**			
	If users must compare graphic data across a series of displays, the same scale should be used for each.			X
1.3.6-9	**Scales Consistent with Function**			
	The scales should be consistent with the intended functional use of the data.			X
1.3.6-10	**Linear Scaling**			
	A linear scale should be used for displayed data, in preference to logarithmic or other non-linear methods of scaling, unless it can be demonstrated that non-linear scaling will facilitate user interpretation of the information.			X
1.3.6-11	**Numeric Scales Start at Zero**			
	When users must compare aggregate quantities within a display, or within a series of displays, scaling of numeric data should begin with zero.			X
1.3.6-12	**Display of Origin**			
	When graphed data represent positive numbers, the graph should be displayed with the origin at the lower left, such that values on an axis increase as they move away from the origin of the graph.			X
1.3.6-13	**Single Scale On Each Axis**			
	Only a single scale should be shown on each axis, rather than including different scales for different curves in the graph.			X
1.3.6-14	**Scaling Against a Reference Index**			
	If different variables on a single graph require different scales, they should be scaled against a common baseline index, rather than showing multiple scales.			X
1.3.6-15	**Indication of Scale**			
	When a graphic display has been expanded from its normal coverage, some scale indicator of the expansion factor should be provided.			X
1.3.6-16	**Manual Rescaling**			
	Users should be able to manually change the scale to maintain an undistorted display under different operating conditions.			X
1.3.6-17	**Indication of Automatic Rescaling**			
	If the system is designed to automatically change scale, an alert should be given to the user that the change is being made.			X
1.3.6-18	**Aids for Scale Interpolation**			
	If interpolation must be made or where accuracy of reading graphic data is required, computer aids should be provided for exact interpolation.			X
1.3.6-19	**Unobtrusive Grids**			
	When grid lines are displayed, they should be unobtrusive and not obscure data elements (e.g., curves and plotted points).			X
1.3.6-20	**Numbering Grids**			
	Graphs should be constructed so that the numbered grids are bolder than unnumbered grids.			X

Guideline #	Review Criteria	Yes	No	N/A
1.3.6-21	**Discontinuous Axes**			
	When data comparisons of interest fall within a limited range, the scaled axis should emphasize that range, with a break in the displayed axis to indicate discontinuity with the scale origin.			X
1.3.6-22	**Duplicate Axes**			
	When scaled data will contain extreme values, duplicate axes should be displayed, so that the X-axis appears at both the top and bottom, and the Y-axis at both the left and right sides of the graph.			X
1.3.6-23	**Restricted Use of Three-Dimensional Scaling**			
	Unless required, use of three-dimensional scales (i.e., where a Z-axis is added to the display) should be avoided.			X
1.3.7	**Borders, Lines, and Arrows**			
1.3.7-1	**Line Types**			
	Meaningful differences between lines appearing in graphic displays, such as flow paths, should be depicted by using various line types, e.g., solid, dashed, dotted, and widths.			X
1.3.7-2	**Conventional Use of Arrows**			
	In flow charts and other graphics displays, arrowheads should be used in a conventional fashion to indicate directional relations in the sequential links between various elements.			X
1.3.7-3	Restricted Use of Borders			X
	Unnecessary borders should not be used in the display.			
1.3.7-4	**Bordering Single Blocks**			
	A border should be used to improve the readability of a single block of numbers or letters.			X
1.3.7-5	**Distinctive Borders Around Critical Information**			
	If several labels or messages are clustered in the same area, distinctive borders should be placed around the critical ones only.			X
1.3.8	**Color**			
1.3.8-1	**Use of Color**			
	Where color is used for coding, it should be employed conservatively and consistently.	X		
1.3.8-2	**Color Coding for Discrete Data Categories**			
	When a user must distinguish rapidly among several discrete categories of data, a unique color should be used to display the data in each category.	X		
1.3.8-3	**Color Coding for Relative Values**			
	When the relative rather than the absolute values of a variable are important, gradual color changes as a tonal code should be used to show the relative values of a single variable.			X
1.3.8-4	**Color Coding to Draw Attention**			
	Brighter and/or more saturated colors should be used when it is necessary to draw a user's attention to critical data.	X		

Guideline #	Review Criteria	Yes	No	N/A
1.3.8-5	**Color Selection**			
	Colors for coding should be based on user conventions with particular colors.	X		
1.3.8-6	**Pure Blue**			
	Pure blue on a dark background should be avoided for text, for thin lines, or for high-resolution information.			X
1.3.8-7	**Easily Discriminable Colors**			
	When color coding is used to group or highlight displayed data, all of the colors in the set should be readily discriminable from each other.			X
1.3.8-8	**Unique Assignment of Color Codes**			
	When color coding is used, each color should represent only one category of displayed data.			X
1.3.8-9	**Color Contrast**			
	Symbols should be legible and readily discriminable against the background colors under all expected ambient lighting conditions.			X
1.3.8-10	**Redundant Color Coding**			
	Color coding should be redundant with some other display feature.			X
1.3.8-11	**Unplanned Patterns from Color Coding**			
	Color coding should not create unplanned or obvious new patterns on the screen.			X
1.3.8-12	**Red-Green Combinations**			
	Whenever possible, red and green colors should not be used in combination.			X
1.3.8-13	**Chromostereopsis**			
	Simultaneous presentation of both pure red and pure blue on a dark background should be avoided.			X
1.3.8-14	**Pure Red**			
	Dominant wavelengths above 650 nanometers in displays should be avoided.			X
1.3.9	**Size, Shape, and Pattern Codding**			
1.3.9-1	**Limited Use of Size Coding**			
	Size coding should be used only for applications where displays are not crowded.			X
1.3.9-2	**Size Variations**			
	A maximum of three size levels should be used. The major dimensions of the larger symbol should be at least 150 percent of the major dimension of the smaller symbol.			X
1.3.9-3	**Size Coding Proportional to Data Value**			
	When the symbol size is to be proportional to the data value, the scaled parameter should be the symbol area rather than a linear dimension such as diameter.			X
1.3.9-4	**Length Coding**			
	For length coding, the maximum number of levels should be six (preferably no more than three).			X

Guideline #	Review Criteria	Yes	No	N/A
1.3.9-5	**Establishing Standards for Shape Coding**			
	When shape coding is used, codes should be based on established standards or conventional meanings.			X
1.3.9-6	**Clearly Discriminable Shapes**			
	Shapes used in coding for data groups should be clearly discriminable.			X
1.3.9-7	**Simple Pattern Codes**			
	When patterns are used to code displayed areas, simple rather than elaborate patterns should be used.			X
1.3.9-8	**Pattern Coding of Extreme Values**			
	Pattern density should vary with the value of the coded variable so that the least dense pattern is associated with one extreme and the most dense pattern with the other extreme.			X
1.3.10	**Highlighting by Brightness and Flashing**			
1.3.10-1	**Easily Recognizable Highlighting**			
	Highlighting should be easily recognizable and used to attract the user's attention to special conditions, items important to decision-making or action requirements, or as a means to provide feedback.			X
1.3.10-2	**Minimal Highlighting**			
	Highlighting of information should be minimized.			X
1.3.10-3	**Consistency**			
	A particular highlighting method should be used consistently.			X
1.3.10-4	**Removing Highlighting**			
	If highlighting is used to emphasize important display items, it should be removed when it no longer has meaning.			X
1.3.10-5	**Appropriate Use of Brightness Coding**			
	Coding by differences in brightness should be used for applications that require discrimination between only two categories of displayed items on a VDU and up to three on a transilluminated display.			X
1.3.10-6	**Significance of Brightness Levels**			
	High brightness levels should be used to signify information of primary importance, and lower levels should be used to signify information of secondary interest.			X
1.3.10-7	**Intensity Levels for Brightness Coding**			
	Levels approximating 33 percent and 100 percent of the display luminance should be used for brightness coding.			X
1.3.10-8	**Inverse Video**			
	Inverse video should be used primarily for highlighting in dense data fields or to indicate selection of on- screen objects and information.			X
1.3.10-9	**Appropriate Use of Flash Coding**			
	Flashing should be used when a displayed item implies an urgent need for attention or action, but not in displays requiring attention to detail or reading of text.	X		

Guideline #	Review Criteria	Yes	No	N/A
1.3.10-10	**Flash Coding for Text**			
	When a user must read a displayed item that is flash coded, an extra symbol such as an asterisk or arrow to mark the item should be used, and the marker symbol should flash rather than the item itself.			X
1.3.10-11	**Small Area**			
	Only a small area of the screen should flash at any time.			X
1.3.10-12	**Coding by Flash Rate**			
	No more than two flash rates should be used.	X		
1.3.10-13	**Flash Suppression**			
	Event acknowledgement or flash suppression keys should be provided.	X		
1.3.10-14	**Long-Persistence Phosphor Displays**			
	Flashing should not be used with long-persistence phosphor displays.			X
1.3.10-15	**Flash Rate for Critical Information**			
	When two rates are used, the higher rate should apply to the more critical information.			X
1.3.11	**Auditory Coding**			
1.3.11-1	**Appropriate Use of Auditory Signals**			
	Auditory signals should be provided to alert the user to situations that require attention, such as an incorrect input action or a failure of the HSI to process an input from the user.	X		
1.3.11-2	**Dedicated Use**			
	Systems used to transmit non-verbal auditory signals should be used only for that purpose.			X
1.3.11-3	**Localization**			
	Auditory signals should provide localization cues that direct users to those control room workstations where attention is required.			X
1.3.11-4	**Selection**			
	Auditory signals should be selected to avoid interference with other auditory sources, including verbal communication.	X		
1.3.11-5	**Signal Priority Distinction**			
	Advisory or caution signals should be readily distinguishable from warning signals and used to indicate conditions requiring awareness, but not necessarily immediate action.	X		
1.3.11-6	**Association with Visual Warnings**			
	Auditory alerts, as well as caution and warning sounds, should accompany visual displays.	X		
1.3.11-7	**Unique Signal-Event Association**			
	Once a particular auditory signal code is established for a given operating situation, the same signal should not be designated for some other display.	X		
1.3.11-8	**Total Number of Simple Signals**			
	If the audio signal varies on one dimension only (such as frequency), the number of signals to be identified should not exceed four.	X		

Guideline #	Review Criteria	Yes	No	N/A
1.3.11-9	**Use with Several Visual Displays**			
	One audio signal may be used in conjunction with several visual displays, provided that immediate discrimination is not critical to personnel safety or system performance.			X
1.3.11-10	**Confusable Signals**			
	Audio warning signals that might be confused with routine signals or with other sounds in the operating environment should not be used.	X		
1.3.11-11	**Signal Compatible with Environment**			
	The intensity, duration, and source location of the signal should be compatible with the acoustical environment of the intended receiver as well as with the requirements of other personnel in the signal area.	X		
1.3.11-12	**Turning Off Non-Critical Auditory Signals**			
	Noncritical auditory signals should be capable of being turned off at the discretion of the user.	X		
1.3.11-13	**Indicating Who is to Respond**			
	When the signal must indicate which user (of a group of users) is to respond, a simple repetition code should be used.			X
1.3.11-14	**Direction of Sound**			
	Sound sources (speakers or buzzers) should direct sound toward the center of the main operating area.	X		
1.3.11-15	**Signal Bending Around Obstacles**			
	When an audio signal must bend around major obstacles or pass through partitions, its frequency should be less than 500 Hz.			X
1.3.11-16	**Audibility**			
	Auditory alert and warning signals should be audible in all parts of the control room.	X		
1.3.11-17	**Signal Intensity**			
	The intensity of auditory signals should be set to unmistakably alert and get a user's attention.	X		
1.3.11-18	**Signal Travel Over 1000 Feet**			
	When an audio signal must travel over 1000 feet, its frequency should be less than 1000 Hz.			X
1.3.11-19	**High or Unknown Noise Environments**			
	When the noise environment is unknown or expected to be difficult to penetrate, audio signals should have a shifting frequency that passes through the entire noise spectrum and/or be combined with a visual signal.			X
1.3.11-20	**Masking**			
	Audio warning signals should not interfere with any other critical functions or warning signals, or mask any other critical audio signals.			X
1.3.11-21	**Failure of Auditory Signals**			
	The audio display device and circuit should be designed to preclude warning signal failure in the event of system or equipment failure and vice versa.	X		

Guideline #	Review Criteria	Yes	No	N/A
1.3.11-22	**False Alarms**			
	Auditory alarm systems should be designed so that false alarms are avoided.	X		
1.3.11-23	**Distinctive Coding**			
	Coding methods should be distinct and unambiguous, and should not conflict with other auditory signals.	X		
1.3.11-24	**Not Contradictory**			
	Similar auditory signals must not be contradictory in meaning with one another.			X
1.3.11-25	**Pulse Coding**			
	Auditory signals may be pulse coded by repetition rate. Repetition rates should be sufficiently separated to ensure discrimination.			X
1.3.11-26	**Frequency Change Coding**			
	If modulation of the frequency (Hz) of a signal denotes information, center frequencies should be between 500 and 1000 Hz.			X
1.3.11-27	**Discrete Frequency Coding**			
	If discrete-frequency codes are used for audible signal coding, frequencies should be broad band and widely spaced within the 200 to 5000 Hz range (preferably between 500 and 3000 Hz).			X
1.3.11-28	**Coding by Intensity**			
	Using the intensity of a sound to convey information is not recommended.	X		
1.3.11-29	**Testing**			
	It should be possible to test the auditory signal system.	X		
1.4	**Data Quality and Update Rate**			
1.4-1	**Display Update Rate Requirements**			
	The maximum update rate should be determined by the time required for the user to identify and process the changed feature of the display.			X
1.4-2	**User Control of Display Update Rate**			
	The user should be capable of controlling the rate of information update on the display, but the allowable rate should not exceed that capable of being met by the information source and the processing equipment.			X
1.4-3	**Changing Values**			
	Changing alphanumeric values that the user must reliably read should not be updated more often than once per second.			X
1.4-4	**Initial Erasure to Replace Changed Data**			
	When the computer generates a display to update changed data, the old items should be erased before adding new data items to the display.			X
1.4-5	**Display Motion**			
	Items on a graphic display should not move faster than 60 degrees of visual angle per second, with 20 degrees per second preferred.			X
1.4-6	**Data Sampling Rate**			
	The sampling rate for each critical plant variable should result in no meaningful loss of information in the data presented.			X

Guideline #	Review Criteria	Yes	No	N/A
1.4-7	**Time Delay**			
	The time delay from when the sensor signal is sampled to when it is displayed should be consistent with the user's task performance requirements.			X
1.4-8	**Accuracy**			
	Each variable should be displayed with an accuracy sufficient for the users to perform their tasks.			X
1.4-9	**Invalid Data**			
	Variables that are subject to validation (e.g., checks for accuracy) should be identified and an indication should be provided when these data are invalid.			X
1.4-10	**Unvalidated Data**			
	When checks for accuracy could not be performed, the unvalidated status of the data should be clearly indicated.			X
1.4-11	**Data Entered by Personnel**			
	Data entered by personnel should be identified such that it is easily distinguished from sensor data or validated data.			X
1.5	**Display Pages**			
1.5-1	**Display Screen Partitioning for HSI Functions**			
	A standard display screen organization should be evident for the location of various HSI functions (such as a data display zone, control zone, or message zone) from one display to another.			X
1.5-2	**Distinctive HSI Functional Organization and Display Elements**			
	The HSI functional zones and display features should be visually distinctive from one another, especially for on-screen command and control elements (which should be visibly distinct from all other screen structures).			X
1.5-3	**Display Title**			
	Every display should begin with a title or header at the top, briefly describing the contents or purpose of the display.			X
1.5-4	**Display Identification**			
	Every display page should have a unique identification to provide a reference for use in requesting the display of that page.			X
1.5-5	**Hierarchy of Titles**			
	Where displays have several levels of titles (and/or labels), the system should provide visual cues to aid users in distinguishing among the levels in the hierarchy.			X
1.5-6	**Display Simplicity**			
	Displays should present the simplest information consistent with their function; information irrelevant to the task should not be displayed, and extraneous text and graphics should not be present.			X
1.5-7	**Redundancy**			
	Redundancy in the presentation of information items should be limited to cases where needed for backup or to avoid excessive movement.			X

Guideline #	Review Criteria	Yes	No	N/A
1.5-8	**Uncluttered Displays**			
	Displays should be as uncluttered as possible.			X
1.5-9	**Task-Related Partitioning of Displays**			
	When displays are partitioned into multiple pages, function/task-related data items should be displayed together on one page.			X
1.5-10	**Numbering Pages of Multipage Displays**			
	Users working with multipage displays should be provided with a page location reference within the display sequence.			X
1.5-11	**Display Frame Location Cues**			
	Users viewing a portion of a larger display should be provided with an indication of the location of the visible position of a display (frame) in the overall display.			X
1.5-12	**Grouping of Information in a Display**			
	Information on a display should be grouped according to principles obvious to the user, e.g., by task, system, function, or sequence, based upon the user's requirements in performance of the ongoing task (see Table 1.5).			X
1.5-13	**Demarcation of Groups**			
	When information is grouped on a display, the groups should be made visually distinct by such means as color coding or separation using blanks or demarcation lines.			X
1.5-14	**Display Background Color**			
	A uniform nondistracting background color should be used with a hue/contrast that allows the data (foreground) to be easily visible and which does not distort or interfere with the coding aspects of the display.			X
1.5-15	**Labeling Scrollable and Multipage Displays**			
	General labels and row/column labels should remain along the top (or bottom) and left (or right) edges of the display.			X
1.5-16	**Data Overlays**			
	Displayed information which temporarily overlays and obscures other display data should not erase the overlaid data.			X
1.6	**Display Devices**			
1.6.1	**Video Display Units**			
1.6.1-1	**VDU Resolution**			
	The display should have adequate resolution; i.e., users should be able to discriminate all display elements and codes from maximum viewing distance.			X
1.6.1-2	**VDU Contrast**			
	The contrast ratio of the display should be greater than 3:1; a contrast ratio of 7:1 is preferred.			X
1.6.1-3	**Flicker**			
	The display should be 'flicker free.'			X
1.6.1-4	**Geometric stability**			
	The display should be free of 'jitter.'			X

Guideline #	Review Criteria	Yes	No	N/A
1.6.1-5	**Image Continuity**			
	The display should maintain the illusion of a continuous image, i.e., users should not be able to resolve scan lines or matrix spots.			X
1.6.1-6	**VDU Image Linearity**			
	The display should be free of geometric distortion.			X
1.6.1-7	**VDU Display Luminance**			
	The display should have adequate luminance.			X
1.6.1-8	**Luminance Uniformity**			
	All luminances that are supposed to be the same should appear the same.			X
1.6.1-9	**VDU Controls**			
	Frequently used controls should be easily visible and accessible to the VDU user from the normal working position.			X
1.6.1-10	**VDU Luminance Control**			
	A control to vary the VDU luminance from 10 percent of minimum ambient luminance to full luminance should be provided.			X
1.6.1-11	**Display Devices for Reducing Interface Management Demands**			
	The number of display devices provided in the HSI should be sufficient to maintain interface management demands at a level that does not impair user performance			X
1.6.1-12	**Display Devices for Concurrent Tasks**			
	The number of display devices provided in the HSI should be sufficient to support all tasks that must be performed concurrently by each user.			X
1.6.2	**Projectors**			
1.6.2-1	**Resolution**			
	Users should be able to resolve all important display detail at the maximum viewing position.			X
1.6.2-2	**Size of Characters**			
	The height of letters and numerals should not subtend less than 15 minutes of visual angle as measured at the maximum viewing distance.			X
1.6.2-3	**Superposed Characters**			
	The contrast polarity of superposed characters should be appropriate for the method of projection.			X
1.6.2-4	**Projected Display Luminance Ratio**			
	The luminance ratio provided by the projection system should be adequate for the type of material being projected.			X
1.6.2-5	**Projected Display Image Luminance**			
	Image luminance and light distribution should be uniform. The luminance of the screen center at maximum viewing angle should be at least half its maximum luminance.			X
1.6.2-6	**Minimize Keystone Effects**			
	If projected displays are used, projector and screen should be arranged so as to minimize 'keystone effect,' i.e., distortion of projected data proportions due to non-perpendicularity between projector and screen.			X

Guideline #	Review Criteria	Yes	No	N/A
1.6.3	**Printers, Recorders, and Plotters**			
1.6.3-1	**Placement of Printers**			
	Printers should be located within the main operating area because they must be verified and attended by the user.			X
1.6.3-2	**Legibility**			
	Print output should be free from character line misregistration, character tilt, smear, or glare.			X
1.6.3-3	**Contrast**			
	A minimum contrast ratio of 4:1 should be provided between the printed material and the background on which it is printed.			X
1.6.3-4	**Illumination**			
	The printer should be provided with internal illumination if the printed matter is not legible in the planned operational ambient illumination.			X
1.6.3-5	**Visibility**			
	When used for real-time applications, the printed matter should not be hidden, masked or obscured in a manner that impairs direct reading.			X
1.6.3-6	**User Annotation Capability**			
	Recording devices used in real-time applications should allow users to write on or mark the printed matter while it is still in the printer or plotter.			X
1.6.3-7	**Take-up Provision**			
	A take-up device should be provided for printed material.			X
1.6.3-8	**Indication of Supply of Materials**			
	A positive indication should be provided of the remaining supply of printing materials (e.g., paper, toner, and ribbons).			X
1.6.3-9	**Quality of Expendable Materials**			
	Pens, inks, and paper should be of a quality to provide clear, distinct, and reliable marking.			X
1.6.3-10	**Availability of Expendable Material**			
	Paper, ink, and other user-maintained expendables should be provided and accessible in the control room.			X
1.6.3-11	**Ease of Routine Replenishment**			
	Printer design should permit quick and easy replenishment of paper, toner, ribbons, or ink.			X
1.6.3-12	**Smudging/Smearing**			
	The hardcopy should be resistant to smudging or smearing when handled by users.			X
1.6.3-13	**Job Aids**			
	Graphic overlays should be provided where these may be critical to proper interpretation of graphic data as it is being generated.			X
1.6.3-14	**Scale Design**			
	Plotter scales should be numbered and marked according to the principles of display design and scale marking given in Sections 1.1, General Display Guidelines, and 1.3.6, Scales, Axes, and Grids.			X

Guideline #	Review Criteria	Yes	No	N/A
1.6.3-15	**Scale Compatibility**			
	Scales printed on the recording paper should be the same as the scales shown on the recorder.			X
1.6.3-16	**Tearing-Off Continuous Recordings**			
	It should be easy for users to tear off records printed on rolled paper.			X
1.6.3-17	**Paper-Speed Adjustability**			
	Provide a high paper-speed option to run out records for detachment and a selection of lower speed options to permit adjustment of the time scale so that rate-of-change information can be indicated.			X
1.6.3-18	**Labeling**			
	Labels should identify the parameters recorded.			X
1.6.3-19	**Ink Colors**			
	Each pen should use a different colored ink to permit channel identification.			X
1.6.3-20	**Channel Overload**			
	The recorder should not be loaded beyond its designed channel capacity because this adds complexity to the analysis and prolongs sampling cycle time.			X
1.6.3-21	**Channel Identification on Instrument**			
	Discrete recorders should be equipped to display the channel being plotted in an easily viewed manner.			X
1.6.3-22	**Channel Identification on Recording**			
	Number-printing mechanisms should be designed and maintained to provide clear, sharp, and small numbering to avoid crowding of data and consequent analysis problems.			X
1.6.3-23	**Channel Selection Capability**			
	Provisions should be made to select any single channel for immediate display without awaiting completion of a sampling cycle.			X
1.6.4	**Meters**			
1.6.4-1	**Circular Scales**			
	Scale values should increase with clockwise movement of the pointer.			X
1.6.4-2	**Vertical Straight Scales**			
	Scale values should increase with upward movement of the pointer.			X
1.6.4-3	**Horizontal Straight Scales**			
	Scale values should increase with pointer movement to the right.			X
1.6.4-4	**Pointer Tip Form**			
	Pointer tips should be simple.			X
1.6.4-5	**Pointer Positioning Relative to Scale**			
	Pointer tip should extend to within about 1/16 inch of (but not overlap) the smallest graduation marks on the scale.			X
1.6.4-6	**Pointer Visibility**			
	Pointer/background contrast and pointer size should be adequate to permit rapid recognition of pointer position.			X

Guideline #	Review Criteria	Yes	No	N/A
1.6.4-7	**Zone Markings**			
	Zone markings should be conspicuous and distinctively different for different zones (see Figure 1.10).			X
1.6.4-8	**Consistency**			
	To facilitate reading of meters and prevent misreading, the orientation of scale markings should be consistent.			X
1.6.4-9	**Numerical Orientation**			
	Individual numerals on any type of fixed scale should be vertical.			X
1.6.4-10	**Zero-Point Orientation**			
	Where pointer movement is more than 360 degrees, the zero point should be located at the 12 o'clock position.			X
1.6.4-11	**End-Point Indication on Partial-Revolution Scales**			
	Where the scale covers less than a full rotation of the pointer, scale end-points should be indicated by a break in scale.			X
1.6.4-12	**Moving-Scale Meters Versus Fixed-Scale Moving-Pointer Types**			
	Moving-scale fixed-pointer meters should be avoided in favor of the more effective fixed-scale moving- pointer types.			X
1.6.5	**Light Indicators**			
1.6.5-1	**Precautions to Assure Availability**			
	Dual-bulb or dual-filament light assemblies should be used.	X		
1.6.5-2	**Unambiguous Light Status**			
	Lights should not appear to be energized when they are off, or vice versa.	X		
1.6.5-3	**Positive Status Indication**			
	System/equipment status should be conveyed by illuminated indicators, and never by the absence of illumination.			X
1.6.5-4	**Use as Alerting Indicators**			
	Alerting the users to unfavorable status should be a function of the alarm system and not assigned to light indicators.			X
1.6.5-5	**Identification of Meaning**			
	Where the meaning of a light indicator is not apparent, labeling should be provided close to the indicator showing the condition that the light represents.			X
1.6.5-6	**Light Intensity**			
	The illuminated indicator should be at least 10 percent greater in light intensity than the surrounding panel as measured by a spot photometer.			X
1.6.5-7	**Visibility of Light Indicators**			
	When using legend light indicators, make sure contrast and ambient/transilluminated conditions are considered.			X
1.6.5-8	**Legend Design**			
	General legend design should be consistent throughout the control room.			X
1.6.5-9	**Distinguishability from Legend Pushbuttons**			
	Illuminated legend indicators should be readily distinguishable from legend pushbuttons by form, size, or other factors.			X

Guideline #	Review Criteria	Yes	No	N/A
1.6.5-10	**Color Coding**			
	The color of the legend background under transillumination should be clearly identifiable and should conform to the general color code established for the control room.			X
1.6.5-11	**Replacing Indicator Lenses**			
	Provisions should be made to prevent interchanging indicator lenses.			X
1.6.3	**Numeric Readouts**			
1.6.6-1	**Orientation**			
	Multi-digit numbers formed by several elements (e.g., drums and LED arrays) should be read horizontally from left to right.			X
1.6.6-2	**Width-to-Height Ratio in Drum Displays**			
	To compensate for the distortion imposed by the curved surface of the drum, counter numerals should reflect a width-height ratio of 1:1.			X
1.6.6-3	**Grouping of Numerals**			
	If more than four digits are required, they should be grouped and the groupings separated as appropriate by commas, by a decimal point, or by additional space.			X
1.6.6-4	**Display of Changing Values**			
	Numerals should not follow each other faster than one per second when the user is expected to read the numerals consecutively.			X
2.0	**USER-INTERFACE INTERACTION AND MANAGEMENT**			
2.1	**General User Input Guidelines**			
2.1-1	**Selection of Dialogue Types**			
	The selection of dialogue types should be based on anticipated task requirements, user skills, and anticipated system response time.			X
2.1-2	**Consistent Procedures**			
	Procedures for entering commands or information should be consistent in form and consequences.	X		
2.1-3	**Consistent Wording of Commands**			
	All terms employed in the user-system interface, and their abbreviations, should be consistent in meaning from one transaction to another, and from one task to another.			X
2.1-4	**Wording Consistent with User Guidance**			
	The wording and required format of information or command entry functions should be consistently reflected in the wording of user guidance, including all operating procedures, labels, messages, and training material.			X
2.1-5	**Minimal Demands on the User**			
	Entry of information or commands should not require the user to remember special codes or sequences or to perform translations or conversions.			X
2.1-6	**Minimal User Actions**			
	User input actions should be simple, particularly for real-time tasks requiring fast user response.			X

Guideline #	Review Criteria	Yes	No	N/A
2.1-7	**Unnecessary Entry of Information**			
	A user should not be required to re-enter information already available to the system.			X
2.1-8	**Availability of Information**			
	Information necessary to accomplish a specific entry (e.g., labels, annotations, prompts, or options lists) should be available to the user when that transaction action is appropriate.			X
2.1-9	**Logical Transaction Sequences**			
	An information entry sequence should be designed so that its organization reflects the user's view of the task, and should provide all control options that may be required.			X
2.1-10	**Flexible User Entry**			
	Flexible means of entering information or commands should be provided so that users can accomplish necessary transactions, and can obtain guidance as needed in connection with any transaction.			X
2.1-11	**Control by Explicit User Action**			
	Users should be allowed to control the processing of information or commands by explicit action.			X
2.1-12	**Compatibility with User Expectations**			
	The results of any entry should be compatible with user expectations, so that the system changes in a 'natural' way in response to user actions.			X
2.1-13	**Feedback for User Entries**			
	The computer should acknowledge every entry immediately.			X
2.1-14	**Periodic Feedback**			
	When system functioning requires the user to stand-by, periodic feedback should be provided to indicate normal system operation.			X
2.1-15	**Indicating Completion of Processing**			
	When processing in response to an entry is lengthy, the user should be given some positive indication of subsequent completion.			X
2.1-16	**Indicating Control Lockout**			
	If entries must be delayed pending computer processing of prior entries, the delay should be indicated to the user.			X
2.1-17	**Interrupt to End Control Lockout**			
	In situations where control lockout does occur, an auxiliary means of control entry should be provided, such as a special function key, to abort a transaction causing extended lockout.			X
2.1-18	**Entry via Principal Display**			
	When data entry is a significant part of a user's task, entered data should appear on the user's main display.			X
2.1-19	**Entry of Corrections**			
	The same explicit ENTER action should be required for entry of corrections as used for the original entry.			X

Guideline #	Review Criteria	Yes	No	N/A
2.1-20	**Editing Capabilities During Text Entry**			
	Users should be able to perform simple editing during text entry without having to invoke a separate edit mode.			X
2.1-21	**Entries Distinct from Text**			
	If entries are made by keying onto the display, such as by keyed menu selections or commands, they should be distinguishable from displayed text.			X
2.1-22	**Variable Length Data Area**			
	Users should not have to remove unused underscores or otherwise enter keystrokes for each position within a variable length entry area.			X
2.1-23	**Optional Versus Required Entry**			
	Optional versus required data entries within fields on input forms should be distinct.			X
2.1-24	**Display of User Annotations**			
	Annotations added by users to displayed text should be distinguishable from the text itself.			X
2.1-25	**Flexible Interaction Design**			
	When information or command entry requirements may change, some means for the user (or a system administrator) to make necessary changes to available functions should be provided.			X
2.1-26	**Guidance Information**			
	Users should be able to request guidance information regarding requirements for information of command entry (e.g., syntax, parameters, and options).			X
2.1-27	**Entry Procedures Matched to User Skill**			
	The means of entering information or commands should be compatible with user skills, permitting simple step-by-step actions by beginners, but permitting more complex entries by experienced users.			X
2.1-28	**Stacked Entries**			
	Users should be allowed to key a sequence of commands or option codes as a single 'stacked' entry.			X
2.1-29	**Consistent Order in Entry Stacking**			
	For control entry stacking, entries should be required to be in the same order as they would normally be made in a succession of separate control entry actions.			X
2.1-30	**Abbreviation in Entry Stacking**			
	For control entry stacking, command names, their abbreviations, or option codes should be accepted just as if those control entries had been made separately.			X
2.1-31	**Minimal Punctuation of Stacked Entries**			
	Users should be allowed to stack control entries without any punctuation other than spaces between words or option codes.			X

Guideline #	Review Criteria	Yes	No	N/A
2.1-32	**Standard Delimiter in Entry Stacking**			
	If punctuation other than spaces is needed to separate entries in a stacked control entry, a single standard symbol should be used for that purpose.			X
2.1-33	**Distinctive Display of Control Information**			
	All displays should be designed so that features relevant to user entries are distinctive in position and/or format.			X
2.1-34	**Displayed Context**			
	If the consequences of a user entry will differ depending upon context established by a prior action, then some continuous indication of current context should be displayed for reference by the user.			X
2.1-35	**Consistent Display of Context Information**			
	Information displayed to provide context for user entries should be distinctive in location and format, and consistently displayed from one transaction to the next.			X
2.1-36	**Record of Prior Entries**			
	Users should be permitted to request a summary of prior entries to help determine present status, and should be allowed to review the parameters currently in effect.			X
2.1-37	**Standard Display Area for Command Entry**			
	A command entry area in a consistent location should be provided on every display, preferably at the bottom.			X
2.1-38	**General List of Options**			
	A general list of basic options should be provided and always be available to serve as a 'home base' or consistent starting point for user input.			X
2.1-39	**Displaying Option Codes**			
	When users must select options by code entry, the code associated with each option should be displayed in a consistent and distinctive manner.			X
2.1-40	**Organization and Labeling of Listed Options**			
	The general options list should show control entry options grouped, labeled, and ordered in terms of their logical function, frequency, and criticality of use, following the general guidelines for menu design.			X
2.1-41	**Indicating Appropriate Control Options**			
	Users should be provided with a list of the control options that are specifically appropriate for any transaction.			X
2.1-42	**Only Available Options Offered**			
	Only control options that are actually available for the current transaction should be offered to users.			X
2.1-43	**Provide Further Available Action**			
	Transactions should never leave the user without further available action and should provide next steps or alternatives.			X

Guideline #	Review Criteria	Yes	No	N/A
2.1-44	**Prompting Command Entries**			
	Users should be provided with whatever information may be needed to guide command entries at any point in a sequence of transactions, by incorporating prompts in a display and/or by providing prompts in response to requests for HELP.			X
2.1-45	**Control by Simultaneous Users**			
	When several users must interact with the system simultaneously, control entries by one user should not interfere with those of another.			X
2.1-46	**Highlighting Selected Data**			
	When a user is performing an operation on some selected display item, that item should be highlighted.			X
2.1-47	**User Control of Processing**			
	Users should be allowed to control processing of a command or request.			X
2.1-48	**Distinctive Interrupt Options**			
	If different kinds of user interrupt are provided, each interrupt function should be designed as a separate control option with a distinct name.			X
2.1-49	**User Transaction Interrupts**			
	User interrupts and aborts should not modify or remove stored or entered data.			X
2.1-50	**User Control of Entry**			
	Users should be allowed to control the pace and sequence of their entry of information or commands.			X
2.1-51	**User-Specified Transaction Timing**			
	When appropriate to task requirements, users should be allowed to specify the timing of transactions.			X
2.1-52	**Indicating PAUSE/SUSPEND Status**			
	If PAUSE or SUSPEND options are provided, some indication of the status should be displayed whenever such an option is selected by a user.			X
2.1-53	**Consistent CONTINUE Option**			
	At any step in a defined transaction sequence, if there is only a single appropriate next step, then a consistent control option to continue to the next transaction should be provided.			X
2.1-54	**Data Manipulation**			
	The user should be able to manipulate information without concern for internal storage and retrieval mechanisms of the system.			X
2.1-55	**Default Values**			
	When likely default values can be defined for the information to be entered in a particular task, those default values should be offered to speed entry.			X
2.1-56	**Display of Default Values**			
	At the start of an input transaction, currently defined default values should be displayed in their appropriate data fields.			X

Guideline #	Review Criteria	Yes	No	N/A
2.1-57	**Easy Confirmation to Enter Default Values**			
	Users should be provided with some simple means to confirm acceptance of a displayed default value.			X
2.1-58	**User Definition of Default Values**			
	Users should be permitted to define, change, or remove default values for any input field.			X
2.1-59	**Indicating Control Defaults**			
	When keyed command or option code entries are used and a default is defined for a null control entry, the default should be indicated to the user.			X
2.1-60	**Single Method for Input**			
	Input transactions and associated displays should be designed so that a user can stay with one method of entry, and not have to shift to another.			X
2.1-61	**Upper and Lower Case Equivalent**			
	For interpreting user-composed control entries, upper and lower case letters should be treated as equivalent.			X
2.1-62	**Justification of Entries**			
	Unless otherwise required by processing or display requirements, alphabetic input should be left justified, and numeric input should be right justified for integer data or decimal point justified for decimal data.			X
2.1-63	**Automatic Justification of Entries**			
	Automatic justification of tabular data entries should be provided.			X
2.1-64	**Maintaining Significant Zeros**			
	When a user must enter numeric values that will later be displayed, all significant zeros should be maintained.			X
2.1-65	**Significance of Numeric Values**			
	Numeric values should be displayed to the level of significance required of the data, regardless of the value of individual input data.			X
2.1-66	**Overwriting Characters**			
	Data entry by overwriting a set of characters within a field should be avoided.			X
2.1-67	**Consistent Location of Interface Management Controls**			
	Controls used for interface management tasks should have consistent locations.			X
2.1-68	**Location of Display Page Navigation Controls**			
	Controls for navigating within a display page should be separate from the main body of the display screen.			X
2.1-69	**Set-Up of Computer-Based Systems**			
	Preset and automated set-up features should be used to ensure that users do not have to perform these functions while operating the plant.			X
2.1-70	**Reminders for Interrupted Tasks**			
	The HSI should provide visual and/or auditory reminders for interrupted tasks.			X

Guideline #	Review Criteria	Yes	No	N/A
2.1-71	**Access to Suspended Tasks**			
	The HSI should provide simple mechanisms for retrieving displays and controls for tasks that have been suspended.			X
2.1-72	**Entry of Data Separators and Delimiters**			
	The user should not be required to enter data separators or delimiters, such as dashes and slashes.			X
2.1-73	**Entry of Measurement Units**			
	The user should not be required to enter units of measure.			X
2.1-74	**Minimize Cursor Travel**			
	Travel distance for cursors across and between display pages and windows on a display screen should be minimized.			X
2.1-75	**Default Configuration for Decluttering**			
	Displays that can provide decluttering capabilities should also provide a means for the user to rapidly return the display to its original configuration.			X
2.2.1	**Command Language**			
2.2.1-1	**Layered Command Language**			
	A command language should be designed so that its functions are organized in groups (or "layers") for ease in learning and use.			X
2.2.1-2	**General List of Commands**			
	A general list of basic commands, with appropriate command format guidance, should be available to the user.			X
2.2.1-3	**Distinctive Meaning for Commands**			
	Words in a command language should be distinctive from one another, and emphasize significant differences in function.			X
2.2.1-4	**Distinctive Spelling for Commands**			
	Words and abbreviations in a command language should have distinctive spelling, so that simple spelling errors will be recognized as such rather than invoking a different command.			X
2.2.1-5	**Abbreviation of Commands**			
	Users should be allowed to abbreviate commands.			X
2.2.1-6	**Recognizing Command Synonyms**			
	The computer should recognize a variety of synonyms for each word defined in the command language.			X
2.2.1-7	**Interpreting Misspelled Commands**			
	Where the set of potential command entries is well defined, the computer should recognize and execute common misspellings of commands, rather than requiring re-entry.			X
2.2.1-8	**Recognizing Alternative Syntax**			
	The computer should recognize probable alternative forms of command syntax.			X
2.2.1-9	**User-Assigned Command Names**			
	A command language should have flexibility to permit a user to assign personal names to frequently used commands.			X

Guideline #	Review Criteria	Yes	No	N/A
2.2.1-10	**User-Requested Prompts**			
	Users should be allowed to request computer-generated prompts as necessary to determine required parameters in a command entry, or to determine available options for an appropriate next command.			X
2.2.1-11	**Minimal Punctuation**			
	Users should be allowed to enter commands without any punctuation other than the spaces between words.			X
2.2.1-12	**Ignoring Blanks in Command Entry**			
	Single and multiple blanks between words should be treated as equivalent when processing command entries.			X
2.2.1-13	**Standard Delimiter**			
	If command punctuation other than spaces is required, a single standard delimiter symbol should be used for that purpose.			X
2.2.1-14	**Illustrations in Guidance Information**			
	Where possible, guidance information should be accompanied with graphical illustrations of command content and syntax.			X
2.2.1-15	**User-Defined Abbreviations and Aliases**			
	Experienced users should be able to define abbreviations or aliases for commands.			X
2.2.1-16	**Aiding Command Recall**			
	The system should provide features that support users in recalling command names.			X
2.2.1-17	**Accepting Minor Variations**			
	The system should tolerate minor variations in input commands for interface management functions.			X
2.2.2.1	**General**			
2.2.2.1-1	**Explicit Option Display**			
	When control entries for any particular transaction will be selected from a small set of options, those options should be displayed in a menu added to the working display, rather than requiring a user to remember them or to access a separate menu display.			X
2.2.2.1-2	**Consistent Display of Menu Options**			
	When menus are provided in different displays, they should be designed so that option lists are consistent in wording and ordering.			X
2.2.2.1-3	**Consistent Location for Menus**			
	Menus should be displayed in consistent screen locations for all modes, transactions, and sequences.			X
2.2.2.1-4	**Consistent Entry Prompt**			
	When permanent menus are used, there should be one standard design for the input prompt that is used across all tasks.			X
2.2.2.1-5	**Permanent Menus Minimized**			
	The use of permanent menus should be minimized.			X

Guideline #	Review Criteria	Yes	No	N/A
2.2.2.1-6	**Activation of Pull-Down and Pop-Up Menus**			
	Pull-down and pop-up menus should be activated only by a specific user action that requests the display of the menu.			X
2.2.2.1-7	**User Requested Menus: Pull-Downs and Pop-Ups**			
	User requested menus should be used whenever possible.			X
2.2.2.1-8	**Hiding Menus After a Command is Carried Out**			
	When a pull-down or pop-up menu item(s) has/have been selected, the menu should revert to its hidden state as the selected command is carried out.			X
2.2.2.1-9	**Programmable Keys**			
	If menu items are selectable via activation of programmable function keys, the arrangement of the menu list should be compatible with the arrangement of the keys to the greatest degree possible.			X
2.2.2.1-10	**Explanatory Title for Menu**			
	An explanatory title should be provided for each menu that reflects the nature of the choice to be made.			X
2.2.2.1-11	**Complete Display of Menu Options**			
	A menu should be designed to display all options appropriate to any particular transaction.			X
2.2.2.1-12	**Option Display Dependent on Context**			
	Menus should display as selectable only those options that are actually available in the current context.			X
2.2.2.1-13	**Function of Menu Should Be Evident**			
	Menus should be designed so that the function of the menu is evident to the user.			X
2.2.2.1-14	**Menus Distinct from Other Displayed Information**			
	If menu options are included in a display that is intended also for data review and/or data entry, the menu options should be distinct from other displayed information.			X
2.2.2.1-15	**Breadth and Depth of Menu Items**			
	Menus should have a limited number of items in breadth and in depth.			X
2.2.2.1-16	**Number of Options**			
	Each menu option list should have 4 to 8 options.			X
2.2.2.1-17	**Equivalent Keyboard Commands**			
	When equivalent keyboard commands are provided, they should be displayed as part of the menu option label.			X
2.2.2.1-18	**Continuous Presentation of Menu**			
	If continual or frequent reference to menu options is necessary, then the menu should be permanently presented in an area of the screen where it will not obscure other data.			X
2.2.2.1-19	**Providing Default Options**			
	If one option on a menu is selected more often than the others, then it should be highlighted.			X

Guideline #	Review Criteria	Yes	No	N/A
2.2.2.1-20	**Option Previews**			
	Where discrimination among options may be difficult for users, menus can provide a preview of options.			X
2.2.2.1-21	**Visual Grouping of Menu Options**			
	If meaningful categories cannot be developed for menu options then visual groups should be created for long menus.			X
2.2.2.1-22	**Critical or Frequently Chosen Options**			
	Options that are critical or frequently chosen should be quickly accessible using as few steps as possible.			X
2.2.2.1-23	**Initial Cursor Position**			
	When a menu is first displayed, the cursor should be positioned so that it may be readily located and used.			X
2.2.2.1-24	**Menu Macro Capability**			
	A menu macro capability should be provided if it produces faster access.			X
2.2.2.1-25	**Use of Multiple Paths**			
	Multiple navigation paths should be provided to items in the display system.			X
2.2.2.1-26	**Representation of Menu Structure**			
	A visual representation of the menu structure should be provided.			X
2.2.2.1-27	**Indicating Selectable Menu Items**			
	Menu systems should clearly indicate which options are selectable.			X
2.2.2.2	**Arrangement of Menu Options**			
2.2.2.2-1	**Logical Ordering of Menu Options**			
	Menu options should be ordered and grouped logically.			X
2.2.2.2-2	**Default Ordering of Menu Options**			
	Where ordering cannot be determined by the above, alphabetic ordering should be used.			X
2.2.2.2-3	**No Scrolling in Menus or Menu Bars**			
	All menu items should be visible to the user without scrolling.			X
2.2.2.2-4	**Single-Column List Format**			
	When multiple menu options are displayed in a list, each option should be displayed on a new line, i.e., format the list as a single column.			X
2.2.2.2-5	**Fixed Menu Order**			
	The order of options on menus should be fixed.			X
2.2.2.3	**Hierarchical Menus**			
2.2.2.3-1	**Labeling Grouped Options**			
	If menu options are grouped in logical subunits, each group should have a descriptive label that is distinctive in format from the option labels themselves.			X
2.2.2.3-2	**Hierarchic Menus for Sequential Selection**			
	When menu selection must be made from a long list, and not all options can be displayed at once, a hierarchic sequence of menu selections should be provided rather than one long multipage menu.			X

Guideline #	Review Criteria	Yes	No	N/A
2.2.2.3-3	**Consistent Design of Hierarchic Menus**			
	The display format and selection logic of hierarchic menus should be consistent at every level.			X
2.2.2.3-4	**Labeling in Hierarchic Menus**			
	Hierarchic menus should be organized and labeled to guide users within the hierarchic structure.			X
2.2.2.3-5	**Visual Representation of Path**			
	Users should be able to access a visual representation of their paths through a hierarchy of menus.			X
2.2.2.3-6	**Minimal Steps in Sequential Menu Selection**			
	When users must step through a sequence of menus to make a selection, the hierarchic menu structure should be designed to minimize the number of steps required.			X
2.2.2.3-7	**Return to Higher-Level Menus**			
	Users should have to take only one simple key action to return to the next higher level in hierarchic menus.			X
2.2.2.3-8	**Indicating Current Position in Menu Structure**			
	When hierarchic menus are used, the user should have some indication of current position in the menu structure.			X
2.2.2.3-9	**Distinct Subordinate Menus**			
	If hierarchical branching is used, each subordinate menu should be visually distinct from each previous superordinate menu.			X
2.2.2.3-10	**Control Options Distinct from Menu Branching**			
	The display of hierarchic menus should be formatted so that options that actually accomplish control entries can be distinguished from options, which merely branch to other menu frames.			X
2.2.2.3-11	**Return to General Menu**			
	Users should have to take only one simple key action to return to the general menu at the top level in hierarchic menus.			X
2.2.2.3-12	**Use of Broad, Shallow Menu Structures**			
	Broad and shallow menu structures, rather than narrow and deep menu structures should be used.			X
2.2.2.3-13	**Minimizing Menu Choices In the Middle of a Menu Structure**			
	The number of menu choices should be minimized on menus located midway in a hierarchical menu structure.			X
2.2.2.3-14	**Direct Selection of Submenus**			
	Users should be able to select a menu or submenu directly, without going through intermediate selection steps.			X
2.2.2.4	**Menu Bars**			
2.2.2.4-1	**Systematic Organization of Items on Menu Bar**			
	The categories listed across the menu bar should be organized systematically.			X

Guideline #	Review Criteria	Yes	No	N/A
2.2.2.4-2	**Category Labels on Menu Bar**			
	Category labels on menu bars should be centered in the vertical dimension. Horizontally, category labels on the menu bar should be separated by enough space to be distinguishable as separate items, i.e., by at least two standard character widths.			X
2.2.2.4-3	**Height of Menu Bar**			
	The height of a menu bar should be sufficient to contain standard text characters that serve as menu category labels, as well as space above and below the text characters.			X
2.2.2.5	**Selection of Menu Options**			
2.2.2.5-1	**Menu Selection by Keyed Entry**			
	When menu selection is a secondary (occasional) means of control entry, and/or only short option lists are needed, then selection by keyed entry should be provided.			X
2.2.2.5-2	**Standard Area for Code Entry**			
	When menu selection is accomplished by code entry, a standard command entry area (window) should be provided where users enter the selected code.			X
2.2.2.5-3	**Stacking Menu Selections**			
	Users should be able to combine a series of selections into a single "stacked" entry.			X
2.2.2.5-4	**Bypassing Menu Selection with Command Entry**			
	Experienced users should be able to bypass a series of menu selections and make an equivalent command entry directly.			X
2.2.2.5-5	**Menu Selection by Pointing**			
	When menu selection is the primary means of command entry, and especially if choices must be made from extensive lists of displayed control options, option selection by direct pointing should be provided.			X
2.2.2.5-6	**Acknowledgment of Menu Selection**			
	When a menu item is chosen, the system should display some acknowledgment of that entry.			X
2.2.2.5-7	**Non-Selection of Conflicting Menu Items**			
	Users should not be able to select menu items that are in conflict.			X
2.2.2.5-8	**Non-Selectable Menu Items**			
	When menu items are not selectable, they should be identified as such to the user.			X
2.2.2.5-9	**Separate Selection and Activation Actions**			
	If menu selection is accomplished by pointing, dual activation should be provided, in which the first action designates the selected option, followed by a separate second action that makes an explicit control entry.			X

Guideline #	Review Criteria	Yes	No	N/A
2.2.2.5-10	**Large Pointing Area for Option Selection**			
	If menu selection is accomplished by pointing, the acceptable area for pointing should be as large as consistently possible, including at least the area of the displayed option label plus a half-character distance around that label.			X
2.2.2.5-11	**Selection of ON/OFF Items**			
	Selection of menu items with "On" and "Off" states should change their state.			X
2.2.2.5-12	**Indicating Selected Menu Items**			
	Menu systems should provide feedback indicating which options have been selected so far.			X
2.2.2.5-13	**Indicating Selectable Area**			
	Menu systems should provide feedback indicating when a pointing device has entered the selectable area of an option.			X
2.2.2.5-14	**Indicating Completion of Selection**			
	Menu systems should provide feedback indicating when the selection process is ended.			X
2.2.2.6	**Wording and Coding Menu Options**			
2.2.2.6-1	**Menu Options Worded as Commands**			
	The wording of menu options should consistently represent commands to the computer, rather than questions to the user.			X
2.2.2.6-2	**Option Wording Consistent with Command Language**			
	If menu selection is used in conjunction with or as an alternative to command language, the wording and syntactic organization of displayed menu options should correspond consistently to defined elements and structure of the command language.			X
2.2.2.6-3	**Consistent Coding of Menu Options**			
	If letter codes are used for menu selection, those letters should be consistently used in designating options from one transaction to another.			X
2.2.2.6-4	**Key Coded Menu Selection**			
	The code associated with each option should be displayed in a consistent and distinctive manner.			X
2.2.2.6-5	**Menu Color**			
	If menu options are grouped in logical subunits, the same color should be used for menus within the same group.			X
2.2.2.6-6	**Letter Codes for Menu Selection**			
	If menu selections are made by keyed codes, each code should be the initial letter or letters of the displayed option label, rather than assigning arbitrary letter or number codes.			X
2.2.2.6-7	**Highlighting When Cursor Passes Over Item**			
	Menu items that are available should be highlighted whenever the cursor passes over them.			X

Guideline #	Review Criteria	Yes	No	N/A
2.2.2.6-8	**ON/OFF Menu Items**			
	For menu items that can be in an "On" or "Off" state, the "On" state should be indicated by making the item more prominent.			X
2.2.2.6-9	**Indication of Active Menu Selection**			
	The active menu selection should be indicated to the user.			X
2.2.3	**Function Keys**			
2.2.3-1	**Function Keys for Interim Command Entries**			
	Function keys should be provided for interim command entries, i.e., for actions taken before the completion of a transaction.			X
2.2.3-2	**Distinctive Labeling of Function Keys**			
	Each function key should be labeled informatively to designate the function it performs.			X
2.2.3-3	**Distinctive Location**			
	Function keys should be grouped in distinctive locations on the keyboard to facilitate their learning and use.			X
2.2.3-4	**Consistent Assignment of Function Keys**			
	A function assigned to a particular key in a given task context should be assigned to the same key in other contexts.			X
2.2.3-5	**Single Key for Continuously Available Functions**			
	When a function is continuously available, its function should be assigned to a single key.			X
2.2.3-6	**Single-Keying for Frequent Functions**			
	Frequently used functions should be executed by means of a single key action and should not require chord-keying (e.g., use of the shift key).			X
2.2.3-7	**Consistent Functions in Different Operational Modes**			
	When a function key performs different functions in different operational modes, equivalent or similar functions should be assigned to the same key.			X
2.2.3-8	**Logical Pairing of Chord-Keyed Functions**			
	If chord-keying is used, the functions paired on one key should be logically related.			X
2.2.3-9	**Consistent Logic for Double Keying**			
	If double (control/shift) keying is used, the logical relation between shifted and unshifted functions should be consistent from one key to another.			X
2.2.3-10	**Labeling Multifunction Keys**			
	If a key is used for more than one function, the function currently available should always be indicated to the user.			X
2.2.3-11	**Easy Return to Base-Level Functions**			
	If the functions assigned to a set of keys change as a result of user selection, the user should be provided with an easy means to return to the initial, base-level functions.			X

Guideline #	Review Criteria	Yes	No	N/A
2.2.3-12	**Feedback for Function Key Activation**			
	When function key activation does not result in any immediately observable natural response, users should be provided with some other form of computer acknowledgment.			X
2.2.3-13	**Disabling Unneeded Function Keys**			
	Function keys that are not needed for a current transaction should be temporarily disabled.			X
2.2.3-14	**Indicating Active Function Keys**			
	If some function keys are active and some are not, the current subset of active keys should be indicated in some noticeable way, such as by brighter illumination.			X
2.2.3-15	**Response to Inappropriate Function Key Input**			
	The system should prompt the user for confirmation if a function key is pressed in a context unrelated to the function.			X
2.2.3-16	**Layout Compatible with Use**			
	The layout of function keys should be compatible with their use.			X
2.2.4	**Macros/Programmable Function Keys**			
2.2.4-1	**User Definition of Macro Commands**			
	Users should be allowed to assign a single name to a defined series of entries, and then to use that named "macro" for subsequent command entry.			X
2.2.4-2	**Index of Macros**			
	Users should have access to an index of their macros and programmable function keys with their respective composition of commands.			X
2.2.4-3	**Limiting User-Definable Macros and Programmable Keys**			
	The use of user definable macros and programmable function keys should be limited.			X
2.2.4-4	**Modification of Defined Macros**			
	A user should be restricted from modifying a macro or programmable function key as defined by a different originating user.			X
2.2.4-5	**No Duplication of Macro Names**			
	Users should not be allowed to duplicate macro names.			X
2.2.5	**Forms**			
2.2.5-1	**Form Filling for Command Entry**			
	Form filling should be provided as an aid for composing complex command entries.			X
2.2.5-2	**Defaults for Command Entry**			
	Appropriate and readily modified default parameters should be displayed in forms used for composing complex command entries.			X
2.2.5-3	**Consistent Format for Command Forms**			
	Forms for command entry should be consistent in format.			X

Guideline #	Review Criteria	Yes	No	N/A
2.2.5-4	**Forms for Information Entry**			
	Form filling should be used for tasks where some flexibility in information entry is needed, such as the inclusion of optional as well as required items, and/or where computer response may be slow.			X
2.2.5-5	**Grouping Data Fields**			
	Where no source documents or forms exist to support information entry, then fields should be logically grouped, by sequence and frequency of use, importance, and functional associations.			X
2.2.5-6	**Combined Entry of Related Data**			
	Just one explicit entry action at the end of the transaction sequence should be required, rather than separate entry of each item.			X
2.2.5-7	**Data Field Labels**			
	For each data field, an associated label should be displayed to help users understand what entries can be made.			X
2.2.5-8	**Minimal Use of Delimiters**			
	Whenever possible, entry of multiple data items should be allowed without keying special separator or delimiter characters.			X
2.2.5-9	**Standard Delimiter Character**			
	When a field delimiter must be used for data entry, a standard character should be employed consistently for that purpose.			X
2.2.5-10	**Flexible Interrupt**			
	When multiple data items are entered as a single transaction, as in form filling, the user should be allowed to review, modify, or cancel the items before entering the form.			X
2.2.5-11	**Deferring Input of Information**			
	When entry of information in a field is deferred or omitted, the system should identify the field by highlighting or other means. Before the information is filed or accessed, the user should be reminded that information has not been entered.			X
2.2.5-12	**Use of Tabular Displays**			
	When sets of data items must be entered sequentially, in a repetitive series, a tabular display format should be provided where data sets can be keyed row by row.			X
2.2.5-13	**Distinctive Label Formats**			
	Distinctive formats should be provided for column headers and row labels, so that users can distinguish them from data entries.			X
2.2.5-14	**Aiding Entry of Duplicated Data**			
	For entry of tabular data, when entries are frequently repeated, users should be provided with some easy means to copy duplicated data.			X
2.2.5-15	**Tabbing to Advance to Subsequent Fields**			
	Where the number of fields is limited, screen traversal distances are short, and when data fields will be accessed sequentially, users should be allowed to tab directly from one data field to the next, so that the cursor can move freely back and forth across rows or columns.			X

Guideline #	Review Criteria	Yes	No	N/A
2.2.5-16	**Direct Pointing Devices for Selecting Fields**			
	Direct pointing devices, such as a mouse or light pen, should be available (1) for selecting fields in complicated forms, or (2) when field entry will be less predictable (as in database update).			X
2.2.5-17	**Row Scanning Cues**			
	For long forms, those with many rows, some extra visual cue should be provided to help a user scan a row accurately across columns.			X
2.2.5-18	**Providing Default Information**			
	If certain information is used frequently, then it should be automatically entered into the form as a default.			X
2.2.6	**Direct Manipulation**			
2.2.6-1	**When to Use Direct Manipulation**			
	Direct manipulation should be used primarily in tasks with actions and objects that lend themselves to pictographic representation, and in which the actions and objects need not be modified for the successful interpretation of the command by the system.			X
2.2.6-2	**Pointing**			
	When user input involves frequent pointing on a display surface, the interface should be designed so that other actions (e.g., display control) are also accomplished by pointing, in order to minimize shifts from one entry device to another.			X
2.2.6-3	**Highlighting the Selected Item**			
	Selection of an icon, menu, or application-specific capability from a function area should be acknowledged by highlighting the selected item.			X
2.2.6-4	**Other Features of the Direct Manipulation Interface**			
	The direct manipulation interface should include (1) windows for containing the data files, (2) menus for additional objects and actions that are not easily represented by pictographic icons.			X
2.2.6-5	**Fast Computer Response with Direct Manipulation**			
	Direct manipulation should not be used when the computer response is slow.			X
2.2.6-6	**Supplementary Text Labels**			
	If icons are used to represent control actions in menus, a text label should be displayed with each icon to help assure that its intended meaning will be understood.			X
2.2.6-7	**Graphic Display of Control Context**			
	Graphic means should be provided for displaying the context of current control actions to users.			X
2.2.6-8	**Graphic Display of Control Prompting**			
	Prompting aids and other guidance pertaining to current control actions should be displayed graphically to the user.			X
2.2.6-9	**'Opening' an Icon**			
	A user should be able to "open" an icon with a simple, explicit action.			X

Guideline #	Review Criteria	Yes	No	N/A
2.2.6-10	**Size of Icons**			
	Items on the screen that are displayed for selection should be a minimum of 0.2 inch (5 millimeters) on a side and separated by at least 0.1 inch (3 millimeters).			X
2.2.6-11	**Text Selection Area**			
	When functions are represented by text labels, a large area for pointing should be provided, including the area of the displayed label, plus a half-character distance around the label.			X
2.2.6-12	**Zooming for Precise Positioning**			
	When data entry requires exact placement of graphic elements, users should be allowed to request expansion of the critical display area ("zooming") to make the positioning task easier.			X
2.2.6-13	**Selecting Graphic Elements**			
	Users should be provided some means for designating and selecting displayed graphic elements for manipulation.			X
2.2.6-14	**Highlighting Selected Elements**			
	All items currently selected should be highlighted in some way so that the user can anticipate the consequences of any proposed action.			X
2.2.6-15	**Displaying Current Attributes**			
	During graphic data entry/editing, the selected attributes that will affect current actions should be displayed for ready reference by the user.			X
2.2.6-16	**Automatic Data Registration**			
	Automatic registration or alignment of computer-generated graphic data should be provided, so that variable data are shown properly with respect to fixed background or map data at any display scale.			X
2.2.6-17	**Automated Data Plotting**			
	When complex graphic data must be entered quickly, computer aids should be provided to automate that process.			X
2.2.6-18	**Plotting Stored Data**			
	Automated plotting of computer-stored data should be provided at user request, with provision for subsequent editing by a user.			X
2.2.6-19	**Predefined Graphic Formats**			
	When graphic data must be plotted in predefined standard formats, templates or skeletal displays for those formats should be provided to aid data entry.			X
2.2.6-20	**Aids for Graph Construction**			
	When graphs must be constructed for data plotting, computer aids should be provided for that purpose.			X
2.2.6-21	**Aids for Scaling**			
	Computer aids should be provided to help users specify appropriate scales for graphic data entry.			X
2.2.6-22	**Grouping Elements**			
	Users should be allowed to designate a group of elements to which graphic editing operations will be applied in common.			X

Guideline #	Review Criteria	Yes	No	N/A
2.2.6-23	**Immediate Effect of Direct Actions**			
	The effects of operations performed on direct manipulation interfaces should be immediately visible.			X
2.2.6-24	**Explicit Messages for Errors Related to Processes**			
	Explicit error messages should be provided for incorrect actions related to the process (as opposed to the interface).			X
2.2.6-25	**Meaning of Icons**			
	Representations used as icons should require minimal interpretation.			X
2.2.7	**Natural Language**			
2.2.7-1	**Use of Natural Language Interface**			
	A natural language interface should not be the sole means of taking actions that may have to be done very quickly or reliably.			X
2.2.7-2	**Output of Natural Language System**			
	The outputs of a natural language system should be consistent with the types of entries required of users.			X
2.2.8	**Query Language**			
2.2.8-1	**Natural Organization of Data**			
	A query language should reflect a single, natural data structure or organization.			X
2.2.8-2	**Task-Oriented Wording**			
	The wording of a query should simply specify what data are requested.			X
2.2.8-3	**Flexible Query Formulation**			
	Users should be allowed to employ alternative forms when composing queries, corresponding to common alternatives in natural language.			X
2.2.8-4	**Minimal Need for Quantifiers**			
	A query language should minimize the need for quantifiers in query formulation.			X
2.2.8-5	**Logic to Link Queries**			
	A query language should include logic elements that permit users to link sequential queries as a single entry.			X
2.2.8-6	**Confirming Large-Scale Retrieval**			
	If a query will result in a large-scale data retrieval, the user should be informed and required to confirm the transaction or to narrow the query before processing.			X
2.2.8-7	**Use of Query Language Interface**			
	A query language interface should not be the sole means of taking actions that may have to be done very quickly or reliably.			X
2.2.9	**Question and Answer**			
2.2.9-1	**Request for Information**			
	The system should provide the user with a specific request for information.			X
2.2.9-2	**Questions Displayed Singly**			
	Each question should be displayed separately.			X

Guideline #	Review Criteria	Yes	No	N/A
2.2.9-3	**Stacking Related Questions**			
	The system should be able to stack questions and their associated answers if a series of questions are concerned with the same topic.			X
2.2.9-4	**Constraints on Answer Should Be Indicated**			
	The system should indicate any constraints that apply to the user's response.			X
2.2.9-5	**Unlimited Room for Answers**			
	The system should accept as much data as the user is willing to provide in an answer.			X
2.2.9-6	**Recapitulating Prior Answers**			
	When a series of computer-posed question are interrelated, answers to previous questions should be displayed when those will provide context to help a user answer the current question.			X
2.2.9-7	**Removing and Recalling Questions**			
	The user should have the ability to remove a question and answer from the screen or recall a question and answer to the screen.			X
2.2.9-8	**Sequence Compatible with Source Documents**			
	When questions prompt entry of data from a source document, the question sequence should match the data sequence in the source document.			X
2.2.9-9	**Question Mark Delimiter**			
	A question mark should be the delimiter of the question and answer dialogue.			X
2.2.10	**Speech**			
2.2.10-1	**Speech Input**			
	Spoken input should be used only when entry cannot be accomplished through more reliable methods such as keyed entry or pointing.			X
2.2.10-2	**Limited Vocabulary for Speech Input**			
	The vocabulary used for spoken input should be constructed so that only a few options are needed for any transaction.			X
2.2.10-3	**Feedback and Error Correction for Speech Input**			
	Feedback and simple error correction procedures should be provided for speech input, so that when a spoken entry has not been correctly recognized by the computer, the user can cancel that entry and speak again.			X
2.2.10-4	**Alternative Entries for Speech Input**			
	When speech input is the only form of input available, alternatives forms for critical entries should be allowed, so that if the system cannot recognize an entry after repeated attempts, another entry form can be substituted.			X
2.2.10-5	**Activation and Deactivation**			
	Speech recognition systems should have an external, non-speech means of activation and deactivation (e.g., PAUSE and CONTINUE options) so that conversation between users is not taken as command input.			X

Guideline #	Review Criteria	Yes	No	N/A
2.2.10-6	**Vocabulary Items**			
	The vocabulary items should (1) consist of words that are meaningful and familiar to the user, (2) be phonetically distinct from one another; and (3) consist of 2-5 syllables.			X
2.2.10-7	**Vocabulary Sets**			
	Application vocabularies should be divided into sets based on the hierarchy of the application and recognition accuracy requirements.			X
2.2.10-8	**Testing the Recognition of Individual Vocabulary Items**			
	The user should be able to test the recognition of any individual vocabulary item without the entire interactive system being on-line. Feedback on the word recognized and the corresponding confidence score should be available immediately after each use of a word.			X
2.2.10-9	**User-Adjustable Features**			
	When the consequences of errors are not significant, the speech amplitude and rejection levels required for input should be user-adjustable.			X
2.2.10-10	**Word Boundaries**			
	Where word boundaries (pauses between words) are required for system interpretation, boundaries of 100 milliseconds or more should be allowed by the system.			X
2.2.10-11	**Confidence Rating**			
	An indication of the similarity of each spoken command to the recorded template should be available to the user.			X
2.2.10-12	**Speaker-Dependent Voice Recognizer**			
	If an application functions with a speaker-dependent voice recognizer, the user should be able to retrain or update any or all vocabulary templates at any time.			X
2.3	**Cursors**			
2.3.1	**Appearance**			
2.3.1-1	**Distinctive Cursor**			
	Cursors should have distinctive visual features (shape, blink, or other means of highlighting).			X
2.3.1-2	**Display of Cursor**			
	The cursor should not move beyond the display boundaries or disappear from sight.			X
2.3.1-3	**Non-Distracting Design**			
	The cursor should not be so distracting as to impair the searching of the display for information unrelated to the cursor.			X
2.3.1-4	**Stable Cursor**			
	The displayed cursor should be stable.			X
2.3.1-5	**Initial Cursor Placement**			
	On the initial appearance of a data entry display, the cursor should appear automatically at some consistent and useful location.			X

Guideline #	Review Criteria	Yes	No	N/A
2.3.1-6	**Consistent HOME Position**			
	When there is a predefined HOME position for the cursor, that position should be consistently defined on all displays of a given type.			X
2.3.1-7	**Automatic Return of Cursor**			
	When the user must repeatedly return the cursor to the origin or other specific screen location, automatic return or repositioning of the cursor should be provided.			X
2.3.2	**Controls**			
2.3.2-1	**Cursor Control – General**			
	The user should be able to adjust the sensitivity of the cursor movement to be compatible with the required task and user skills.			X
2.3.2-2	**Compatible Control of Cursor Movement**			
	Control actions for cursor positioning should be compatible with movements of the displayed cursor, in terms of control function and labeling.			X
2.3.2-3	**Easy Cursor Positioning**			
	Users should be provided with an easy, accurate means of positioning a displayed cursor to point at different display elements and/or display locations.			X
2.3.2-4	**Consistent Positioning**			
	Where cursor positioning is incremental by discrete steps, the step size of cursor movement should be consistent horizontally and vertically.			X
2.3.2-5	**Cursor Control Key Functions**			
	At the minimum, keys for cursor control should allow horizontal and vertical cursor movement.			X
2.3.2-6	**Cursor Control at Keyboard**			
	When position designation is required in a task emphasizing keyed data entry, cursor control should be provided by some device integral to the keyboard (function keys, joystick, and trackball).			X
2.3.2-7	**Location of Cursor Control Keys**			
	If cursor movement is accomplished by depressing keys, the keys should be located on the main keyboard.			X
2.3.3	**Movement**			
2.3.3-1	**Cursor Movement**			
	If the cursor is moved by depressing a key, releasing the key should cause the cursor to stop moving.			X
2.3.3-2	**Responsive Cursor Control**			
	The cursor control should permit both fast movement and accurate placement.			X
2.3.3-3	**Precise Pointing**			
	When fine accuracy of positioning is required, as in some forms of graphic interaction, the displayed cursor should include a point designation feature.			X

Guideline #	Review Criteria	Yes	No	N/A
2.3.3-4	**Selectable Rate Aiding**			
	The user should be able to turn rate aiding of the cursor movement on or off.			X
2.3.3-5	**User Selectable Speed**			
	Users should be able to select at least two speeds (normal and fast) for the movement of the cursor when the keys for cursor control are held down.			X
2.3.3-6	**Variable Step Size**			
	When character size is variable, the incremental cursor positioning should vary correspondingly, with a step size matching the size of currently selected characters.			X
2.3.3-7	**Easy Cursor Movement to Data Fields**			
	If a cursor must be positioned sequentially in predefined areas, such as displayed data entry fields, this should be accomplished by simple user action.			X
2.3.3-8	**Explicit Activation**			
	Users should be required to take a separate, explicit action, distinct from cursor positioning, for the actual entry (enabling, activation) of a designated function.			X
2.3.3-9	**Display Format Protection**			
	When there are areas of a display in which data entries cannot be made (such as in field labels or in blank spaces that are part of data formatting), the cursor should 'step over' those areas, and they should be insensitive to pointing actions.			X
2.3.3-10	**Free Cursor Movement**			
	For text editing, users should be allowed to move the cursor freely over a displayed page of text to specify items for change, and to make changes directly to the text.			X
2.3.3-11	**Proportional Spacing**			
	If proportional spacing is used for displayed text, computer logic should make necessary adjustments automatically when the cursor is being positioned for data entry or data change.			X
2.3.3-12	**Cursor Movement by Units of Text**			
	Users should be able to move the cursor by specific units of text, as well as one character at a time.			X
2.3.3-13	**Data Entry Independent of Cursor Placement**			
	An ENTER action for multiple data items should result in entry of all items, regardless of where the cursor is placed on the display.			X
2.3.4	**Multiple Cursors**			
2.3.4-1	**Minimal Use of Multiple Cursors**			
	Multiple cursors on a single display should be used only when it can be demonstrated that they are required by the task.			X

Guideline #	Review Criteria	Yes	No	N/A
2.3.4-2	**Multi Monitor/Multi Controller Cursor Characteristics**			
	In a multitasking environment with multiple monitors, controllers, or cursors, the location of the active cursor should be obvious to the user.			X
2.3.4-3	**Distinctive Multiple Cursors**			
	If multiple cursors are used, they should be visually distinctive from one another.			X
2.3.4-4	**Compatible Control of Multiple Cursors**			
	If multiple cursors are controlled by different devices, their separate controls should be compatible in operation.			X
2.3.4-5	**Distinctive Control of Multiple Cursors**			
	When multiple cursors are controlled by a single device, the cursor currently being controlled should be clearly indicated.			X
2.3.4-6	**Multiple Pointing Cursor Control Devices**			
	When there are multiple cursor control/pointing devices, a unique pointing cursor shape should be associated with each device.			X
2.3.4-7	**Unique Shapes**			
	Cursors of different shapes should be used for different purposes.			X
2.3.5	**Pointing Cursors**			
2.3.5-1	**Pointing Cursor Visibility**			
	The pointing cursor should be visible to the user at all times and may obscure characters unless it interferes with performance within an application.			X
2.3.5-2	**Pointing Cursor Blink**			
	The pointing cursor should not blink.			X
2.3.5-3	**Pointing Cursor Image Quality**			
	Pointing cursors should maintain image quality throughout an entire range of motion within the display. The position of the pointing cursor should be clearly visible during movement from one screen position to another. Flicker should be minimized.			X
2.3.5-4	**Pointing Cursor Design**			
	To the greatest degree possible, pointing cursors should be completely graphic and should not contain a label.			X
2.3.5-5	**Pointing Cursor Size Constancy**			
	The pointing cursor should maintain its size across all screen and display locations.			X
2.3.5-6	**Pointing Cursor Movement**			
	The movement of the pointing cursor should appear to the user to be smooth and continuous, with smooth and continuous movement of the cursor control device. The pointing cursor should not move in the absence of any input from the user.			X

Guideline #	Review Criteria	Yes	No	N/A
2.3.6	**Text Entry Cursors**			
2.3.6-1	**Text Entry Cursor Visibility**			
	The text entry cursor should only be visible when text entry is possible.			X
2.3.6-2	**Identification of Text Entry Cursor**			
	At the initiation of a task, an application, or a new display, the user should be able to immediately determine the location of the text entry cursor. Following the initial placement of the text entry cursor, the position of the cursor should be under the user's control.			X
2.3.6-3	**Text Entry Cursor Blink**			
	If text entry cursor blinking is to be used to direct the user's attention, the default blink rate should be 3 Hz.			X
2.3.6-4	**Nonobscuring Text Entry Cursor**			
	The placeholding cursor should not obscure any other character displayed in the position designated by the cursor.			X
2.3.6-5	**Number of Text Entry Cursors**			
	There should be only one text entry cursor per window.			X
2.3.6-6	**Text Entry Cursor Size**			
	The text entry cursor should assume the height and/or width of the text characters adjacent to it.			X
2.3.7	**Multiple Display Devices**			
2.3.7-1	**Cursor Motion Across Contiguous Similar Displays**			
	When displays are the same size and are located adjacent to each other, the cursor should appear to move in a smooth, continuous motion from one display device to the next.			X
2.3.7-2	**Cursor Motion Across Physically Separated Dissimilar Displays**			
	When display devices are physically separated, have different orientations, or different sizes, techniques should be employed to help the user keep track of the cursor's position.			X
2.4	**System Response**			
2.4.1	**Prompts**			
2.4.1-1	**Prompting User Entries**			
	Users should be provided with clear and specific information to guide entries during logon/logoff or command or information entry.			X
2.4.1-2	**Prompting Address Entry**			
	When a user must specify the address for a message, prompting should be provided.			X
2.4.1-3	**Standard Symbol for Prompting Entry**			
	Standard symbols should be used for input prompting.			X
2.4.1-4	**Prompting Command Correction**			
	When a command entry is not recognized or inappropriate, users should be prompted to correct, rather than re-enter the command.			X
2.4.1-5	**Prompting Field Length**			
	Cues should be provided to indicate the size of a fixed-length data entry field.			X

Guideline #	Review Criteria	Yes	No	N/A
2.4.1-6	**Data Format Cuing in Labels**			
	Additional cuing of data format should be included in a field label when that seems helpful.			X
2.4.1-7	**User-Requested Prompts**			
	Users should be able to request computer generated prompts to determine required parameters or available options for a command.			X
2.4.1-8	**Prompting Data Entry**			
	Prompting should be provided for required formats and acceptable values for data entries.			X
2.4.1-9	**Graphic Display of Control Prompting**			
	Graphic means may be provided for displaying prompting aids and other guidance pertaining to current control actions.			X
2.4.2	**Feedback**			
2.4.2-1	**Feedback During Data Entry**			
	Feedback should be displayed for all user actions during data entry; keyed entries should be displayed stroke by stroke.			X
2.4.2-2	**Feedback for Completion of Data Entry**			
	The computer should acknowledge completion of a data entry transaction with a confirmation message if data entry was successful, or else with an error message.			X
2.4.2-3	**Feedback for Repetitive Data Entries**			
	For a repetitive data entry task that is accomplished as a continuing series of transactions, successful entry should be indicated by regenerating the data entry display, automatically removing the just-entered data in preparation for the next entry.			X
2.4.3	**System Response Time**			
2.4.3-1	**Response Time Appropriate to Transaction**			
	The speed of computer response to user entries should be appropriate to the transaction involved.			X
2.4.3-2	**Response Time Appropriate to Tasks**			
	When information from different locations must be compared or mentally integrated, the system response time for information retrieval should be minimized.			X
2.4.3-3	**Display Average System Response Time**			
	Average system response time, if affected by the number of on-line users, should be displayed at time of logon.			X
2.4.3-4	**Response Time Consistent with Requirements**			
	System response times should be consistent with operational requirements.			X
2.4.3-5	**Processing Delay**			
	Where system overload or other system conditions will result in a processing delay, the system should acknowledge the data entry and provide an indication of the delay to the user.			X

Guideline #	Review Criteria	Yes	No	N/A
2.4.3-6	**Indicating Completion of Processing**			
	When processing in response to a control entry is lengthy, the user should be given a positive indication of subsequent completion time and appropriate related information.			X
2.4.3-7	**Response Time Induced Keyboard Lockout**			
	If computer processing time requires delay of concurrent user inputs and no keyboard buffer is available, keyboard lockout should occur until the computer can accept the next transaction. An alert should be displayed to indicate to the user that lockout has occurred.			X
2.4.3-8	**Keyboard Restoration**			
	A signal should be presented when the computer is ready to continue following response time-induced keyboard lockout.			X
2.4.3-9	**Variability of Response Time**			
	Response time deviations should not exceed more than half the mean response time.			X
2.4.3-10	**Maximum System Response Times**			
	Maximum system response times for real-time systems should not exceed the values presented in Table 2.4.			X
2.5	**Managing Displays**			
2.5.1	**Display Selection and Navigation**			
2.5.1.1	**Orientation Features**			
2.5.1.1-1	**Organization of the Display Network**			
	The organization of the display network should reflect an obvious logic based on task requirements and be readily understood by users.			X
2.5.1.1-2	**Cues to Display Network Structure**			
	The display system should provide information to support the user in understanding the display network structure.			X
2.5.1.1-3	**Overview of Display Network**			
	A display should be provided to show an overview of the structure of an information space, such as a display network or a large display page.			X
2.5.1.1-4	**Perceptual Landmarks**			
	Easily discernable features should appear in successive views and provide a frame of reference for establishing relationships across views.			X
2.5.1.1-5	**Location Cues**			
	Cues should be provided to help the user retain a sense of location within the information structure.			X
2.5.1.1-6	**Directional Cues**			
	Directional cues should be provided.			X
2.5.1.1-7	**Scales, axes, and grids**			
	Scales, axes, and grids should be used for spatial representations (such as maps) that exceed a display page.			X
2.5.1.1-8	**Display Page Titles and Identification Codes**			
	Display page title and identifying information should be used to communicate the position of a display in a larger information space.			X

Guideline #	Review Criteria	Yes	No	N/A
2.5.1.1-9	**Orientation Coding**			
	Orientation coding, such as different background colors and patterns, may be applied to display pages to differentiate them from displays in other parts of the display network.			X
2.5.1.1-10	**Display Overlap**			
	There should be physical or functional overlaps between displays that prevent the displays from appearing as disjointed views.			X
2.5.1.1-11	**Explicit Indication of Context**			
	If the interpretation of displayed data depends on its context (i.e., the location in the display network), an explicit indication of the context should appear in the display.			X
2.5.1.1-12	**Understanding Successive Views**			
	A hypertext information system should show how a destination node is related to the point of departure.			X
2.5.1.2	**Retrieval Features**			
2.5.1.2-1	**Flexibility in Display System Interaction**			
	The display network should provide more than one way to access displays.			X
2.5.1.2-2	**Minimal Navigation Path Distance**			
	Short navigation paths should be provided between display pages that will be used one after the other.			X
2.5.1.2-3	**Short Navigational Distances in Hierarchies**			
	Navigation distances should be kept short.			X
2.5.1.2-4	**Relatedness of Successive Views**			
	During navigation, displays should support users' comprehension of the relationships between successive views or destinations.			X
2.5.1.2-5	**Time to Complete Navigation**			
	The time required to complete a display navigation action should be minimized.			X
2.5.1.2-6	**Detection of Navigation Targets**			
	Navigation targets should be easily detectable.			X
2.5.1.2-7	**Lateral Moves in a Hierarchy**			
	Users should be able to make lateral transitions among locations within a particular level of the site, rather than vertical transitions from the higher-level, central location.			X
2.5.1.2-8	**Simultaneous Display of Related Items**			
	Users should be able to display related items so they may be viewed simultaneously.			X
2.5.1.2-9	**Support for 'Top-Down' Strategies for Navigating Hierarchies**			
	Use of top-down navigation strategies should be supported.			X
2.5.1.2-10	**Support for 'Bottom-Up' Strategies for Navigating Hierarchies**			
	The display system should support users in identifying reversal points.			X

Guideline #	Review Criteria	Yes	No	N/A
2.5.1.2-11	**Representation of Distance**			
	The display system should be represented so that the user's perception of the relatedness of displays is consistent with distance in the structure of the display hierarchy.			X
2.5.1.2-12	**Distortion-Based Orientation**			
	If user orientation is based on seeing landmarks that are beyond what can fit on a single display, distorted views can be presented to facilitate user recognition of location.			X
2.5.1.2-13	**Visually Identifying Hypertext Links**			
	The visual coding of selectable items should not add visual clutter or decrease the overall effectiveness of the coding scheme.			X
2.5.1.2-14	**Typographically Identifying Hypertext Links**			
	Codes such as bold, italics, and underline should not be used to identify selection points if other conventional uses of these codes in the text, such as to emphasize certain words, is likely to confuse the user.			X
2.5.1.2-15	**Identifying Hypertext Links by Cursor Coding**			
	A selection point should not be identified solely by changes in the cursor.			X
2.5.1.2-16	**Evaluating Hypertext Links**			
	The user should be able to evaluate the information to which a link refers prior to actually retrieving it.			X
2.5.1.2-17	**Navigating Individual Hypertext Nodes**			
	The amount of information presented at a single node should be consistent with the user's ability to readily navigate to the needed information.			X
2.5.1.2-18	**Backtracking Capabilities in Hypertext Interfaces**			
	Backtrack capabilities should always be available in hypertext interfaces and should function in the same way.			X
2.5.1.2-19	**Multiple Hypertext Navigation Methods**			
	When multiple methods are provided for navigating in a hypertext system, they should function similarly.			X
2.5.1.3	**Navigation Features for Large Display Pages**			
2.5.1.3-1	**Integrating Information within Large Display Pages**			
	When users are required to integrate information across a large display, the HSI should be designed to minimize navigation burdens for paging, scrolling, and zooming.			X
2.5.1.3-2	**Consistent Framing for Pan and Zoom**			
	Framing functions should be performed consistently for panning and zooming operations so that the same area of the display remains in view when switching between zoom and pan modes.			X
2.5.1.3-3	**Selecting the Center for Zoom and Pan Operations**			
	Prior to executing a zoom or pan operation, the user should be able to select a particular position on the display to become the center for that operation.			X

Guideline #	Review Criteria	Yes	No	N/A
2.5.1.3-4	**Default Configuration for Zoom, Pan, and Scroll**			
	Displays that can be navigated via zoom, pan, or scroll operations should provide a means for the user to rapidly return the display to the default or starting configuration.			X
2.5.1.3-5	**Size Compensation for Zoom**			
	When users zoom a display, the system should compensate for changes in the size of symbols, labels, and other graphical objects.			X
2.5.1.3-6	**Minimize Scrolling Demands**			
	Displays should be designed to preclude the need for excessive scrolling.			X
2.5.1.3-7	**Column Width of Scrolled Text**			
	If text is meant to be scanned while it is scrolled, the column width should be 35 or fewer characters across.			X
2.5.2	**Windows**			
2.5.2-1	**Window Identification**			
	Windows should be identified by a label consistently located at the top of the window's border.			X
2.5.2-2	**Window Selection and Display**			
	Users should be able to select separate data windows that will share a single display screen.			X
2.5.2-3	**Displaying Multiple Windows**			
	When multiple windows are open simultaneously, the user should have the capability to easily tile, layer, or sequentially view the windows (see Figure 2.2).			X
2.5.2-4	**Managing Open Windows**			
	The system should keep track of the windows that are open (but not necessarily active or displayed), and provide a means of displaying the list of open windows to the user.			X
2.5.2-5	**Window Demarcation**			
	Windows should be visually separated from each other and from their background, preferably by borders or similar demarcation.			X
2.5.2-6	**Distinction Between Window Types**			
	Window types should be perceptually distinct (see Figure 2.2).			X
2.5.2-7	**Active Windows Priority**			
	Under normal operating conditions, active windows should be frontmost on the display.			X
2.5.2-8	**Caution and Warning Window Priority**			
	Caution and warning windows should be frontmost on the display.			X
2.5.2-9	**Default Window Size**			
	The size and shape of the initial presentation of a window should be consistent with its contents (amount of information, number of menus, and data fields).			X
2.5.2-10	**Minimum Height for Text Windows**			
	The default height for text windows and windows used for scanning data should be at least four lines of information.			X

Guideline #	Review Criteria	Yes	No	N/A
2.5.2-11	**Minimum Width for Text Windows**			
	The default width for a generic text window should enable 50 to 80 characters to be displayed.			X
2.5.2-12	**Consistent Window Control**			
	User control of windows should operate consistently from one display to another for each type of window.			X
2.5.2-13	**Window Control Functions**			
	As appropriate to the user task, windows should be capable of the following operations: scrolling/panning, resizing, moving, hiding, activating, deactivating, copying to/from, zooming in/out, tabbing, and undo-last.			X
2.5.2-14	**Consistent Control Within Windows**			
	When control actions such as command entry may be taken by a user working within a window, those control actions should be consistent from one window to another.			X
2.5.2-15	**Window Opening Methods**			
	The user should be able to open a window by performing any of a set of simple actions.			X
2.5.2-16	**Closing Windows**			
	Users should be able to close a window with a single action.			X
2.5.2-17	**Easy Shifting Among Windows**			
	If several windows are open, several easy means should be provided for a user to shift among them.			X
2.5.2-18	**Activating a Previously Opened Window**			
	The user should be able to activate a window by performing any of a set of simple actions in that window or related to that window.			X
2.5.2-19	**Activation of Window Cursor**			
	The action that activates a window should automatically position the placeholding cursor in that window so that the user can provide inputs through that window.			X
2.5.2-20	**Multi-Modal Window Designation**			
	If windows are capable of different modes, the system should provide immediate and unambiguous feedback concerning which mode is active.			X
2.5.2-21	**Movable Windows**			
	Window movement capability should be provided such that the user can move windows to different areas of the display.			X
2.5.2-22	**Window Position**			
	It should not be possible to position windows in such a way that menu bars, access to the command area, or caution and warning messages are obscured.			X
2.5.2-23	**Smooth Window Movement**			
	Movement of a window should appear to be smooth and continuous to the user.			X

Guideline #	Review Criteria	Yes	No	N/A
2.5.2-24	**Indicate Active Window**			
	If several windows are displayed at once, the window(s) in which action can be taken should be indicated.			X
2.5.2-25	**Update of Hidden Windows**			
	A window that is not displayed should be capable of receiving information from the system.			X
2.5.2-26	**Alerting User to Information Availability**			
	The system should alert the user to critical information that becomes available in an inactive or non- displayed window.			X
2.5.2-27	**Window Activates Upon Opening**			
	The action that opens a window should automatically make that window active.			X
2.5.2-28	**Varying Window Size**			
	Users should be able to change the horizontal and vertical dimensions of a window independently or together.			X
2.5.2-29	**Accessibility to Partially Removed Windows**			
	Windows partially moved off the display should be made readily accessible with a single action.			X
2.5.2-30	**Scrollable Windows**			
	The user should have the ability to scroll through the contents of a window both horizontally and vertically.			X
2.5.2-31	**User Control of Automatic Update**			
	Automatically updated windows should have display freeze capability.			X
2.5.2-32	**Multiple Views**			
	If separate display pages contain information that the user must compare, combine, or otherwise mentally process, then they should be presented simultaneously.			X
2.5.2-33	**Minimize Needs for Window Manipulation**			
	The amount of resizing, placement, and manipulation of windows required for using the HSI should be minimized.			X
2.5.2-34	**Obscured Critical Information**			
	The system should not allow the user to move or resize a window containing non-critical information such that it obscures critical information.			X
2.5.2-35	**Positioning Critical Windows**			
	The system should not allow the user to move a window containing critical information off the display screen.			X
2.5.2-36	**Default Window Location**			
	Windows should have a default location on the display screen.			X
2.5.2-37	**Temporarily Obscured Display Data**			
	Display data that is temporarily obscured by a window object should reappear when the object is removed.			X

Guideline #	Review Criteria	Yes	No	N/A
2.5.2-38	**Obscuring the Active Window**			
	A temporary window object should not obscure critical control information and command entry interfaces of the active window.			X
2.5.2-39	**Number of Allowable Open Windows**			
	An upper limit on the number of windows allowed to be open at one time should be defined to ensure that system response time is not compromised.			X
2.5.2-40	**Suppression of Window Objects**			
	An easy means for the user to suppress the display of windows should be provided.			X
2.5.2-41	**Separate Menu Bars for Applications**			
	A separate menu bar should be provided for each application window, where different applications are operating concurrently in open windows (e.g., multi-tasking).			X
2.5.2-42	**Conveying the Relationship Between Window, Icon, and Action**			
	The window system should convey to the user the relationship between the window, the icon, and the action when a window is opened or closed.			X
2.5.2-43	**Labeling Windows**			
	Window objects, dialog boxes, and subordinate windows should be labeled.			X
2.5.2-44	**Closing Main Window and Subordinate Objects**			
	When a main application window is closed by the user, all associated subordinate windows and dialog boxes should also close.			X
2.5.2-45	**Matching Selection Items and Window Labels**			
	The titles of subordinate windows should match the menu selection items of the menus from which they are selected.			X
2.5.2-46	**Indication of All Open Windows**			
	The system should indicate all open windows.			X
2.5.2-47	**Window Automation Coordinated with Tasks**			
	Automated window management should be coordinated with the user's tasks.			X
2.5.3	**Display Control**			
2.5.3-1	**Display Control**			
	Users should be able to specify the information to be displayed and select the format in which it is presented.			X
2.5.3-2	**Display of Control Options**			
	Screen control locations and control options should be clearly and appropriately indicated.			X
2.5.3-3	**Zooming for Display Expansion**			
	The user should be able to expand the size of any selected area of the display.			X

Guideline #	Review Criteria	Yes	No	N/A
2.5.3-4	**Functional Labeling for Display Framing**			
	Display framing should be described (e.g., in user instructions and key labels) in functional terms, and wording that implies spatial orientation should be avoided.			X
2.5.3-5	**Easy Paging**			
	When requested data exceeds the capacity of a single display frame, users should be given some easy means to move back and forth over displayed material by paging or panning/scrolling.			X
2.5.3-6	**Show Changing Scale**			
	When a display is expanded from its normal coverage, a scale indicator of the expansion factor should be provided.			X
2.5.3-7	**Show Overview Position of Visible Section**			
	When a display is panned and/or expanded from its normal coverage, some graphic indicator of the position in the overall display of the currently visible section should be provided.			X
2.5.3-8	**Return to Normal Display Coverage**			
	If a user is allowed to pan over an extended display, or zoom for display expansion, an easy means for the user to return to normal display coverage should be provided.			X
2.5.4	**Display Update/Freeze**			
2.5.4-1	**Data Updated as Available**			
	Displayed values should be automatically updated as more current data become available.			X
2.5.4-2	**Readability of Changing Data**			
	Changing data values that must be read should be displayed in a fixed position and updated no more than once per second. If users need only to monitor general trends in changing data values, and do not need to take exact readings, faster update rates may be acceptable.			X
2.5.4-3	**Visual Integration of Changing Graphics**			
	When a user must visually integrate changing patterns on a graphic display, the data should be updated at a rate appropriate to human perceptual abilities for that kind of data change.			X
2.5.4-4	**Refresh Rate for Free-drawn Graphics**			
	For free-drawn graphics, the refresh rate on the monitor should be high enough to produce the appearance of a continuous track.			X
2.5.4-5	**Display Freeze**			
	The user should be able to "freeze" automatically updated data at any point. This is necessary in order for the user to examine changed data more deliberately.			X
2.5.4-6	**Labeling Display Freeze**			
	When a display is "frozen," the display should be appropriately labeled to remind users of its "frozen" status.			X

Guideline #	Review Criteria	Yes	No	N/A
2.5.4-7	**Signaling Changes to Frozen Data**			
	When a display being updated in real-time has been frozen, the user should be advised if some significant, but not displayed, change should be detected in the computer processing of new data.			X
2.5.4-8	**Resuming Update After Display Freeze**			
	When the user elects to resume update after a display being updated in real time has been frozen, the resumed display update should be positioned at the current real-time point.			X
2.5.5	**Display Suppression**			
2.5.5-1	**Temporary Suppression of Displayed Data**			
	The user should be able to temporarily suppress standard data displays.			X
2.5.5-2	**Labeling Display Suppression**			
	A data display that has been suppressed should be annotated with an appropriate label to remind users that data have been suppressed.			X
2.5.5-3	**Signaling Changes to Suppressed Data**			
	Users should be advised if some significant (but not displayed) change is detected in the computer processing of new data when data have been suppressed from a display.			X
2.5.5-4	**Resuming Display of Suppressed Data**			
	Data that has been suppressed from a display should be able to be quickly restored to its complete, originally generated form.			X
2.5.5-5	**Dedicated Function Key**			
	Function keys used to restore suppressed data should have no other use.			X
2.5.6	**Scrolling and Paging**			
2.5.6-1	**Continuous Text Data**			
	Paging and windowing should not be used when searching through continuous text data.			X
2.5.6-2	**Consistent Orientation**			
	A consistent orientation for display framing should be used.			X
2.5.6-3	**Panning with Free Cursor Movement**			
	In applications where a user moves a cursor freely about a page of displayed data, panning should be adopted rather than scrolling as the conceptual basis of display framing.			X
2.5.6-4	**Framing Applied to All Data**			
	Framing functions (e.g., panning, zooming) should affect all displayed data in the same way.			X
2.5.6-5	**Paging Controls**			
	Users should be allowed to move easily from one page to another for displays that are partitioned into separately displayable pages.			X
2.5.6-6	**Horizontal Scrolling**			
	The user should have the ability to shift the text information shown when the user cannot view all of the characters in the horizontal line.			X

Guideline #	Review Criteria	Yes	No	N/A
2.5.6-7	**Appropriate Scrolling/Paging Structures**			
	Structures for horizontal scrolling/paging should appear only on displays for which horizontal movement is appropriate. Similarly, structures for vertical scrolling/paging should appear only on displays for which vertical movement is applicable.			X
2.5.6-8	**Common Display Structure**			
	Display structure used for scrolling and paging should be common to all files.			X
2.5.6-9	**Scrolling/Paging Techniques**			
	Users should have the ability to scroll or page using several different techniques.			X
2.5.6-10	**One Structure for Vertical, One for Horizontal Movement**			
	Only one scrolling/paging structure should be used for vertical movement in a display and one for horizontal movement in a display.			X
2.5.6-11	**Labeling Scrolling Function**			
	The function of the scrolling/paging structure should be clearly indicated by either a textual or graphic label.			X
2.5.6-12	**Evident Direction of Paging**			
	The direction that users must page (toward the top or bottom, left or right) should be evident to users before they begin to page.			X
2.5.6-13	**Paging in One or Multiple Page Increments**			
	Users should be able to page in one page or multiple page increments.			X
2.5.6-14	**Discrete Paging**			
	When moving over multiple pages, the movement should be discrete with no display of intermediate pages between the starting page and the selected page.			X
2.5.6-15	**Indicate Absolute and Relative Positions of User**			
	Scrolling/paging structures should indicate both the absolute and relative positions of the user in the data file.			X
2.5.6-16	**Graphic Indication of Scroll Position**			
	Large display outputs that are viewed by continuous panning/scrolling should be provided with a graphic indicator inset at the margin of the display frame to indicate current location.			X
2.5.6-17	**Scroll by Line or Display Unit**			
	The scroll motion rate should allow the user to scroll by line or by display unit.			X
2.5.6-18	**Display Window**			
	ROLL and SCROLL commands should refer to the display window, not the text/data.			X
2.5.6-19	**Parameters Refer to Data not Window**			
	The parameters of roll/scroll functions should refer to the data being inspected, not to the window.			X

Guideline #	Review Criteria	Yes	No	N/A
2.5.7	**Automated Actions**			
2.5.7-1	**Anticipation of Automated Interface Management Actions**			
	Automated interface management features should be designed such that their operation can be anticipated by users.			X
2.5.7-2	**Observability of Automated Interface Management Actions**			
	The operation of automated interface management features should be apparent to the user.			X
2.5.7-3	**Distracting Automated Interface Management Actions**			
	The operation of automated interface management features should not draw excessive attention from the user.			X
2.6	**Managing Information**			
2.6.1	**Editing Documents**			
2.6.1-1	**Natural Units of Text**			
	Users should be allowed to specify segments of text in whatever units are natural for entry/editing.			X
2.6.1-2	**Text Displayed as Printed**			
	Users should be allowed to display text exactly as it will be printed.			X
2.6.1-3	**Format Control by User**			
	Easy means should be provided for users to specify required format control features (e.g., margin and tab settings) during text entry/editing.			X
2.6.1-4	**Establishing Predefined Formats**			
	When text formats must follow predefined standards, the standard format should be provided automatically and not rely on users to remember and specify proper formats.			X
2.6.1-5	**Storing User-Defined Formats**			
	When text formats cannot be predicted in advance, users should be able to specify and store for future use the formats that might be needed for particular applications.			X
2.6.1-6	**Consistent Word Spacing**			
	Unless otherwise specified by the user, entered text should be left-justified to maintain constant spacing between words, leaving right margins ragged if that is the result.			X
2.6.1-7	**Hyphenation by Users**			
	In the entry/editing of text, automatic pagination and line breaks by the computer should keep words intact, and hyphenation should only be introduced where specified by users.			X
2.6.1-8	**Changing Physical Characteristics of Text**			
	The user should have the ability to change the physical characteristics of text.			X
2.6.1-9	**Tabs**			
	A tab function should be available for paragraph indentation and for moving the cursor to a preselected location.			X

Guideline #	Review Criteria	Yes	No	N/A
2.6.1-10	**Tab Controls**			
	For editing programs or tabular data, cursor tab controls or other provisions for establishing and moving readily from field to field should be provided.			X
2.6.1-11	**Margins**			
	The user should have the ability to change margins for a text file.			X
2.6.1-12	**Automatic Line Break**			
	For entry/editing of unformatted text, an automatic line break ("return") should be provided when text reaches the right margin, with provision for user override.			X
2.6.1-13	**Automatic Pagination Aids**			
	Automatic pagination for text entry/editing should be provided, allowing users to specify the page size.			X
2.6.1-14	**User Control of Pagination**			
	When automatic pagination is provided, users should be allowed to override that pagination in order to specify page numbers at any point in a document.			X
2.6.1-15	**Controlling Integrity of Text Units**			
	When automatic pagination is provided, users should be allowed to specify how many lines in a paragraph can stand alone at the bottom or top of a page ("widows" and "orphans"), and to specify any text that should not be divided between two pages, such as lists or tables.			X
2.6.1-16	**Protecting Text During Page Overruns**			
	When a user is inserting text into a document that has already been paginated, no text should be lost if the user inserts more text than a page can hold.			X
2.6.1-17	**Head- and Foot-of File**			
	The means should be provided to readily move the cursor to the head (beginning) or the foot (end) of the file.			X
2.6.1-18	**Inserting**			
	When inserting words or phrases, items to be inserted should be displayed as the final copy will appear.			X
2.6.1-19	**String Search**			
	Users should be allowed to specify a string of text and request the computer to advance (or back up) the cursor automatically to the next (or last previous) occurrence of that string.			X
2.6.1-20	**Multiple Methods of Searching**			
	Users should have multiple methods for searching for lines or alphanumeric strings.			X
2.6.1-21	**Search for Line Numbers**			
	Users should have the ability to search for and move to a specific line number in a file.			X

Guideline #	Review Criteria	Yes	No	N/A
2.6.1-22	**Upper and Lower-Case Equivalent in Search**			
	Unless otherwise specified by a user, upper and lower-case letters should be treated as equivalent in searching text.			X
2.6.1-23	**Specifying Case in Search**			
	When case is important, users should be allowed to specify case as a selectable option in string search.			X
2.6.1-24	**Global Search and Replace**			
	When systematic editing changes will be made throughout a long document, a "global search and replace" capability should be provided.			X
2.6.1-25	**Case in Global Search and Replace**			
	If a global search and replace capability is provided, the case of the replacement string should match the case of the old string, unless otherwise specified by the user.			X
2.6.1-26	**Moving Text**			
	Users should be allowed to select and move text segments from one place to another within a document.			X
2.6.1-27	**Pasting Text into a Graphical File and Vice Versa**			
	The user should be able to paste (1) alphanumeric data cut or copied from a text file or table into a graphical display, and (2) graphical data into a text or tabular file.			X
2.6.1-28	**Cutting Graphical Objects and Areas of Graphical Displays**			
	Users should be able to cut both graphical objects and areas of a graphical display.			X
2.6.1-29	**Viewing Text Prior to Pasting**			
	Users should be able to view text that has been cut or copied prior to pasting.			X
2.6.1-30	**Placing Cut Text in Compatible Files**			
	Users should be able to insert copied text at any location in the current file or other files created with the same application.			X
2.6.1-31	**Placement of Pasted Text**			
	The pasted text should be inserted at the location immediately before the cursor (in a text file), or at the approximate location of the cursor (in a graphical file).			X
2.6.1-32	**Pasting the Same Text More than Once**			
	Pasting the most recently cut or copied text should have no effect on the users' ability to paste the same text again.			X
2.6.1-33	**Cutting Without a Gap in the Text**			
	No gap should be left in the file at the point from which cut text was removed.			X
2.6.1-34	**Storing Frequently Used Text**			
	Users should be allowed to label and store frequently used text segments, and to later recall (copy into current text) stored segments identified by their assigned labels.			X

Guideline #	Review Criteria	Yes	No	N/A
2.6.1-35	**Vertical Scrolling When Selecting Text**			
	If the selected text, table, or graphics area extends beyond the bottom of the displayed page, the screen should automatically scroll until the user stops selecting or when the end of the display page is reached.			X
2.6.1-36	**Non-Contiguous Blocks of Text**			
	Users should not be able to select non-contiguous blocks of text when copying, cutting, or pasting.			X
2.6.2	**Saving Files**			
2.6.2-1	**Saving to a Data File**			
	The user should be able to save the information entered into a file by a single action that will permit the user to continue interacting with that file.			X
2.6.2-2	**Exit With Save**			
	After finishing the interaction with any type of file, the user should be able to save the information and stop interacting with the file by a single action.			X
2.6.2-3	**Exiting a File**			
	After finishing the interaction with any type of file, the user should be able to stop interacting with the file by a single action (e.g., selecting a menu item) without saving the changes to the file.			X
2.6.2-4	**Distinct Commands for Exit With and Without Save**			
	The command used to "exit with save" should differ from the commands for "save" (without exit) and for "exit without save."			X
2.6.2-5	**Protection Against Exiting a File Without Saving**			
	The user should be protected against exiting a file without the opportunity to save the file contents.			X
2.6.2-6	**Recovery of Replaced File**			
	Information from a file that has been modified and stored with the "save" or "exit with save" actions should be retrievable with a simple action.			X
2.6.2-7	**Automatic Saving of a File**			
	The system should save a file automatically at frequent intervals while being edited.			X
2.6.2-8	**Automatic Backup**			
	Users should have the option of invoking an automatic backup function that retains previous versions of files. The specific number of previous versions saved should be selectable by the user.			X
2.6.2-9	**Access of Modified Information After Exit Without Save**			
	Information from a file that has been modified by new input should be retrievable with a single action even after exiting without saving new input.			X

Guideline #	Review Criteria	Yes	No	N/A
2.6.3	**Temporary Editing Buffer**			
2.6.3-1	**Automatic Placement of Cut Data in Buffer**			
	When selected data is cut or copied from a text file, tabular file, and/or graphics file and placed in a temporary editing buffer, the data should be placed in the buffer automatically, with the only specific action required by the user being the cut or copy action.			X
2.6.3-2	**Contents of Temporary Buffer**			
	The contents of the temporary editing buffer should remain intact after the application from which the contents were taken is closed.			X
2.6.3-3	**Default Conditions of Buffer**			
	The default condition should be that additions to the temporary editing buffer are not cumulative.			X
2.6.3-4	**Access to Contents of Temporary Buffer**			
	The user should be able to access the contents of the temporary editing buffer in a window with a single action.			X
2.6.4	**Excerpt Files**			
2.6.4-1	**Accessing Information Across Applications**			
	The capability to accept and maintain information, independent of application, should be provided for holding relevant information across displays or applications.			X
2.6.4-2	**Excerpt File**			
	Users should have the capability to create multiple excerpt files.			X
2.6.4-3	**Integrating Data**			
	The user should have the capability to integrate new data with data already in the excerpt file.			X
2.6.4-4	**Copying Excerpt File**			
	The user should be able to cut or copy data from the excerpt file and paste it to any other file.			X
2.6.4-5	**Saving Excerpt File**			
	The user should be able to save the excerpt file.			X
2.7	**User Assistance**			
2.7.1	**General**			
2.7.1-1	**Standard Display Location**			
	System messages should appear in standard locations.			X
2.7.1-2	**Consistent Format for System Messages**			
	Consistent grammatical construction should be used in system messages.			X
2.7.1-3	**Familiar Wording**			
	System messages should use familiar terminology.			X
2.7.1-4	**Concise Wording of System Messages**			
	System messages should be concise and clearly worded.			X
2.7.1-5	**Speaking Directly to Users**			
	Wording for system messages should be directed at the user.			X

Guideline #	Review Criteria	Yes	No	N/A
2.7.1-6	**Only Necessary Information Displayed**			
	No extraneous information should be displayed.			X
2.7.1-7	**Anthropomorphism**			
	Presenting the system as a person should be avoided.			X
2.7.1-8	**User Control of Automated Guidance/Help**			
	Experienced users should be able to define when and how guidance will be provided by automated guidance/help systems.			X
2.7.1-9	**Content of Online Help**			
	The content of help information should be oriented toward users' completion of their tasks; i.e., the information should be procedural.			X
2.7.1-10	**Display of Online Help**			
	The display of online help should not obscure important information.			X
2.7.1-11	**Interaction Styles**			
	Online help should accommodate users' differing levels of expertise and preferred interaction styles.			X
2.7.2	**Advisory Messages**			
2.7.2-1	**Distinctive and Consistent Advisory Messages**			
	Advisory messages should be distinctive.			X
2.7.2-2	**Redundant Display**			
	Important information should be presented through both visual and auditory means.			X
2.7.2-3	**Informing Users of Potential Data Loss**			
	Protection against data loss should be provided.			X
2.7.2-4	**Time-consuming processes**			
	Users should be informed when a command will be time-consuming to process.			X
2.7.3	**Error Messages**			
2.7.3-1	**Informative Error Messages**			
	When the computer detects an entry error, an error message should be displayed stating the error and possible subsequent operations.			X
2.7.3-2	**Task-Oriented Error Messages**			
	Wording for error messages should be appropriate to the task.			X
2.7.3-3	**Neutral Wording for Error Messages**			
	Error messages should use neutral wording.			X
2.7.3-4	**Non-Disruptive Error Messages**			
	The computer should display an error message only after completion of an entry.			X
2.7.3-5	**Invalid Action**			
	Where an entry is invalid or inoperative at the time of selection, no action should result except a display of an advisory message indicating the error and the appropriate functions, options, or commands.			X

Guideline #	Review Criteria	Yes	No	N/A
2.7.3-6	**Advisory Error Messages**			
	Where data or control entry is made from a small set of alternatives, error messages should indicate the correct alternatives.			X
2.7.3-7	**Displaying Erroneous Entries**			
	When an entry error has been detected, the erroneous entry should remain displayed until the error has been corrected.			X
2.7.3-8	**Cursor Placement Following Error**			
	In addition to providing an error message, the location of a detected error should be marked by positioning the cursor at that point on the display, i.e., at that data field or command word.			X
2.7.3-9	**Indicating Repeated Errors**			
	If a user repeats an error, a noticeable change should exist in the displayed error message.			X
2.7.3-10	**Errors in Stacked Commands**			
	If an error is detected in a group of entries, the system should process correct commands until the error is displayed.			X
2.7.3-11	**Multilevel Error Messages**			
	Following the output of a simple error message, users should be able to request a more detailed explanation of the error.			X
2.7.3-12	**Cautionary Messages**			
	When a data or command entry error is suspected but cannot be determined (in terms of system error logic), a cautionary message asking for confirmation should be displayed.			X
2.7.3-13	**Multiple Error Messages**			
	Notification should be made for each error when multiple errors are detected.			X
2.7.3-14	**Error Message Placement**			
	Error messages should be presented at the point of the error or in a consistent area of the display.			X
2.7.3-15	**Documenting Error Messages**			
	As a supplement to on-line guidance, system documentation should include a listing and explanation of all error messages.			X
2.7.4	**Validating User Input**			
2.7.4-1	**Automatic Data Validation**			
	Automatic data validation should be provided to check any item whose entry and/or correct format or content is required for subsequent data processing.			X
2.7.4-2	**Validation**			
	Data entries should be validated by the system for correct format, legal value, or range of values. Where repetitive entry of data sets is required, data validation for each set should be completed before another transaction can begin.			X

Guideline #	Review Criteria	Yes	No	N/A
2.7.4-3	**Stroke-By-Stroke Echo**			
	Data being entered through a keyboard should be echoed on the screen on a stroke-by-stroke basis, except when applied to passwords or other security measures.			X
2.7.4-4	**System Validation**			
	Where possible, when a command entry does not meet validation logic, a cautionary message should be displayed asking the user to confirm data entry.			X
2.7.4-5	**Data Verification by User Review**			
	When verification of prior data entries is required, users should be allowed to review and confirm the data, rather than re-entering the data.			X
2.7.4-6	**Cross Validation of Related Data**			
	For the entry of related data items, automatic cross validation should be provided to ensure that the data set is logically consistent.			X
2.7.4-7	**Displaying Default Values**			
	Currently operative default values should be displayed for data entry, so that users can review and confirm them for computer processing.			X
2.7.4-8	**Non-Disruptive Error Messages**			
	If data validation detects a probable error, an error message should be displayed to the user at the completion of data entry.			X
2.7.4-9	**Timely Validation of Sequential Transactions**			
	In a repetitive data entry task, the data for each transaction should be validated as it is completed, and the user should be allowed to correct errors before beginning another transaction.			X
2.7.4-10	**Optional Item-by-Item Validation**			
	Optional item-by-item data validation within a multiple-entry transaction should be provided.			X
2.7.4-11	**Deferral of Required Data Entry**			
	If a user wishes to defer entry of a required data item, the user should be required to enter a special symbol in the data field to indicate that the item has been temporarily omitted rather than ignored.			X
2.7.4-12	**Reminder of Deferred Entry**			
	If a user has deferred entry of required data but then requests processing of entries, that omission should be signaled to the user, and immediate entry (or perhaps further deferral) of missing items should be allowed.			X
2.7.4-13	**User Validation**			
	The user should be able to obtain a paper copy (screen dump) of the contents of alphanumeric or graphic displays.			X
2.7.5	**Confirming Entries**			
2.7.5-1	**User Confirmation of Destructive Entries**			
	When a control entry will cause any extensive change in stored information, procedures, and/or system operation, and particularly if that change cannot be easily reversed, the user should be notified and confirmation of the action should be required before implementing it.			X

Guideline #	Review Criteria	Yes	No	N/A
2.7.5-2	**Informing Users of Potential Information Loss**			
	For conditions that may require special user attention to protect against information loss, an explicit alert and/or advisory message should be provided to prompt appropriate user action.			X
2.7.5-3	**Preventing Data Loss at Logoff**			
	When a user requests logoff, pending transactions should be checked and if any pending transaction will not be completed, or if data will be lost, an advisory message requesting user confirmation should be displayed.			X
2.7.5-4	**Displaying Data to be Changed**			
	If a user requests change (or deletion) of a stored data item that is not currently being displayed, both the old and new values should be displayed so that the user can confirm or nullify the change before the transaction is completed.			X
2.7.6	**Protecting Data**			
2.7.6-1	**Protection from Computer Failure**			
	Automatic measures should be provided to minimize data loss from computer failure.			X
2.7.6-2	**Protection from Interrupts**			
	When a proposed user action will interrupt a current transaction sequence, automatic means to prevent data loss should be provided.			X
2.7.6-3	**Protection from Data Change**			
	When information must not be changed, users should not be permitted to change controlled items.			X
2.7.6-4	**Explicit Action to Select Destructive Modes**			
	Users should take explicit action to select any mode of interaction that might result in data loss.			X
2.7.6-5	**Safe Defaults**			
	If automatic defaults are provided for control entries, those defaults should protect against data loss, or at least not contribute to the risk of data loss.			X
2.7.6-6	**Protecting Physical Controls**			
	If activation of function keys (and other control devices) may result in data loss, they should be located separately and/or physically protected to reduce the likelihood of accidental activation.			X
2.7.6-7	**Disabling Unneeded Controls**			
	When function keys and other devices are not needed for current control entry, and especially when they may have destructive effects, they should be temporarily disabled by the software so that they cannot be activated by a user.			X
2.7.6-8	**Distinctive File Names**			
	When data files may be deleted (or overwritten) by name, the file names assigned by the system should be distinctive.			X

Guideline #	Review Criteria	Yes	No	N/A
2.7.6-9	**Feedback for Mode Selection**			
	When the result of user actions will be contingent upon prior selection among differently defined modes of interaction, a continuous indication of the current mode should be provided, particularly when user inputs in that mode might result in data loss.			X
2.7.6-10	**Protection from Interference by Other Users**			
	Data should be protected from inadvertent loss caused by the actions of other users.			X
2.7.6-11	**Segregating Real from Simulated Data**			
	When simulated data and system functions are displayed or provided (perhaps for user training), real data should be protected and real system use should be clearly distinguished from simulated operations.			X
2.7.6-12	**Data Entry/Change Transaction Records**			
	In situations where unauthorized data changes may be possible, users (or a system administrator) should be able to request a record of data entry/change transactions.			X
2.7.7	**Correcting Information/Command Entries**			
2.7.7-1	**Acknowledging Corrections**			
	All error corrections by the user should be acknowledged by the system, either by indicating a correct entry has been made or by another error message.			X
2.7.7-2	**UNDO to Reverse Control Actions**			
	Any user action should be immediately reversible by an UNDO command.			X
2.7.7-3	**User Review and Editing of Entries**			
	For all inputs, whether data entries or commands, users should be allowed to edit composed material before requesting computer processing.			X
2.7.7-4	**Immediate Error Correction**			
	When the system detects an error in a user input, the user should be allowed to make an immediate correction.			X
2.7.7-5	**Editing Entries After Error Detection**			
	Following error detection, users should be allowed to edit entries by rekeying only those portions that were in error.			X
2.7.7-6	**Explicit Entry of Corrections**			
	Users should be required to take an explicit ENTER action for computer processing of error corrections.			X
2.7.7-7	**Automated Correction Aid**			
	When inappropriate or unrecognized commands are detected, a list should be provided to the user showing permissible commands, anticipating the command intended.			X
2.7.7-8	**Flexible BACKUP for Error Correction**			
	Users should be allowed to BACKUP easily to previous steps in a transaction sequence in order to correct an error or make any other desired change.			X

Guideline #	Review Criteria	Yes	No	N/A
2.7.7-9	**Errors in Stacked Commands**			
	If an error is detected in a stacked series of command entries, the computer should either consistently execute to the point of error, or else consistently require users to correct errors before executing any command.			X
2.7.7-10	**Partial Execution of Stacked Commands**			
	If only a portion of a stacked command can be executed, the user should be notified and provided appropriate guidance to permit correction, completion, or cancellation of the stacked command.			X
2.7.7-11	**Replacing Erroneous Commands**			
	If a user makes a command entry error, after the error message has been displayed, the user should be allowed to enter a new command.			X
2.7.7-12	**Correcting Command Entry Errors**			
	If a command entry is not recognized, the user should be allowed to revise the command rather than rejecting the command outright.			X
2.7.8	**User Guidance/Help**			
2.7.8-1	**On-Line Guidance**			
	Reference material describing system capabilities, procedures, and commands and abbreviations, should be available on-line.			X
2.7.8-2	**Access to Guidance**			
	Explicit actions should be required to access or suppress user guidance.			X
2.7.8-3	**HELP Request**			
	At any point in an interaction, users should be able to access on-line user guidance by means of a simple action that is consistent throughout the interface.			X
2.7.8-4	**HELP Guidance**			
	Advisory messages or prompts should be available to guide users in accessing help messages.			X
2.7.8-5	**Synonyms for Standard Terminology**			
	When a user requests HELP on a topic, the computer should accept synonyms and abbreviations.			X
2.7.8-6	**Context-Sensitive HELP**			
	The information presented in response to a HELP request should be tailored to the task context.			X
2.7.8-7	**Clarifying HELP Requests**			
	When a request for HELP is ambiguous in context, the computer should initiate a dialogue to specify what data, message, or command requires explanation.			X
2.7.8-8	**Multilevel HELP**			
	When a HELP display provides summary information, more detailed explanations should be available.			X
2.7.8-9	**Browsing HELP**			
	Users should be able to browse on-line HELP.			X

Guideline #	Review Criteria	Yes	No	N/A
2.7.8-10	**Return from HELP**			
	The user should be able to easily return to the task after accessing HELP.			X
2.7.8-11	**Hardcopy Procedures**			
	A complete hardcopy set of computer system operating procedures and contingency procedures should be available in the control room.			X
2.7.8-12	**Computer System Procedures**			
	Procedures should be prepared from the point of view of the user.			X
2.7.8-13	**Display Indices**			
	Cross-indices of the available data displays should be available in the control room in hardcopy form.			X
2.8	**Interface Flexibility**			
2.8-1	**Appropriate Use of HSI Flexibility Features**			
	Flexible HSI features should be provided when they provide specific benefits to user tasks and their use does not impair user performance.			X
2.8-2	**Design for User Requirements**			
	Users should not have to use flexible interface features to support tasks and circumstances that could have been anticipated and designed for.			X
2.8-3	**Scope of Flexibility**			
	The system should be sufficiently flexible to enable users to respond to unanticipated situations or where personal preference can positively impact performance.			X
2.8-4	**Limits to Flexibility**			
	Users' flexibility in configuring the interface should not be unlimited.			X
2.8-5	**Default Configuration and HSI Flexibility Features**			
	Displays that can be modified by users should provide a means for the user to rapidly return the display to its default configuration.			X
2.8-6	**Changes to Display Characteristics**			
	Users should not be able to change display characteristics that have been specifically designed to convey information important to their tasks.			X
2.8-7	**User Expertise and HSI Flexibility Features**			
	The design of flexible HSI features should provide capabilities that are consistent with the levels of expertise of the users.			X
2.9	**System Security**			
2.9.1	**User Identification**			
2.9.1-1	**Automated Security Measures**			
	When required, automated measures to protect data security should be provided, relying on computer capabilities rather than on more fallible human procedures.			X
2.9.1-2	**Notification of Threats to Security**			
	Messages or signals should be provided in order to notify users (and system administrators) of potential threats to data security (i.e., of attempted intrusion by unauthorized users).			X

Guideline #	Review Criteria	Yes	No	N/A
2.9.1-3	**Auxiliary Tests to Authenticate User Identity**			
	When system security requires more stringent user identification than is provided by password entry, auxiliary tests should be devised that authenticate user identity without imposing impractical demands on the user's memory.			X
2.9.1-4	**Easy Logon**			
	The logon process and procedures for user identification should be as simple as possible, consistent with protecting the system and associated data.			X
2.9.1-5	**Private Entry of Passwords**			
	When a password must be entered by a user, password entry should not be displayed.			X
2.9.1-6	**User Choice of Passwords**			
	When passwords are required, users should be allowed to choose their own passwords and to change their passwords as needed.			X
2.9.1-7	**Limiting Unsuccessful Logon Attempts**			
	A maximum limit on the number and rate of unsuccessful logon attempts should be imposed.			X
2.9.1-8	**Continuous Recognition of User Identity**			
	Once a user's identity has been authenticated, any authorized data access/change privileges are for that user should continue throughout a work session.			X
2.9.1-9	**Single Authorization for Data Entry/Change**			
	User authorization should be established at initial logon.			X
2.9.1-10	**Logging On**			
	When users must log on to a system, logon should be a separate procedure that is completed before a user may select any operational options.			X
2.9.1-11	**Logon Frame**			
	The logon frame should appear as soon as possible on the display with no additional user involvement.			X
2.9.1-12	**Logon Delays**			
	Logon delays should be accompanied by an advisory message to tell the user its current status and when the system will become available.			X
2.9.1-13	**Immediate Start of Productive Work**			
	After completing the logon process, the user should be able to start productive work immediately.			X
2.9.1-14	**Logging Off**			
	If there are pending actions and the user requests a logoff, the system should inform the user that these actions will be lost and allow the user to cancel either the pending actions or the logoff.			X
2.9.1-15	**Saving Open Files in Automatic Logoff**			
	Where possible, in the event of automatic logoff, open files should be saved to some defined file name.			X

Guideline #	Review Criteria	Yes	No	N/A
2.9.1-16	**Automatic Logoff**			
	Interactive timesharing systems should allow some specified time between keyboard actions before automatic logoff unless a longer period is requested by the user.			X
2.9.1-17	**Audible Signal for Automatic Logoff**			
	An audible signal should be presented at specified intervals prior to automatic logoff.			X
2.9.2	**Information Access**			
2.9.2-1	**Encryption**			
	When sensitive data may be exposed to unauthorized access, a capability for encrypting those data should be provided.			X
2.9.2-2	**Ensuring Reversible Encryption**			
	Encrypted data should be protected from any change that might prevent successful reversal of their encryption.			X
2.9.2-3	**Displayed Security Classification**			
	When displayed data are classified for security purposes, a prominent indication of security classification should be included in each display.			X
2.9.2-4	**Display Suppression for Security**			
	When confidential information is displayed at a workstation that might be viewed by casual onlookers, the user should be provided with some rapid means of temporarily suppressing a current display if its privacy is threatened, and then resuming work later.			X
2.9.2-5	**Protecting Printed Data**			
	As required for security, procedures to control access to printed data should be established, rather than simply prohibiting the printing of sensitive data.			X
2.9.2-6	**Protecting Display Formats**			
	Display formatting features, such as field labels and delimiters, should be protected from accidental change by users.			X
2.9.2-7	**Protecting Displayed Data**			
	When protection of displayed data is essential, computer control over the display should be maintained.			X
2.9.2-8	**Indicating 'Read-Only' Displays**			
	When users are not authorized to change displayed data, "read-only" status should be indicated on the display.			X
2.9.2-9	**Automatic Records of Data Access**			
	When records of data access are necessary, the records should be maintained automatically.			X
3	**CONTROLS**			
3.1	**General Control Guidelines**			
3.1.1	**Design Principles**			
3.1.1-1	**Appropriate Use of Input Devices**			
	Input and control devices provided for interacting with the HSI should be appropriate for the user's task requirements.	X		

Guideline #	Review Criteria	Yes	No	N/A
3.1.1-2	**Input Device Stability**			
	Input and control devices should be stable during normal usage, i.e., they should not slip or rock, unless such actions are a part of the controller operation.	X		
3.1.1-3	**Feedback**			
	Visual or auditory feedback should be provided to indicate that the system has received a control input.	X		
3.1.1-4	**Accidental Input or Actuation Prevention**			
	The system should be located and designed to prevent the accidental manipulation of control and input devices that could result in changes to the status of the system functions, components, or data.	X		
3.1.1-5	**Location**			
	Controls should be operable from the location where the user is most likely to need to interact with the system.	X		
3.1.1-6	**Speed**			
	Controls should provide rapid positioning of cursors or selection of choices.			X
3.1.1-7	**Accuracy**			
	The accuracy of the control device or method should be commensurate with the functions to be served.	X		
3.1.1-8	**Displacement**			
	Control design should allow the user freedom of movement to perform other duties.			X
3.1.1-9	**Range and Precision**			
	Control should provide the sufficient range and precision required by the task.	X		
3.1.1-10	**Economy**			
	Each control or input device should be necessary, use minimal space, and be the simplest effective control for the task concerned.	X		
3.1.1-11	**Human Suitability**			
	Controls and input devices should be suitable for use in a control room environment.			X
3.1.1-12	**Compatibility with Emergency Gear**			
	If used while wearing protective equipment (e.g., oxygen masks and protective gloves), controls and input devices should be easy to identify and activate, or use.			X
3.1.1-13	**Durability**			
	Controls and input devices should be sufficiently rugged to withstand normal and emergency use.	X		
3.1.1-14	**Control Activation**			
	Controls and input devices should require distinct or sustained effort for activation.	X		

Guideline #	Review Criteria	Yes	No	N/A
3.1.1-15	**Sequential Activation**			
	When a strict sequential activation is necessary, controls should be provided with locks to prevent the controls from passing through a position.			X
3.1.1-16	**Population Stereotypes**			
	Control movements should conform to population stereotypes (see Figure 3.1).	X		
3.1.2	**Coding of Controls**			
3.1.2-1	**Consistency**			
	The coding system should be uniform throughout the control room.			X
3.1.2-2	**Size Coding Levels**			
	No more than three different sizes of controls should be used for discrimination by absolute size.			X
3.1.2-3	**Size Coding Uniformity**			
	Controls used for performing the same function on different items of equipment should be the same size.			X
3.1.2-4	**Shape Coding**			
	When possible, controls should be differentiated by shape.			X
3.1.2-5	**Color Coding Contrast**			
	The color of the control should contrast with the panel background.			X
3.1.2-6	**Color Coding Between Control and Display**			
	When color coding is used to relate a control to its corresponding display, the same color should be used for both the control and the display.			X
3.1.2-7	**Location Coding by Function**			
	Controls should be located so as to be easily related to functions and functional groupings.			X
3.1.2-8	**Location Coding Across Panels**			
	Controls with similar functions should be in the same location from panel to panel.			X
3.2	**Input Devices**			
3.2.1	**Alphanumeric Keyboards**			
3.2.1-1	**General Keyboard Layout**			
	An ANSI standard (QWERTY) layout should be used for the typing keyboard.			X
3.2.1-2	**Numeric Keypad**			
	When users must enter numeric data, keyboards should be equipped with a numeric keypad.			X
3.2.1-3	**Numeric Keypad Layout**			
	Keypads used for numeric entry should be consistently designed.			X
3.2.1-4	**Cursor Control Capability**			
	Horizontal and vertical cursor control keys should be provided for text processing applications.			X

Guideline #	Review Criteria	Yes	No	N/A
3.2.1-5	**Cursor Key Layout**			
	Cursor control keys should be arranged in a two-dimensional layout so that their orientation is compatible with the cursor motion they produce.			X
3.2.1-6	**Overlays**			
	Mechanical overlays, such as coverings over the keyboard, should be not used.			X
3.2.1-7	**Keyboard Surfaces**			
	A matte finish should be used for keyboard surfaces.			X
3.2.1-8	**Keyboard Thickness**			
	1.25 inches (30 mm) or less is preferred.			X
3.2.1-9	**Keyboard Slope Adjustment**			
	The slope of the keyboard should be adjustable by the user.			X
3.2.1-10	**Standard Keyboard Placement**			
	The user should be able to reposition the standard keyboard on the worksurface.			X
3.2.1-11	**Keytop Size**			
	The minimum horizontal strike surface of the keytop should be at least 0.47 inches (12 mm) in width.			X
3.2.1-12	**Key Symbol Size and Contrast**			
	The primary symbols on the keys should be a minimum of 0.1 inches (2.5 mm) in height and has a contrast ratio of 3:1.			X
3.2.1-13	**Keytop Symbol Marking**			
	Key symbols should be etched (to resist wear) and colored with high contrast lettering.			X
3.2.1-14	**Key Spacing**			
	Center line distances between adjacent keys should be between 0.71 and 0.75 inches (18 and 19 mm) horizontally and between 0.71 and 0.82 inches (18 and 21 mm) vertically.			X
3.2.1-15	**Key Height**			
	Key height for alphanumeric keyboards should be between 0.35 and 0.5 inches (10 and 13 mm).			X
3.2.1-16	**Key Force**			
	The maximum force required to depress keys should be between 0.9 and 5.4 ounces (0.25 and 1.5 N); a key force of between 1.8 and 2.2 ounces (0.5 and 0.6 N) is preferred.			X
3.2.1-17	**Key Displacement**			
	Keys should have a maximum vertical displacement between 0.05 and 0.25 inches (1.5 mm and 6.0 mm); the preferred displacement is between 0.1 and 0.15 inches (2.0 and 4.0 mm).			X
3.2.1-18	**Keying Feedback**			
	The actuation of a key should be accompanied by tactile or auditory feedback or both.			X

Guideline #	Review Criteria	Yes	No	N/A
3.2.1-19	**Repeat Capability**			
	A repeat capability for alphanumeric, symbol character, and cursor keys should be provided.			X
3.2.1-20	**Rapid Keystrokes**			
	Rapid bursts of keystrokes should not result in characters to be lost or transmitted out of sequence.			X
3.2.1-21	**Keystroke Commands**			
	When it is necessary to distinguish command entries from text input, a specially designated key should be one of the keys used for keystroke commands.			X
3.2.1-22	**Simultaneous Keystrokes**			
	Commands executed by chord-keying should require the user to press the keys simultaneously, not in close temporal sequence.			X
3.2.1-23	**Inadvertent Operation**			
	Keys with major or destructive effects should be located so that inadvertent operation is unlikely.			X
3.2.1-24	**Alternate Key Definitions**			
	When the keyboard is redefined, a display of the alternate characters and their locations should be available to the user.			X
3.2.2	**Function Keys**			
3.2.2-1	**Availability**			
	Fixed function keys should be available to control functions that are often utilized and continuously available.			X
3.2.2-2	**Inactive Function Keys**			
	Unneeded function keys, either fixed or programmable, should be disabled so that no other action occurs upon their depression except an advisory message.			X
3.2.2-3	**Inactive Keys**			
	Non-active fixed function keys should not be present on the keyboard.			X
3.2.2-4	**Grouping**			
	Fixed function keys should be logically grouped and placed in distinctive locations on the keyboard.			X
3.2.2-5	**Function Labels**			
	Key assignments should be displayed at all times, preferably through direct marking.			X
3.2.2-6	**Consistency**			
	Fixed function keys should be used consistently throughout the system.			X
3.2.2-7	**Actuation**			
	Fixed function keys should require only a single actuation to accomplish their function.			X
3.2.2-8	**Repeat for Special Functions**			
	Function keys (except for the delete key) should not repeat upon prolonged depression.			X

Guideline #	Review Criteria	Yes	No	N/A
3.2.2-9	**Status Display**			
	When the effect of a function key varies, the status of the key should be displayed.			X
3.2.2-10	**Easy Return to Initial Functions**			
	Where the functions assigned to a set of function keys change as a result of user selection, the user should be given an easy means to return to the initial functions.			X
3.2.2-11	**Reprogrammable or Inactive Default Functions**			
	When keys with labeled default functions are reprogrammed or turned off, a visual indication should alert the user that the standard function is not currently accessible via that key.			X
3.2.2-12	**Shifted Characters**			
	Shift keys should be not required to operate variable function keys.			X
3.2.3	**Trackballs, Joysticks, and Mice**			
3.2.3-1	**Dynamic Characteristics**			
	The controller should be able to produce any combination of x-and y-axis output values.			X
3.2.3-2	**Positive Centering**			
	If there is a "home position," the capability for an automatic return to that point should be provided.			X
3.2.3-3	**Single Monitor/Single Controller Cursor Travel Limits**			
	In a single monitor/single controller environment, movement of the controller should drive the follower to the edge of the screen only and not off the screen.			X
3.2.3-4	**Separation of Selectable Screen Items**			
	Selectable screen items or regions should be separated from each other by a sufficient distance to minimize inadvertent activation of adjacent items or regions.			X
3.2.3-5	**Selectable Tracking Speed**			
	The user should be able to select the controller tracking speed (control-display ratio) from a predefined range; the default speed should be moderate.			X
3.2.3-6	**Selectable Inter-Click Interval**			
	If multiple clicks are required on a selection button, the user should be able to select the inter-click interval from a predefined range; the default interval should be moderate.			X
3.2.3-7	**Limb Support for Trackballs and Mice**			
	When trackballs and mice are used to make precise or continuous adjustments, hand, wrist, or arm supports should be provided.			X
3.2.3-8	**Mouse Shape**			
	The mouse should have no sharp edges but should be shaped roughly as a rectangular solid.			X

Guideline #	Review Criteria	Yes	No	N/A
3.2.3-9	**Use of Mouse by Either Hand**			
	Users should be able to configure a mouse for right- or left-handed operation.			X
3.2.3-10	**Appropriate Use of Displacement (Isotonic) Joysticks**			
	Displacement joysticks are preferred over force joysticks when positioning accuracy is more critical than positioning speed.			X
3.2.3-11	**Appropriate Use of Force (Isometric) Joysticks**			
	Force joysticks are preferred over displacement joysticks when precise or continuous control in two or more related dimensions is required.			X
3.2.3-12	**Force Joysticks Dynamic Characteristics**			
	The output of the force joystick should be proportional to and in the same direction as the user's perceived applied force. Maximum force for full output should not exceed 27 lb (118 N).			X
3.2.3-13	**Displacement Joystick Dynamic Characteristics**			
	The output of the displacement joystick should be proportional to and in the same direction as the displacement of the joystick from the center. Movement should not exceed 45 degrees from the center position.			X
3.2.3-14	**Hand-Operated Joysticks Dimensions and Clearance**			
	The handgrip length should be between 4.25 to 7 inches (110 to 180 mm). The grip diameter should not exceed 2 inches (50 mm). Clearances of 4 inches (100 mm) to the side and 2 inches (50 mm) to the rear should be provided to allow for hand movement.			X
3.2.4	**Touch Screens, Light Pens, and Graphic Tablets**			
3.2.4-1	**Appropriate Use of Touch Screens**			
	Touch screens are not recommended if the task requires holding the arm up to the screen for long periods of time.			X
3.2.4-2	**Appropriate Use of a Light Pen**			
	A light pen may be used for non-critical input when precise positioning is not required; it should not be used when the task would require holding the pen up to the screen for long periods of time.			X
3.2.4-3	**Appropriate Use of a Graphics Tablet**			
	Grid and stylus devices may be used for picking data from a display and entering points on a display.			X
3.2.4-4	**Activation**			
	Light pens and graphics tablets should be equipped with an actuating/deactuation mechanism.			X
3.2.4-5	**Feedback**			
	Two forms of feedback should be provided: (1) feedback concerning the position of the follower, and (2) feedback that the pointing device has actuated and the input has been received by the system.			X
3.2.4-6	**Dynamic Characteristics**			
	When used as a two-axis controller, movement of the pointing device in any direction on the surface of the screen or tablet should result in smooth movement of the follower in the same direction.			X

Guideline #	Review Criteria	Yes	No	N/A
3.2.4-7	**Follower Visibility**			
	For touch screens and light pens, the follower should be visible on screen while the pointing device is touching the screen.			X
3.2.4-8	**Serial Command Response**			
	The system should accept only one command at a time.			X
3.2.4-9	**Feedback for Multiple Workstations**			
	Discriminable audible beeps (used to supply feedback) should be used when more than one touch screen, light pen, or graphics tablet is employed.			X
3.2.4-10	**Dimensions and Separation of Touch Zones**			
	To allow for finger size and parallax inaccuracy, the dimensions of response areas of touch screens should be a maximum height and width of 1.5 inches (40 mm) and a minimum height and width of 0.6 inches			X
3.2.4-11	**Touch Screen Resistance**			
	Force required to operate force-actuated touch screens should be a maximum of 5.3 ounces (1.5 N) and minimum of 0.9 ounces (0.25 N).			X
3.2.4-12	**Neutral Tint of Touch Overlays**			
	Touch screen overlays should have a neutral tint that does not distort colors or interfere with color coding.			X
3.2.4-13	**Touch Screen Luminance Transmission**			
	Touch screen displays should have sufficient luminance transmission to allow the display with touch screen installed to be clearly readable in the intended environment.			X
3.2.4-14	**Light Pen Dimensions and Mounting**			
	The light pen should be between 4.75 to 7 inches (120 to 180 mm) long with a diameter of 0.3 to			X
3.2.4-15	**Graphic Tablet Size and Orientation**			
	Transparent grids that are used as display overlays should conform to the size of the display. Grids that are displaced from the display should approximate the display size and should be mounted below the display in an orientation to preserve directional relationships to the maximum extent.			X
3.3	**Conventional Control Devices**			
3.3.1	**Pushbutton Controls**			
3.3.1.1	**General**			
3.3.1.1-1	**Position**			
	Pushbuttons in a row or matrix should be positioned in a logical order, or in an order related to the procedural sequence.	X		
3.3.1.1-2	**Indication of Activation**			
	To ensure that the user knows that a pushbutton has been pressed far enough for activation, a positive indication should be provided.	X		
3.3.1.1-3	**Pushbutton Surface**			
	The surface of a pushbutton should offer slip resistance or be concave.	X		

Guideline #	Review Criteria	Yes	No	N/A
3.3.1.2	**Round Pushbuttons**			
3.3.1.2-1	**Dimensions of Round Pushbuttons**			
	Round pushbuttons should conform to the dimensions given in Figure 3.5.			X
3.3.1.2-2	**Resistance of Round Pushbuttons**			
	Resistance should be 10 to 40 ounces (2.8 to 11.1 N) for fingertip operation and 10 to 80 ounces (2.8 to 22.2 N) for thumb or palm operation.			X
3.3.1.3	**Legend Pushbuttons**			
3.3.1.3-1	**Discriminability**			
	Legend pushbuttons should be readily distinguishable from legend lights.			X
3.3.1.3-2	**Legend**			
	The legend should be readable under all environmental conditions.			X
3.3.1.3-3	**Lamp Reliability**			
	A lamp test or dual lamp/dual filament capability should be provided if the mean time between failure is less than 100,000 hours.			X
3.3.1.3-4	**Easy Replacement of Covers**			
	Lamps within the pushbutton should be replaceable from the front of the panel.			X
3.3.1.3-5	**Safe Replacement of Lamps**			
	Legend pushbuttons should not short out during lamp replacement or be susceptible to inadvertent activation during the process of lamp removal or replacement.			X
3.3.1.3-6	**Correct Replacement of Covers**			
	Legend covers should be keyed to prevent the possibility of interchanging the covers.			X
3.3.1.3-7	**Barriers**			
	Barriers should be used when legend pushbuttons are contiguous.			X
3.3.1.3-8	**Dimensions of Legend Pushbuttons**			
	Legend pushbuttons should conform to the dimensions shown in Figure 3.6.			X
3.3.1.3-9	**Resistance of Legend Pushbuttons**			
	Resistance should be 10 to 60 ounces (2.8 to 16.7 N).			X
3.3.2	**Rotary Controls**			
3.3.2.1	**General**			
3.3.2.1-1	**Direction of Activation**			
	Rotary control settings should increase in value with a clockwise rotation.			X
3.3.2.1-2	**Rotary Control Shape Coding**			
	Shape coding should be employed if rotary controls used for widely different functions are placed on the same panel.			X
3.3.2.1-3	**Coding Specifications**			
	Shape-coded rotary controls should be visually and tactually identifiable.			X

Guideline #	Review Criteria	Yes	No	N/A
3.3.2.1-4	**Rotating Knob Shape Options**			
	Rotating knob controls for different types of control actions should be distinguishable by sight and touch and not easily confused with each other.			X
3.3.2.1-5	**Rotary Action Control Applications**			
	Rotary action controls should be used in situations where linear or pushbutton controls would be subject to inadvertent activation and fixed protective structures are impractical or inappropriate.			X
3.3.2.2	**J-Handles**			
3.3.2.2-1	**Dimensions of J-Handles**			
	High torque J-handles should conform to the dimensions shown in Figure 3.8.			X
3.3.2.2-2	**Resistance of J-Handles**			
	Resistance should be 6 to 12 inch-pounds (0.7 to .14 N-m).			X
3.3.2.2-3	**Low-Torque Designs**			
	When using smaller scale J-handles, the handle portion usually has a flattened or flared tip for finger placement, and the clearance between handle and panel surface can be less.			X
3.3.2.3	**Key-Operated Controls**			
3.3.2.3-1	**Use**			
	Key-operated controls should be used when system requirements dictate that the function being controlled should be secured against activation by unauthorized personnel.			X
3.3.2.3-2	**Teeth: Single Row**			
	Keys with a single row of teeth should be inserted into the lock with the teeth pointing up or forward.			X
3.3.2.3-3	**Teeth: Double Row**			
	Keys with teeth on both edges should fit the lock with either side up or forward.			X
3.3.2.3-4	**Off Orientation**			
	Locks should be oriented so that the OFF or SAFE state is in effect when the key is in the vertical position.			X
3.3.2.3-5	**Key Removal**			
	Users should not normally be able to remove the key from the lock unless the switch is turned to the OFF or SAFE position.			X
3.3.2.3-6	**Labeling**			
	Control positions should be labeled.			X
3.3.2.3-7	**Actuation of Key Switch**			
	Actuation of an item by a key operated switch should be accomplished by turning the key clockwise from the vertical OFF (i.e., upright) position.			X
3.3.2.3-8	**Dimensions of Key-Operated Controls**			
	Key-operated control dimensions should conform to the dimensions shown in Figure 3.9.			X

Guideline #	Review Criteria	Yes	No	N/A
3.3.2.3-9	**Resistance of Key-Operated Controls**			
	The resistance of key-operated controls should be 1 to 6 inch-pounds (0.11 to 0.68 N-m).			X
3.3.2.4	**Continuous Adjustment Controls**			
3.3.2.4-1	**Knobs**			
	Knobs for continuous adjustment controls should be round in shape, with knurled or serrated edges.			X
3.3.2.4-2	**Position Indication**			
	When an indication of position is desirable, it should allow the user to easily recognize the position.			X
3.3.2.4-3	**Knob Dimensions**			
	Fingertip grasp knobs should be between 0.5 and 1 inch (13 and 25 mm) in height and between 0.375 and 4 inches (10 and 100 mm) in diameter. Thumb and forefinger encircled knobs should be between 1 and			X
3.3.2.4-4	**Knob Torque**			
	Knob torque should be within the range of 4.5 to 6.0 inch-ounces (32 to 42 mN-m).			X
3.3.2.4-5	**Dimensions of Knobs with Skirts**			
	Knobs with skirts should conform to the dimensions shown in Figure 3.10.			X
3.3.2.5	**Rotary Selector Controls**			
3.3.2.5-1	**Selection**			
	Rotary selector controls should be used when three or more detented positions are required, and may also be used for two-detented position operation.			X
3.3.2.5-2	**Positioning**			
	Detents should be provided at each control position to ensure proper positioning of a discrete rotary control.			X
3.3.2.5-3	**Readability**			
	Rotary controls should have a moving pointer and fixed position settings to maximize readability.			X
3.3.2.5-4	**Position Indication**			
	Position indication should be provided.			X
3.3.2.5-5	**Dimensions of Rotary Selector Controls**			
	Rotary selector controls should conform to the dimensions shown in Figure 3.11.			X
3.3.2.5-6	**Resistance of Rotary Selector Controls**			
	Resistance should be 1 to 6 inch-pounds (0.11 to 0.68 N-m).			X
3.3.2.5-7	**Momentary Contact Rotary Selector Controls**			
	Knobs for spring-loaded momentary contact rotary selector controls should be large enough to be easily held against the spring torque, without fatigue, for as long as necessary to accomplish the control action.			X

Guideline #	Review Criteria	Yes	No	N/A
3.3.3	**Other Controls**			
3.3.3.1	**Thumbwheels**			
3.3.3.1-1	**Visibility**			
	To minimize error, thumbwheel readouts should be visible from the thumbwheel operating position.			X
3.3.3.1-2	**Coding**			
	If the thumbwheel is used as an input device, the OFF, zero, or normal position should be coded to facilitate visual recognition of status.			X
3.3.3.1-3	**Dimensions of Continuous Adjustment Thumbwheels**			
	At least 1 inch of circumference of a continuous adjustment thumbwheel should be exposed to permit easy manipulation.			X
3.3.3.1-4	**Resistance of Continuous Adjustment Thumbwheels**			
	The resistance of a continuous adjustment thumbwheel should be between 3 and 6 ounces.			X
3.3.3.1-5	**Dimensions of Discrete Thumbwheel Controls**			
	Discrete thumbwheel controls should conform to the dimensions shown in Figure 3.12.			X
3.3.3.1-6	**Resistance of Discrete Thumbwheel Controls**			
	The resistance of discrete thumbwheel controls should be 6 to 20 ounces (1.7 to 5.6 N).			X
3.3.3.2	**Slide Switches**			
3.3.3.2-1	**Surface**			
	The surface of slide switches should be serrated or knurled.			X
3.3.3.2-2	**Detents**			
	Detents should be provided for each slide switch setting.			X
3.3.3.2-3	**Accidental Actuation**			
	Channel guards or other preventive features should be provided when accidental actuation would have undesirable consequences.			X
3.3.3.2-4	**Orientation**			
	Slide switches should be vertically oriented.			X
3.3.3.2-5	**Positive Indication**			
	Slide switches involving more than two positions should be designed to provide positive indication of the control setting, preferably a pointer located on the left side of the slide handle.			X
3.3.3.2-6	**Dimensions of Slide Switches**			
	Slide switches should conform to the dimensions shown in Figure 3.13.			X
3.3.3.3	**Toggle Switches**			
3.3.3.3-1	**Positioning**			
	To minimize the possibility of inadvertent activation or setting between control positions, toggle switches should have an elastic resistance that increases as the control is moved and drops as the switch snaps into position.			X

Guideline #	Review Criteria	Yes	No	N/A
3.3.3.3-2	**Feedback**			
	Toggle switches should emit an audible click, or provide some other source of feedback on activation.			X
3.3.3.3-3	**Dimensions of Toggle Switches**			
	Toggle switches should conform to the dimensions shown in Figure 3.14.			X
3.3.3.3-4	**Resistance of Toggle Switches**			
	Resistance should be 10 to 16 ounces (2.8 to 4.4 N) for small switches and 10 to 40 ounces (2.8 to			X
3.3.3.4	**Rocker Switches**			
3.3.3.4-1	**Orientation**			
	Rocker switches should ordinarily be oriented vertically.			X
3.3.3.4-2	**Indication of Activation**			
	Activation should be indicated by a snap feel, an audible click, or an integral light.			X
3.3.3.4-3	**Resistance**			
	Control resistance should gradually increase, then drop to zero when the control snaps into position.			X
3.3.3.4-4	**Inadvertent Activation**			
	If it controls a critical function, the switch should be protected by channel guards or other means to prevent inadvertent activation.			X
3.3.3.4-5	**Dimensions of Rocker Switches**			
	Rocker switches should conform to the dimensions shown in Figure 3.15.			X
3.3.3.4-6	**Resistance of Rocker Switches**			
	Resistance should be 10 to 40 ounces (2.8 to 11.1 N).			X
4	**ALARM SYSTEM**			
4.1	**Alarm System High-Level Functions**			
4.1.1	**Alarm Definition**			
4.1.1-1	**Alarm Selection**			
	The following criteria should be included in the basis for selecting alarm conditions: • Monitoring critical safety functions and key parameters, • Preventing personnel hazards, • Avoiding significant damage to equipment having a safety function, • Assuring that technical specifications are met, • Monitoring emergency procedure decision points, and • Monitoring plant conditions appropriate to plant modes ranging from full power to shutdown.	X		
4.1.1-2	**Timely Warning**			
	Alarm set points should be determined to ensure that the operating crew can monitor and take appropriate action for each category of alarms, e.g., respond to out-of-tolerance conditions, in a timely manner.	X		

Guideline #	Review Criteria	Yes	No	N/A
4.1.1-3	**Setpoint Determination and Nuisance Alarm Avoidance**			
	The determination of alarm setpoints should consider the trade-off between the timely alerting of an operator to off-normal conditions and the creation of nuisance alarms caused by establishing setpoints so close to the "normal" operating values that occasional excursions of no real consequence are to be expected.	X		
4.1.1-4	**Darkboard Configuration**			
	Alarms and setpoints should be designed so that only parameters and conditions that fall outside of the normal and expected range and that require operator attention or action are in the alarm state.	X		
4.1.2	**Alarm Processing**			
4.1.2-1	**Assured Functionality Under High Alarm Conditions**			
	The alarm processing system should ensure that alarms that require immediate action or indicate a threat to plant critical safety functions are presented in a manner that supports rapid detection and understanding under all alarm loading conditions.	X		
4.1.2-2	**Alarm Reduction**			
	The number of alarm messages presented to the crew during off-normal conditions should be reduced by alarm processing techniques (from a no-processing baseline) to support the crew's ability to detect, understand, and act upon all alarms that are important to the plant condition within the necessary time.			X
4.1.2-3	**Alarm Signal Validation**			
	Sensor and other input signals should be validated to ensure that spurious alarms are not presented to plant personnel, due to sensor or processing system failure.			X
4.1.2-4	**Parameter Stability Processing**			
	The alarm system should incorporate the capability to apply time filtering, time delay, or deadbanding to the alarm inputs to allow filtering of noise signals and to eliminate unneeded momentary alarms.			X
4.1.2-5	**Segregation of Status Indications**			
	Status indications, messages that indicate the status of plant systems but are not intended to alert the user to the need to take action, generally should not be presented via the alarm system display because they increase the demands on the users for reading and evaluating alarm system messages.			X
4.1.2-6	**First-Out Processing**			
	As an aid to diagnostic procedures and root cause analysis, provision should be made for identifying the initiating event associated with automatic plant trips through the use of first-out alarms.			X
4.1.2-7	**Mode Dependence Processing**			
	If a component's status or parameter value represents a fault in some plant modes and not others, it should be alarmed only in the appropriate modes.			X

Guideline #	Review Criteria	Yes	No	N/A
4.1.2-8	**System Configuration Processing**			
	If a component's status or parameter value represents a fault in some system configurations and not others, it should be alarmed only in the appropriate configurations.			X
4.1.2-9	**Logical Consequences Processing**			
	If a single event invariably leads to subsequent alarmed events that are the direct consequence of this event, only the alarm message associated with the main event may be presented and the other alarm messages suppressed, so long as this does not interfere with the use of alarm information.			X
4.1.2-10	**Exceptions to Expected Alarm Patterns**			
	The system should notify the user when 'unexpected' alarms occur, if the alarm processing logic can support such an analysis.			X
4.1.2-11	**Intelligibility of Processed Alarm Information**			
	The alarm system should provide functions that enable users to evaluate the meaning or validity of the alarm messages resulting from alarm processing; for example, it should be possible to view the inputs to the alarm processing system.	X		
4.1.3	**Alarm Prioritization and Message Availability**			
4.1.3-1	**Prioritization Criteria**			
	Alarm messages should be presented in prioritized form to indicate urgency (immediacy of required action) and challenges to plant safety.			X
4.1.3-2	**Access to Suppressed Alarms**			
	When alarm suppression is used, the user should be able to access the alarm information that is not displayed.	X		
4.1.3-3	**Filtered Alarms**			
	Alarm filtering should only be employed where alarm messages have no current operational significance to the crew's monitoring, diagnosis, decision making, procedure execution, and alarm response activities.			X
4.2	**Information Display**			
4.2.1	**General Alarm Display Guidelines**			
4.2.1-1	**Display Functions**			
	The alarm display should support the user's ability to rapidly discern: • Priority (e.g., urgency for action and importance to plant safety); • Distinct alarm states: new, acknowledged, and cleared; • The first-out alarms for reactor trip; • The need to access other displays to verify or clarify the alarm state; and • The difference between alarms which can be cleared through ongoing corrective actions (i.e., by operations personnel) and alarms that require significant maintenance intervention.	X		

Guideline #	Review Criteria	Yes	No	N/A
4.2.1-2	**Coordination of Alarm Alerting and Informing Functions**			
	When alarm alerts are displayed separately from detailed alarm information, the design should support rapid transitions between alerts and detailed information.			X
4.2.1-3	**Presentation of Alarm Priority with Detailed Alarm Information**			
	When alarm alerts are displayed separately from detailed alarm information, the detailed alarm information display should provide an indication of the priority and status of the alarm condition.			X
4.2.1-4	**Use of Spatially Dedicated, Continuously Visible Displays**			
	Spatially dedicated, continuously visible (SDCV) alarm displays should be considered for: • Regulatory Guide 1.97 Category 1 parameters, • Alarms that require short-term response, • The most important alarms used in diagnosing and responding to plant upsets, and • The most important alarms used to maintain an overview of plant and system status.			X
4.2.1-5	**Alarm Coding Consistency**			
	Coding (e.g., flash-rate, intensity, and color coding) conventions should be consistently applied throughout alarm displays (e.g., on tiles and on VDUs).	X		
4.2.1-6	**Multi-Unit Alarms**			
	Alarms for any shared systems in multiple-unit plants should be duplicated in all control rooms.			X
4.2.2	**Display of High-Priority Alarms**			
4.2.2-1	**Precedence for Important Information**			
	Alarms that have higher importance or greater safety significance should be given greater priority in their presentation than less important or significant alarms.	X		
4.2.2-2	**Simultaneous Display of High-Priority Alarms**			
	For non-spatially dedicated alarm presentations such as VDU message lists, sufficient display area should be provided for the simultaneous viewing of all high-priority alarms.			X
4.2.2-3	**Coding of Alarm Priority**			
	A method of coding the visual signals for priority should be employed.			X
4.2.3	**Display of Alarm Status**			
4.2.3-1	**Indication of Alarm Status**			
	Unacknowledged, acknowledged, and cleared alarm states should have unique presentations to support the users' ability to rapidly distinguish them.	X		
4.2.3-2	**Unacknowledged Alarm Indication**			
	Unacknowledged alarms should be indicated both by visual (e.g., flashing) and audible means.	X		

Guideline #	Review Criteria	Yes	No	N/A
4.2.3-3	**Notice of Undisplayed Unacknowledged Alarms**			
	If the user is not currently viewing the VDU display where unacknowledged alarm messages appear, the alarm system should notify the user that an alarm message is available, the priority of the alarm message, and the location where the alarm message can be found.	X		
4.2.3-4	**Acknowledged Alarm Indication**			
	After the user has acknowledged an alarm (e.g., pressed the acknowledge button), the alarm display should change to a visually distinct acknowledged state.	X		
4.2.3-5	**Clearing Alarm Ringback**			
	When an alarm clears (i.e., the parameter returns to the normal range from an abnormal range), the return to normal conditions should be indicated by visual and audible means.	X		
4.2.3-6	**Cleared Alarms That Re-Enter the Abnormal Range**			
	If an alarm has cleared but was not reset and the variable re-enters the abnormal range, then the condition should be presented as a new alarm.	X		
4.2.4	**Display of Shared Alarms**			
4.2.4-1	**Minimize Shared Alarms**			
	Alarms that are triggered by any one of an aggregate of individual alarms (e.g., 'Pump Trouble') and which require the operators to perform additional actions to determine the cause should be limited.			X
4.2.4-2	**Access to Shared Alarm Information**			
	The system should allow users to access the individual alarm information when a shared alarm activates.			X
4.2.4-3	**Shared Alarm Reflash**			
	If a new parameter deviation has occurred before a preceding alarm has cleared, the shared alarm should return to the new alarm state (e.g., flashing).			X
4.2.5	**Alarm Contents**			
4.2.5-1	**Alarm Titles/Legends**			
	Titles/legends should be clearly understandable, use standard terminology, and address conditions specifically.	X		
4.2.5-2	**Alarm Messages – SDCV Tile Format**			
	The format of messages on alarm tiles or tile-like displays should be consistent for all alarms.			X
4.2.5-3	**Alarm Messages – List or Printer Format**			
	The format of printed alarm lists should be consistent with that of VDU and SDCV displays.			X
4.2.5-4	**Alarm Source**			
	The content of each message should provide information that identifies the alarm source.			X
4.2.5-5	**Alarm Priority**			
	An alarm message should indicate its priority.			X

Guideline #	Review Criteria	Yes	No	N/A
4.2.5-6	**Setpoint Values**			
	If an alarm condition requires verification before action is taken, the relevant setpoint limits should be included in the alarm message when alarm information is presented on a VDU or is printed.			X
4.2.5-7	**Parameter Values**			
	Deviant parameter values should be included in the alarm message when alarm information is presented on VDU or printer displays.			X
4.2.5-8	**Required Immediate Actions**			
	Immediate actions should be presented or made available directly upon request when alarm information is presented on VDU or printer displays.			X
4.2.5-9	**Reference to Procedures**			
	When alarm information is presented on VDU or printer displays, references to alarm response procedures should be provided.			X
4.2.5-10	**Reference to Other Panels**			
	Alarms which refer the user to another, more detailed display located outside the main operating area should be minimized.			X
4.2.6	**Coding Methods**			
4.2.6.1	**General**			
4.2.6.1-1	**Coding Effectiveness**			
	The coding scheme used by the alarm system should assure rapid detection and interpretation by the users under all control room operating conditions.			X
4.2.6.1-2	**Coding Dimension Discriminability**			
	Each level of a coding dimension should be easily and readily distinguishable from the other levels.			X
4.2.6.1-3	**Single Coding Dimensions**			
	Each technique used to code alarms should represent only one dimension of the alarm classification.			X
4.2.6.1-4	**Coding Complexity**			
	The number of different coding techniques should be kept to a minimum, so that the coding system does not become too difficult to use or understand.			X
4.2.6.2	**Visual**			
4.2.6.2-1	**Visual Coding for Importance**			
	A visual coding method should be used to indicate alarm importance and should be consistently applied throughout the alarm system.			X
4.2.6.2-2	Redundant Priority Coding			X
	Redundant codes (e.g., color and location) should be used for alarms that require rapid action.			
4.2.6.2-3	**Flash Rate**			
	Flash rates should be from three to five flashes per second with approximately equal on and off times.	X		

Guideline #	Review Criteria	Yes	No	N/A
4.2.6.2-4	**Brightness Levels for Transilluminated Displays**			
	For transilluminated displays, such as lighted alarm tiles, the luminance of the dim state (if used) should be at least 10 percent greater than the inactivated state; the brightest state should not be more than 300 percent of the surrounding luminance.			X
4.2.6.2-5	**Brightness Levels for VDU Displays**			
	For VDU displays, the bright state should be at least 100 percent brighter than the normal state.			X
4.2.6.2-6	**Color Detectability**			
	Low-intensity indications (e.g., dark red) in the periphery of the visual field should be avoided where color coding is used, since they may not be readily detected.			X
4.2.6.2-7	**Spatial Coding**			
	Spatial coding may be used to indicate alarm importance.			X
4.2.6.2-8	**Suppressed Visual Codes**			
	If the visual codes indicating alarm status are automatically suppressed or delayed during high alarm volume conditions or the presence of more important alarms, they should be automatically presented after the more important alarms have been addressed.			X
4.2.6.3	**Audible Codes**			
4.2.6.3-1	**Audio Signals for Alarms**			
	An auditory signal should be used to alert the user to the existence of a new alarm, or any other condition of which the user must be made immediately aware.	X		
4.2.6.3-2	**Auditory Coding of Remote Alarms**			
	Auditory coding techniques should be used when the workstation associated with the alarm is not in the main operating area.			X
4.2.6.3-3	**Distinguishable Auditory Signals**			
	The auditory signal associated with a SDCV alarm should be easily distinguishable from the auditory signal associated with an alarm message displayed by other means (e.g., on a VDU message display).			X
4.2.6.3-4	**Audible Signals for Alarm States**			
	The tones used for incoming alarms should be separate and distinct from tones used to signify "clearing" alarms.	X		
4.2.6.3-5	**Reminder Audible Signals**			
	If the tone associated with an unacknowledged alarm automatically turns off after an interval of time, a reminder tone should be presented to alert the user to the continued presence of an unacknowledged alarm.			X
4.2.6.3-6	**Reset of Auditory Alert**			
	The auditory alert mechanism should automatically reset when it has been silenced.	X		
4.2.6.3-7	**Interference Among Signals**			
	Audio alarm signals should not conflict with other auditory codes or signals.			X

Guideline #	Review Criteria	Yes	No	N/A
4.2.6.3-8	**Readily Identifiable Source**			
	The user should be able to quickly determine where to direct attention (e.g., which functional area of the plant or which station) from the characteristics of the auditory alert and/or the source from which the auditory alert originated.	X		
4.2.6.3-9	**Signal Level**			
	The signal intensity should be such that users can reliably discern the signal above the ambient control room noise.	X		
4.2.6.3-10	**Design of Audio Signals**			
	Audio signals should be designed to minimize irritation and startle.	X		
4.2.6.3-11	**Manual Disable/Adjustment of Signal Intensity**			
	Manual disable or adjustment of auditory signal intensity (loudness) should be avoided.	X		
4.2.6.3-12	**Sound Sources**			
	The number and placement of loudspeakers should be such that auditory signals are free of distortion and are equally audible at any workstation in the control room.	X		
4.2.6.3-13	**Auditory Signal Discriminability**			
	Each audio signal should be unambiguous and easily distinguishable from every other tone in the control room.	X		
4.2.6.3-14	**Number of Tonal Signals**			
	When information is coded by the pitch of narrow-band signals (i.e., tones), no more than three frequencies should be used.			X
4.2.6.3-15	**Frequency of Tonal Signals**			
	Center frequencies should be widely spaced within a range of from 500 to 3,000 Hz, although a wider range of from 200 to 5,000 Hz may be acceptable.			X
4.2.6.3-16	**Pulse Codes**			
	No more than three pulse repetition rates should be used for coding purposes.			X
4.2.6.3-17	**Number of Frequency Modulated Signals**			
	No more than three modulated frequency codes for audible alarms should be used.			X
4.2.6.3-18	**Center Frequency of Frequency Modulated Signals**			
	If modulation of frequency (Hz) of a signal is used to denote information, the center frequencies should be between 500 and 1000 Hz.			X
4.2.6.3-19	**Audio Pattern Codes**			
	If sequences of tones are used to represent information, the patterns should be easily recognizable.			X
4.2.6.3-20	**Compound Codes**			
	A maximum of nine auditory signals should be used when coded in two or more dimensions.			X
4.2.6.3-21	**Intensity Coding**			
	Coding of auditory signals by intensity (loudness) should not be used.			X

Guideline #	Review Criteria	Yes	No	N/A
4.2.6.3-22	**Speech Presentation of Alarm Information**			
	Using speech alone for presenting alarm information is not recommended.			X
4.2.7	**Organization of Alarms**			
4.2.7.1	**Spatially Dedicated, Continuously Visible Alarm Displays**			
4.2.7.1-1	**Functional Grouping of Alarms**			
	Alarms within a display should be grouped by function, system, or other logical organization.			X
4.2.7.1-2	**Visual Distinctness of Functional Groups**			
	Alarm functional groups should be visually distinct from one another.			X
4.2.7.1-3	**Group Labels**			
	System/functional groups should be clearly delineated and labeled such that the operating crew can easily determine which systems have alarms that have not yet cleared and which system is affected by a particular incoming alarm.			X
4.2.7.1-4	**Coordinate Designation Identifiers**			
	If alarm displays are organized in matrices, the vertical and horizontal axes of the displays should be labeled with alphanumerics for ready coordinate designation of a particular visual element.			X
4.2.7.1-5	**Density of Alarm Elements**			
	An alarm tile display matrix should contain a maximum of 50 alarms.	X		
4.2.7.1-6	**Logical Arrangement of Alarms**			
	Alarms should be ordered to depict naturally occurring relationships.			X
4.2.7.1-7	**Consistent Ordering**			
	Alarm parameters (e.g., pressure, flow, level, and temperature) arranged in one order on one panel should be arranged in the same order on other panels.			X
4.2.7.1-8	**Alarm Display Identification Label**			
	Each group of alarm displays should be identified by a label above the display.			X
4.2.7.2	**Alarm Message Lists**			
4.2.7.2-1	**Listing by Priority**			
	Lists of alarm messages should be segregated by alarm priority with highest priority alarms being listed first.			X
4.2.7.2-2	**Message Listing Options**			
	In addition to priority grouping, users should have the capability to group alarm messages according to operationally relevant categories, such as function, chronological order, and status (unacknowledged, acknowledged/active, cleared).			X
4.2.7.2-3	**Blank Lines**			
	Alphanumeric alarm lists should have a separation (blank row) between every four or five alphanumeric messages.			X

Guideline #	Review Criteria	Yes	No	N/A
4.2.7.2-4	**Scrolling of Message List**			
	The method of adding alarm messages to the list should preclude message scrolling.			X
4.2.7.2-5	**Message Overflow**			
	Alphanumeric alarm messages that overflow the first page of alarm messages should be kept on subsequent alarm pages.			X
4.3	**User-System Interaction and Controls**			
4.3.1	**General Alarm Control Guidelines**			
4.3.1-1	**Access to Undisplayed Unacknowledged Alarms**			
	A VDU-based alarm system should provide rapid access to any unacknowledged alarm messages that are not shown on the current display.			X
4.3.2	**Silence Functions**			
4.3.2-1	**Global Silence Capability**			
	It should be possible to silence an auditory alert signal from any set of alarm system controls in the main operating area.			X
4.3.2-2	**Manual Silencing**			
	Auditory signals should be silenced manually unless this interferes with other more critical actions.	X		
4.3.3	**Acknowledge Controls**			
4.3.3-1	**Effect of Acknowledge Function**			
	An alarm acknowledgment function should cause the alarm's visual coding to change from that indicating an unacknowledged alarm to a visually distinct ' not cleared' state.	X		
4.3.3-2	**Acknowledgment Locations**			
	Acknowledgment should be possible only from locations where the alarm message can be read.	X		
4.3.3-3	**Acknowledgment of Alarm Messages**			
	Non-SDCV alarms should only be acknowledged when the alarm message is on the screen.			X
4.3.4	**Reset Functions**			
4.3.4-1	**Effect of Reset Function**			
	The reset function should place an alarm in an unalarmed state after the condition has cleared.	X		
4.3.4-2	**Appropriate Use of Manual Reset**			
	A manual reset sequence should be used where it is important to explicitly inform users of a cleared condition that had once been deviant.			X
4.3.4-3	**Appropriate Use of Automatic Reset**			
	An automatic reset sequence should be available where users have to respond to numerous alarms or where it is essential to quickly reset the system.			X

Guideline #	Review Criteria	Yes	No	N/A
4.3.4-4	**Reset Function Location**			
	The reset function should be effective only from locations at which plant personnel know which alarm they are resetting.	X		
4.3.5	**Alarm Management**			
4.3.5-1	**User-Selectable Alarm System Configuration**			
	If the alarm system provides user-selectable operational configurations, then these configuration changes should be coupled with an indication of the present configuration.			X
4.3.5-2	**Acknowledgment of Alarm System Configuration Changes**			
	Acknowledgment (or confirmation) should be required if a significant alarm system configuration change is to be made by user selection.			X
4.3.5-3	**User-Defined Alarms/Setpoints**			
	The alarm system may provide temporary, user-defined alarms and user-defined set points for specific conditions where such alarms are determined to be of assistance in selected evolutions (e.g., temporary alarms to support increased monitoring of a problem component, or at other times when the user wants to know of a parameter trend that is approaching a limit).			X
4.3.5-4	**Interference of User-Defined Alarms/Setpoints with Existing Alarms**			
	User-defined alarms and setpoints should not override or interfere with the existing alarms and setpoints.			X
4.3.5-5	**Indication of User-Defined Alarms/Setpoints**			
	The alarm system should provide clear indication of user-defined alarms and setpoints as distinct from the alarm/setpoints designed into the system.			X
4.3.5-6	**Control of User-Defined Alarms/Setpoints**			
	The definition and removal of operator-defined system characteristics should be under administrative controls.			X
4.3.6	**Automatic Features**			
4.3.6-1	**Automated Alarm System Configuration**			
	If the alarm system automatically changes operational configurations under some alarm situations, then these configuration changes should be coupled with an alert to the user and an indication that the configuration has changed.			X
4.3.6-2	**Acknowledgment of Automatic Alarm System Configuration Changes**			
	Acknowledgment (or confirmation) should be required if a significant alarm system configuration change is to be made automatically.			X
4.3.6-3	**Automatic Mode-Defined Setpoints**			
	The need for operator acknowledgment of system-generated setpoint changes based on plant mode should be evaluated on a case-by-case basis.			X

Guideline #	Review Criteria	Yes	No	N/A
4.3.7	**Control Devices**			
4.3.7-1	**Separate Controls for Alarm Functions**			
	Separate controls should be provided for silence, acknowledgment, reset (acknowledging an alarm that has cleared and returning it to normal), and testing.	X		
4.3.7-2	**Distinct Coding of Control Functions**			
	Alarm system controls should be distinctively coded for easy recognition.	X		
4.3.7-3	**Consistent Layout of Control Group**			
	Each set of alarm system controls should have the functions in the same relative locations.	X		
4.3.7-4	**Separate Controls for Tile and VDU Alarms**			
	If the alarm system contains both alarm tiles and VDU alarm displays, each should have its own set of controls.			X
4.3.7-5	**Defeating Controls**			
	Alarm system control designs should not allow the controls to be altered or defeated.	X		
4.4	**Reliability, Test, Maintenance, and Failure Indication Features**			
4.4.1	**Reliability**			
4.4.1-1	**Design for Reliability**			
	The alarm system should be designed so that no single failure will result in the loss of a large number of alarms.		X	
4.4.1-2	**VDU Reliability**			
	Where alarms are presented on a VDU as the primary display, users should be able to access the alarms from more than one VDU.			X
4.4.1-3	**Dual Light Bulbs**			
	Annunciator tile-type displays should be designed with dual light bulbs so that a single bulb failure will not interfere with detection of the alarm condition.	X		
4.4.1-4	**Flasher Failure Mode**			
	In case of flasher failure, an unacknowledged alarm should assume a highly conspicuous state such as a steady on (e.g., illuminated) state rather than a less conspicuous state such as off.	X		
4.4.2	**Test**			
4.4.2-1	**Testing Capabilities**			
	Test controls should be available to initiate operability tests for all essential aspects of the alarm system (including processing logic, audible alarms, and visual alarm indications).	X		
4.4.2-2	**Testing Requirement**			
	Periodic testing of the alarm system should be required and controlled by administrative procedure.	X		

Guideline #	Review Criteria	Yes	No	N/A
4.4.3	**Maintenance**			
4.4.3-1	**Design for Maintainability**			
	The alarm system should be designed so that maintenance activities can be performed with minimal interference with the activities of the users.	X		
4.4.3-2	**Tagged-Out Alarms**			
	Tagging out an alarm (taking it out of service) should require disabling of the associated visual and audio signals.	X		
4.4.3-3	**Out-of-Service Alarm Indication**			
	Cues for prompt recognition of an out-of-service alarm should be designed into the system.		X	
4.4.3-4	**Extended Duration Illumination**			
	If an alarm tile must be 'on' for an extended period during normal operations because of equipment repair or replacement, it should be (1) distinctively coded for positive recognition during this period, and (2) controlled by administrative procedures.			X
4.4.3-5	**Tile Cover Replacement**			
	If a lamp replacement requires legend tile removal, there should be a way to ensure that the tile is replaced in the correct location.			X
4.4.3-6	**Hazard Avoidance**			
	Lamp replacement should not pose an electrical shock hazard.	X		
4.4.3-7	**Aids for Alarm System Maintenance**			
	Aids should be provided, if needed, to assist personnel in performing alarm system maintenance.	X		
4.4.4	**Failure Indication**			
4.4.4-1	**Alarm System Failure Indication**			
	Users should be given prompt indication of a failure of the alarm system or its major subcomponents.	X		
4.5	**Alarm Response Procedures (ARPs)**			
4.5-1	**ARP Scope**			
	ARPs should be available for alarm conditions that require a response that affects the plant process control system or plant equipment.			X
4.5-2	**ARP Access**			
	Users should have immediate access to ARPs from the location at which the alarm messages are read.			X

Guideline #	Review Criteria	Yes	No	N/A
4.5-3	**ARP Content**			
	ARPs should contain the following information: • The system/functional group to which the alarm belongs, • The exact alarm text or legend, • The alarm source (i.e., the sensor(s) sending the signal, processors and signal validation logic, and the actuating device(s) for the alarm with a reference to a schematic diagram on which such devices can be found), • Alarm setpoints, • Priority, • Potential underlying causes for the alarm (e.g., low water level - inadequate feed flow), • Required immediate actions, including actions that can be taken to confirm the existence of the alarm condition, • Actions which occur automatically when the alarm occurs (and which should be verified as having taken place), • Followup actions, • Explanations of relevant alarm processing (e.g., comparisons and combinations of plant parameters; alarm filtering and suppression; alarm setpoints that are conditional, such as setpoint values and time delays used to prevent the occurrence of nuisance alarms when a parameter oscillates in an out of the alarm range), and • Pertinent references.			X
4.5-4	**Information Consistency with the HSI**			
	Information contained in the ARPs should be consistent with information on control boards, in the alarm system, in I&C procedures used to calibrate alarm setpoints, in controlling documents that determine setpoints (e.g., Technical Specifications and accident analyses), in P&IDs, in emergency operating procedures, and in other plant procedures.			X
4.5-5	**Presentation Consistency with the HSI**			
	The terminology, conventions, standards, and codes used in the presentation of the ARPs should be consistent with the rest of the HSI.			X
4.5-6	**ARP Format**			
	The ARP format should: • Highlight the ARP identifier on each page of the procedure, • Highlight important items, • Locate information categories in the same position on each page, • Consistently present information throughout the ARP, and • Minimize the need for paging back and forth to obtain the information.			X
4.6	**Control-Display Integration and Layout**			
4.6-1	**Display and Line of Sight**			
	Visible alarm indications should be located within about 60 degrees on either side of the direct line of sight of the user's normal work position.			X

Guideline #	Review Criteria	Yes	No	N/A
4.6-2	**Location of Alarm System Displays and Controls**			
	Alarm displays and controls should be located so that the display can be read while operating the controls.			X
4.6-3	**Location of First-Out Alarms**			
	First-out displays should be located at the main workstation for the system and/or at a plant overview display visible to the crew.			X
4.6-4	**Consistent Ordering**			
	The ordering (e.g., left-to-right positioning) of displayed alarm groups should be consistent with the ordering of displays and controls of related plant systems and components.	X		
4.6-5	**Location for Prompt Response**			
	Alarm displays and controls should be arranged and located such that those in the control room who must respond to an alarm can access the alarm information in sufficient time to respond adequately.			X
4.6-6	**Location for Access to Process Controls and Displays**			
	Visual alarm panels should be located near the controls and displays which are required for corrective or diagnostic action in response to the alarm.			X
4.6-7	**Interference from Nearby Lights**			
	Indicator lights or other non-alarm illuminated displays should not be located so close to alarm displays that they could be mistaken for an alarm or mask an alarm.	X		
4.7	**Integration with Other HSI Elements**			
4.7-1	**Consistency with the Main HSI**			
	The alarm system HSI should be consistent with the standards and conventions used for the HSIs for other displays and controls in the control room.			X
4.7-2	**Consistency with Emergency Operating Procedures**			
	The alarm system HSI should be consistent with the standards, conventions, and terminology used in the plant emergency operating procedures.			X
4.7-3	**Conformance to HSI Design Review Guidelines**			
	Alarm system elements (e.g., displays and controls) should conform to general HSI guidelines as well as alarm system guidelines.			X
5	**SAFETY FUNCTION AND PARAMETER MONITORING SYSTEM**			
5.1	**Information Display**			
5.1-1	**Convenient and Ready Access to Data**			
	Plant parameters and variables important to safety should be displayed in a way that is convenient and readily accessible.			X
5.1-2	**Critical Safety Function Display Visibility**			
	Critical safety function displays should be readable from the workstations of users needing access to these displays.			X

Guideline #	Review Criteria	Yes	No	N/A
5.1-3	**Critical Variables and Parameters**			
	Critical plant variables and parameters should be displayed to help users evaluate the plant's safety status.			X
5.1-4	**Severe Accident Symptoms**			
	The display system should display information about severe accident symptoms associated with the plant safety parameters and functions.			X
5.1-5	**Concise Display of Information**			
	Critical plant variables should be displayed in a concise format.			X
5.1-6	**Display Response to Transient and Accident Sequences**			
	The display's respond to transient and accident sequences should keep the user informed of the current plant status.			X
5.1-7	**Rapid and Reliable Recognition of Safety Status Change**			
	Critical safety function displays should allow users to comprehend a change in safety status in a matter of seconds.			X
5.1-8	**Data Sampling Rate**			
	The sampling rate for each critical plant variable should be consistent with the users' needs for performing tasks.			X
5.1-9	**Display Accuracy**			
	Each critical variable should be displayed with sufficient accuracy for the user to discriminate between normal conditions and those affecting plant safety status.			X
5.1-10	**Magnitudes and Trends of Critical Variables**			
	The display should provide magnitudes and trends for critical plant variables or derived variables.			X
5.1-11	**Continuous Display**			
	Displays for monitoring safety parameters and functions should continuously display this information.			X
5.1-12	**Separate Display Pages for Plant Modes**			
	Where plant operating modes impose different demands, separate display pages should be provided for each mode.			X
5.2	**User-System Interaction**			
5.2-1	**Critical Parameter Monitoring Support**			
	The system should assist the user in monitoring critical parameters, especially parameters that change very rapidly or very slowly, by alerting the user when values are out of range.	X		
5.2-2	**Alerts for Abnormal Conditions**			
	Where feasible, the system should provide perceptual (audible or visual) cues to alert personnel to abnormal operation conditions that potentially warrant corrective action.	X		

Guideline #	Review Criteria	Yes	No	N/A
5.2-3	**Alert to Higher Level Displays**			
	While viewing secondary (lower-level) displays, a perceptual (audible or visual) cue should be provided by the safety parameter or function monitoring system to alert the user to return to the primary (higher-level) display format if significant information in that display requires user attention.			X
5.2-4	**Ease of Interaction**			
	User interactions with the display system should be within the skill capability of the control room crew and should not significantly increase personnel workload.	X		
5.3	**Reliability, Test, Maintenance, and Failure Indication Features**			
5.3-1	**Display Reliability**			
	The display should not give false indications of plant status.	X		
5.3-2	**Data Reliability/Validation for Critical Plant Variables**			
	Critical plant variables should be reliable and should be validated in real time.	X		
5.3-3	**Display of Data Reliability/Validation for Critical Plant Variables**			
	The status of the data should be displayed to the operator with an appropriate data quality indicator (e.g., valid, invalid, or unvalidated; or a derived numerical estimate).	X		
5.4	**Integration with Other HSI Elements**			
5.4-1	**Interference with Crew Movement**			
	The location of displays for monitoring safety parameters and functions should not interfere with the normal movement of the control room crew.	X		
5.4-2	**Visual Interference with Other Controls and Displays**			
	The display system should not interfere with visual access to other control room operating systems or with displays that are important to safe operation of the plant.	X		
5.4-3	**Labeling**			
	Display devices for monitoring safety parameters and functions should be labeled and readily distinguished from other devices.	X		
6	**GROUP-VIEW DISPLAY SYSTEM**			
6.1	**Functional Characteristics**			
6.1.1	**General**			
6.1.1-1	**Applicability**			
	Group-view displays should be used when crew performance may be enhanced by access to a common view of plant information or a means of sharing information between personnel.			X
6.1.1-2	**Group-View Display Information**			
	Information presented in a group-view display should be relevant to the task requirements of multiple personnel and presented in a manner that is evident to its intended users.			X

Guideline #	Review Criteria	Yes	No	N/A
6.1.1-3	**Consistency With Other Portions of the HSI**			
	The design of group-view displays, including information presentation and interaction characteristics, should be consistent with the rest of the HSI.			X
6.1.1-4	**Control of Group-View Display**			
	Individuals should not be permitted to make changes to the group-view display in a way that would reduce its usefulness to others.			X
6.1.1-5	**Retrieving Information via the Group-View Display**			
	If individuals use the group-view display system to access additional information for their own use, this information should be presented on a separate display (e.g., an individual-view display).			X
6.1.2	**Overview Display**			
6.1.2-1	**Providing an Overview Display**			
	The group-view display should provide an overview display if user performance may be supported by a display that combines and integrates diverse plant data in a way that informs personnel of important conditions and allows them to see the overall status of the plant or process.			X
6.1.2-2	**Indicating Plant Status**			
	The overview display should support the personnel in obtaining an overall view of plant status, gaining awareness of major changes in plant status, and identifying minor changes in plant state that are important to the plant condition.			X
6.1.2-3	**Flexibility In Searching Information**			
	The overview display should provide flexibility in the types of information searches that personnel may employ to assess plant status.			X
6.1.2-4	**Support for Rapid Shift of View**			
	The overview display should support personnel in rapidly shifting their focus of attention when tracking an evolving event.			X
6.1.2-5	**Overall Assessment at a Glance**			
	The manner in which information is presented in the overview display should provide a characterization of the situation as a whole in a concise form that can be recognized at a glance.			X
6.1.2-6	**Level of Abstraction**			
	The information presented on the overview display should be abstracted to a level that is consistent with users' information requirements for assessing plant status.	X		
6.1.2-7	**Relevant to the Viewer's Context**			
	The overview display should present information that is relevant to activities that are ongoing and which help users determine whether events are proceeding according to expectations.	X		

Guideline #	Review Criteria	Yes	No	N/A
6.1.2-8	**Mimic Format**			
	The overview display should include a plant mimic when a mimic may enhance personnel performance by (1) communicating functional relationships between components or (2) providing a means of organizing information that aids information retrieval and plant monitoring.			X
6.1.2-9	**Display of Safety Parameters and Functions**			
	If plant safety parameters and functions are presented via a combination of the overview display and other display devices, then these display devices should be within easy view of each other.			X
6.1.3	**Access to Additional Information**			
6.1.3-1	**Support for Identifying Relevant Information**			
	Where personnel performance may be enhanced by assistance in retrieving information, the group-view display should direct the user to relevant detailed information.			X
6.1.3-2	**Automatic Retrieval and Presentation of Information**			
	If information is automatically retrieved, it should be presented in a way that conveys where it came from and why it was retrieved.			X
6.1.3-3	**Manual Retrieval of Information**			
	Support provided for manual retrieval of additional information should convey the location of both the user and the additional information in relationship to the total display space and the available pathways and mechanisms for accessing this information.			X
6.1.4	**Support for Crew Coordination**			
6.1.4-1	**Support for Crew Coordination**			
	The group-view display may be used to support crew coordination when crew performance would benefit from better awareness and coordination of actions.			X
6.1.4-2	**Openness of Tools**			
	Where enhanced coordination is desired between personnel, the group-view display should feature open tools for interacting with the HSI or the plant.			X
6.1.4-3	**Openness of Interaction**			
	Where enhanced coordination is desired between personnel and communication is restricted by the design of the workstations, the group-view display may be used to facilitate open interactions.			X
6.1.4-4	**Horizon of Observation**			
	Where enhanced coordination is desired between personnel, the group-view display should be used to allow each crew member to perceive a greater portion of the task environment.			X

Guideline #	Review Criteria	Yes	No	N/A
6.1.5	**Crew Communication and Collaboration**			
6.1.5-1	**Supporting Communication and Coordination**			
	Where crew performance may be enhanced by improved coordination, the group-view display may be used to support operators in actively participating in the same task through the sharing of information, ideas, and actions.			X
6.1.5-2	**General Requirements for Communication/Collaboration**			
	If the group-view display is to be used to support communication/collaboration, it should provide a representation of the task/problem and the tools required for examining and explaining the task/problem.			X
6.1.5-3	**Coordinating Input Between Participants**			
	The group-view display should contain mechanisms to regulate the participants' access to the group-view display to allow information to be provided in an orderly manner.			X
6.1.5-4	**Minimizing Communication/Collaboration Interaction Burdens**			
	The methods of interaction provided by a group-view display to support communication/collaboration should be designed to minimize the demands associated with executing these interactions.			X
6.1.5-5	**Compatibility With Social Conventions**			
	The methods of interaction for communication/collaboration provided by a group-view display should be compatible with social conventions within the intended user group.			X
6.1.5-6	**Flexibility in Communication/Collaboration Methods**			
	The methods of interaction provided by the group-view displays to support communication/collaboration should be flexible enough to accommodate the range of personnel interactions that occur during normal and upset conditions.			X
6.1.5-7	**Identification of Participants**			
	A coding scheme or designation system should be used to identify participants while they manipulate information on the group-view display.			X
6.1.5-8	**Maintaining Historical Record of Contributions**			
	The group-view display system should support the recording of information regarding the history of interactions if personnel tasks require this information.			X
6.1.5-9	**Spatial Coordination of Inputs**			
	When transferring information between an individual-view display and the group-view display, the information should be presented in a manner consistent with the sender's expectations.			X
6.1.5-10	**Timing Coordination of Inputs**			
	When transferring information between an individual-view display and the group-view display, the information should be presented promptly and with minimal delay.			X

Guideline #	Review Criteria	Yes	No	N/A
6.2	**User-System Interaction**			
6.2-1	**Separate Input Devices for Displays**			
	When control of the large- and individual-view display devices is performed by separate input devices, their design should support coordinated use.			X
6.2-2	**Mode Switch**			
	When a mode switch is provided to transfer input control between the large- and individual-view display devices, protection should be provided to prevent input from being entered into the wrong display.			X
6.2-3	**Cursor Motion**			
	If a cursor motion is used to transfer input control between the large- and individual-view display devices, then the movement between the displays should be smooth and contiguous.			X
6.2-4	**Compensating for Different Screen Sizes and Shapes**			
	If a cursor motion is used to transfer input control between the large- and individual-view display devices of different size and shape, then features should be incorporated to make their spatial relationships clear to the user.			X
6.2-5	**Indicating Active Display**			
	When using the group-view display, the user should receive a clear indication that the display is active.			X
6.2-6	**Processing Information to Match User Requirements**			
	The information associated with selectable items of the group-view display item should be processed to match each user's task requirements when this processing would reduce distracting and unnecessary information and enhance operator performance.			X
6.2-7	**Shared Cursors**			
	When multiple users must share a single cursor for interaction with the group-view display, features should be provided to manage access to the cursor and indicate current ownership.			X
6.2-8	**Multiple Individual Cursors**			
	When multiple users operate individual cursors for interaction with the group-view display, a coding scheme should be provided so the users can readily identify their own cursors and identify the users of the other cursors.			X
6.2-9	**Shared Window**			
	If the communication/collaboration function is performed by presenting information on a shared window of the group-view display, features should be incorporated to prevent new information from obscuring old information.			X

Guideline #	Review Criteria	Yes	No	N/A
6.3	**Group-View Display Devices**			
6.3.1	**Appropriate Use**			
6.3.1-1	**Selection of Group-View Display Devices**			
	The selection of display hardware for group-view displays should consider such factors as the user's need for immediate access to the group-view display, user's need to view the group-view display from multiple locations in the control room, ability of users to leave their usual work areas, and the type of interaction that occurs between users when viewing the displayed information.			X
6.3.2	**Large Display Devices**			
6.3.2-1	**Control of Critical Information Display**			
	Control of large-screen group display systems should be such that critical information cannot be modified or deleted inadvertently or arbitrarily.			X
6.3.2-2	**Maximum Viewing Distance**			
	The determination of the maximum viewing distance on a large-screen display should be based on an analysis of the information requirements of individuals and their locations in the work area.			X
6.3.2-3	**Minimum Viewing Distance**			
	The display should not be closer to any observer than half the display width or height, whichever is greater.			X
6.3.2-4	**Off-Centerline Viewing Angle**			
	The determination of the acceptability of off-centerline viewing should take into account both the spatial distortion of the image and the effect of the viewing angle upon screen characteristics such as brightness and color rendition.			X
6.3.2-5	**Viewing of Multiple Display Devices**			
	When multiple, large display devices are used, the normal work areas of each user should be within the acceptable off-centerline viewing area of each large display that each user must view.			X
6.3.2-6	**Unobstructed View**			
	Seating areas should be arranged to provide critical observers with unobstructed views of the display.			X
6.3.2-7	**Externally Illuminated Displays**			
	Externally illuminated displays should have adequate illumination.			X
6.3.2-8	**Projected Displays**			
	The optical characteristics of projection systems should conform to the guidelines given in Section 1.6.2.			X
6.3.2-9	**Text Size**			
	The size of text for labels and detailed information should be based on analyses of the maximum viewing distances of personnel.			X
6.3.2-10	**Use of Labels**			
	The presence of labels should not cause excessive clutter or detract from detailed information.			X

Guideline #	Review Criteria	Yes	No	N/A
6.3.2-11	**Use of Information Displays Developed for Standard Video Display Units (VDUs)**			
	Displays developed for standard VDUs should not be presented on large-screen display systems without first being evaluated for acceptability.			X
7	**SOFT CONTROL SYSTEM**			
7.1	**General**			
7.1-1	**Coordinating Soft Control Use Among Operators**			
	If a soft control can be accessed from more than one location in the HSI, protective measures should ensure its coordinated use among multiple users.			X
7.1-2	**Operation with Protective Clothing**			
	Soft controls should be designed to accommodate any protective clothing that personnel may be required to wear.			X
7.2	**Information Display**			
7.2.1	**General**			
7.2.1-1	**Representing Relationships Between Control System Components**			
	The display capabilities of soft controls should allow users to quickly assess the status of individual components of a control system and their relationships with other components.			X
7.2.1-2	**Making Options Distinct**			
	The interface should be designed so that users can, at a glance, distinguish options by such characteristics as context, visually distinct formats, and separation.			X
7.2.2	**Selection Displays**			
7.2.2-1	**Visually Distinct Selection Displays**			
	Displays used for selecting components and variables should be visually distinct to support choice of the correct display.			X
7.2.2-2	**Visually Distinct Components**			
	The representation of components and variables within selection displays should be visually distinct to support their correct selection.			X
7.2.2-3	**Identification of Loops on Multiple-Loop Controllers**			
	The loops of multiple-loop controls should be distinctly marked to prevent the selection or use of the wrong loop.			X
7.2.3	**Input Fields**			
7.2.3-1	**Cues for Matching Input Fields to Selection Displays**			
	A user looking at the field for providing a control input should be able to determine which plant component or variable is being controlled.			X
7.2.3-2	**Labeling of Input Fields**			
	The input field should be labeled with sufficient information to uniquely identify its corresponding component.			X

Guideline #	Review Criteria	Yes	No	N/A
7.2.3-3	**Coordination of Soft Controls with Process Displays**			
	Displays should be readily accessible from the input field so the user can readily verify that the control actions have had the intended effect on plant systems and processes.			X
7.2.4	**Input Formats**			
7.2.4-1	**Appropriate Use of Discrete-Adjustment Interfaces**			
	Discrete-adjustment interfaces should be used for selecting among a set of individual settings or values.			X
7.2.4-2	**Labeling Selection Options in Discrete-Adjustment Interfaces**			
	The selection options in discrete input formats should be clearly labeled.			X
7.2.4-3	**Feedback for Discrete-Adjustment Interface with Multiple Settings**			
	Discrete-adjustment interfaces should indicate which setting was selected.			X
7.2.4-4	**Feedback for Discrete-Adjustment Interface with Continuous Operation**			
	If a discrete-adjustment interface has continuous operation, it should provide continuous feedback on the current state.			X
7.2.4-5	**Appropriate Use of Continuous-Adjustment Interfaces**			
	Continuous-adjustment interfaces should be used when precise adjustments along a continuum are needed or when many discrete settings are present.			X
7.2.4-6	**Appropriate Use of Soft Sliders**			
	A soft slider should be considered as an input device when the range of possible values and the ratio of a value to that range need to be displayed.			X
7.2.4-7	**Indicating the Range of Values on Soft Sliders**			
	The range of values should be indicated on horizontal sliders with the low value on the left and the high value on the right, and on vertical sliders with the low value on the bottom and the high value on the top.			X
7.2.4-8	**Displaying the Digital Value on Soft Sliders**			
	The numerical value to which a soft slider is set should be presented in digits on the soft slider.			X
7.2.4-9	**Dimensions of Soft Sliders**			
	The physical dimensions of the soft slider should allow the user to read the current and target positions and position the slider with the required precision, accuracy, and response time.			X
7.2.4-10	**Depicting Critical Ranges on Soft Sliders**			
	When part of the range of values depicted by a soft slider represents critical information, such as alarm limits, those values should be coded to facilitate recognition.			X
7.2.4-11	**Appropriate Use of Arrow Buttons**			
	A set of arrow buttons should be considered as the input device when it is desirable to incrementally increase or decrease a variable from its previous value.			X

Guideline #	Review Criteria	Yes	No	N/A
7.2.4-12	**Indicating Current Value for Arrow Buttons**			
	Arrow buttons should have a display indicating the current value of the variable being controlled.			X
7.2.4-13	**Uniform Changes in Values Via Arrow Buttons**			
	Each press of an arrow button should change the current value uniformly.			X
7.2.4-14	**Feedback Regarding Arrow Button Actuation**			
	Arrow buttons should provide salient feedback when they are actuated.			X
7.2.4-15	**Apparent Operation of Arrow Buttons**			
	Labeling and other coding should be used when the operation of the arrow buttons is not apparent.			X
7.2.4-16	**Reference Values For Continuous Variable Inputs**			
	Reference values should be provided to help the user judge the appropriateness of values when entering continuous variable inputs.			X
7.2.5	**Display Devices**			
7.2.5-1	**Adequate Display Area**			
	Adequate display space should be provided so that short-term monitoring and control tasks do not interfere with longer-term tasks.	X		
7.3	**User-System Interaction**			
7.3.1	**General**			
7.3.1-1	**Minimizing Soft Control Modes**			
	The excessive use of modes in soft controls should be avoided.	X		
7.3.1-2	**Distinctive Indication of Soft Control Modes**			
	When multiple modes exist, they should be distinctively marked so the user can determine the current mode at a glance.			X
7.3.1-3	**Coordination of Destructive and Safety-Significant Commands Across Modes**			
	A command that produces a benign action in one mode should not cause a different action with serious negative consequences in another mode.	X		
7.3.1-4	**Unique Commands for Destructive and Safety-Significant Commands**			
	Unique commands associated with actions that have important consequences should not be easily confused with other commands used in the same or different modes.			X
7.3.1-5	**Discrimination of Interface Management Actions and Process Control Actions**			
	The design of the user interface should clearly distinguish between interface management actions and process control actions.			X
7.3.1-6	**Reducing the Likelihood of Unintended Actuation**			
	For actions that can have significant negative consequences, the user interface should be designed to reduce the likelihood of unintended actuation by requiring deliberate action for their execution.			X
7.3.1-7	**Feedback For Selected Actions Before Execution**			
	The HSI should give the user feedback indicating the action that was selected and allow the action to be canceled before it is executed.			X

Guideline #	Review Criteria	Yes	No	N/A
7.3.1-8	**Use of Error-Mitigation Approaches**			
	Error-mitigation approaches should not be the sole means for achieving error tolerance, but should be used in conjunction with other means for error prevention and system-assisted error detection.			X
7.3.1-9	**Undo Features**			
	If undo features are provided they should be consistently available.			X
7.3.2	**Sequential Actions**			
7.3.2-1	**Indicating the Status of Sequential Actions**			
	Computer-based HSIs should support users in rapidly assessing the status of sequential actions in progress.			X
7.3.2-2	**Drawing Attention to Points Where Similar Sequences Diverge**			
	The design of the HSI should draw the user's attention to points where operational sequences that have multiple steps in common begin to diverge from each other.			X
7.3.2-3	**Interruption of Transaction Sequences**			
	The HSI should allow the user to interrupt or terminate a current transaction sequence.			X
7.3.2-4	**Interrupted Sequence Prompt**			
	The HSI should support the user in maintaining awareness or recalling tasks that were interrupted or suspended by giving a reminder.			X
7.3.2-5	**Resumption of Interrupted Sequences**			
	A minimum number of actions should be required to resume a control-action sequence that was temporarily suspended.			X
7.3.3	**Verification and Confirmation Steps**			
7.3.3-1	**Separate Action For Verification Steps**			
	Verification steps should be separate from input actions.			X
7.3.3-2	**Confirmation of Goals**			
	When feasible, confirmation steps should draw attention to the goal of the action, not just to the action.			X
7.3.4	**Interlocks, Lockouts, and Lockins**			
7.3.4-1	**Use of Interlocks, Lockouts, and Lockins**			
	Interlocks, lockouts, and lockins should be provided to restrict personnel actions that may affect plant safety.			X
7.3.4-2	**Override of Interlocks, Lockouts, and Lockins**			
	The design of interlocks, lockouts, and lockins should not limit the users' authority unless there is a clear safety reason.			X
7.3.4-3	**Visibility of Interlocks, Lockouts, and Lockins**			
	Interlocks, lockouts, and lockins should be designed to indicate which actions are being blocked and what conditions activated the block.			X
7.3.4-4	**Automatic Logging of the Activation of Interlocks, Lockouts, and Lockins**			
	The activation of an interlock, lockout, or lockin should be automatically logged.			X

Guideline #	Review Criteria	Yes	No	N/A
7.3.4-5	**No Automatic Actuation of Blocked Actions**			
	An interlock, lockout, or lockin should not initiate an action that was previously blocked merely because the status of the triggering condition has changed.			X
7.3.5	**Error Detection and Correction**			
7.3.5-1	**Warning Message Content**			
	Warning messages should draw users' attention to the goal of the action, not just to the action.			X
7.3.5-2	**Automatic, Self-Correct Features for Interface Management Action**			
	Automatic, self-correcting features should only be used for interface management actions, such as retrieving displays.			X
7.3.5-3	**Undo Capabilities for Self-Correct Features**			
	Automatic, self-correcting features should only be used if they include good 'Undo' capabilities, so that inappropriate changes made by the system can be reversed by the user.			X
7.3.5-4	**Use of Inspection and Transfer Steps**			
	Inspection and transfer steps should be considered if inputs are complex, or if incorrect inputs can seriously affect safety.			X
7.3.6	**Selecting Plant Variables or Components**			
7.3.6-1	**Identification of Plant Variables and Components**			
	The HSI should support the identification of plant variables and components based on recognition rather than relying strictly upon recall.			X
7.3.6-2	**Simple Input Actions for Selection**			
	The user should be able to select a component or variable from a display by using simple input actions.			X
7.3.6-3	**Minimize Action-Sequence Errors for Selecting Plant Variables**			
	If a sequence of actions is required to select a component or variable, the HSI should be designed to prevent misordered action-sequence errors.			X
7.3.6-4	**Minimize the Number of Retrieval Steps for Controls that are Used Together**			
	When a group of controls must be used together, their retrieval should require a minimal number of actions.			X
7.3.7	**Control Inputs**			
7.3.7-1	**No Activation When Display Is Inoperable**			
	Users should not be able to activate a soft control if its display is not working.			X
7.3.7-2	**Automatic Reset of Multi-Variable Controls**			
	If an input device controls more than one variable, the user should not have to reset the device to match the value of the new variable before executing a control action.			X
7.3.7-3	**Numerical Input Values**			
	The HSI should provide feedback to support the user in verifying the correctness of numerical values entered.			X

Guideline #	Review Criteria	Yes	No	N/A
7.3.8	**Handling Stored Data**			
7.3.8-1	**Minimize the Use of Irreversible Actions**			
	The design of the HSI should minimize the use of irreversible actions for handling stored data.			X
7.3.8-2	**Deferring Execution of Operations that are Destructive to Stored Information**			
	Whenever practical, irreversible operations that destroy stored information should be deferred and require a separate action for their execution rather than being carried out immediately.			X
7.3.9	**System Response**			
7.3.9-1	**Actuation Feedback**			
	Soft controls should provide feedback about their operating state after activation.			X
7.3.9-2	**Notification of Automatic Mode Changes**			
	Systems that can change mode automatically should provide feedback to make the user aware of the current mode.			X
7.3.9-3	**Delaying System Response**			
	Where appropriate, systems that are sensitive to incorrect inputs should be designed to limit the rate at which these inputs can affect the process.			X
8	**COMPUTER-BASED PROCEDURE SYSTEM**			
8.1	**Information Display**			
8.1.1	**Procedure Identification**			
8.1.1-1	**Procedure Title and Identification Information**			
	Each procedure should contain identifying information including title, procedure number, revision number, date, and organizational approval.			X
8.1.1-2	**High-Level Goals**			
	Each procedure should state its high-level goals and applicability, including its procedure category, e.g., emergency or abnormal.			X
8.1.2	**Basic Steps**			
8.1.2-1	**Concise Steps**			
	Procedure steps should be concise.			X
8.1.2-2	**Short Sentences**			
	Procedure steps should be written as short sentences.			X
8.1.2-3	**Active Voice**			
	Procedure steps should be written in active voice.			X
8.1.2-4	**Positive Commands**			
	Procedure steps should be written as positive commands.			X
8.1.2-5	**Simple Wording**			
	Short, simple words from standard American English should be used.			X
8.1.2-6	**Standard Punctuation**			
	Punctuation should conform to standard American English usage.			X

Guideline #	Review Criteria	Yes	No	N/A
8.1.2-7	**Consistent Word References**			
	Words, phrases, and equipment names and numbers should be used consistently within and among procedures, drawings, other HSIs, and equipment labels.			X
8.1.2-8	**Abbreviations and Acronyms**			
	Abbreviations and acronyms should be used consistently and limited to those well known to the users.			X
8.1.2-9	**Units of Measures**			
	Numerical information should include units of measure.			X
8.1.2-10	**Numerical Precision**			
	Numbers should be specified at the appropriate precision.			X
8.1.2-11	**Number Ranges**			
	Ranges of numbers should be specified, rather than error bands.			X
8.1.2-12	**Use Arabic Numerals**			
	Arabic numerals should be used.			X
8.1.2-13	**Spelled Numbers**			
	Numbers that are spelled out should be consistently spelled under the same conditions.			X
8.1.2-14	**Presentation of Conditional Steps**			
	Conditional steps should be shown in traditional text formats following the guidance in Appendix B of NUREG-0899.			X
8.1.2-15	**Specification of Preconditions for Steps**			
	The procedure should specify any conditions that must be met before an action can be undertaken.			X
8.1.3	**Warnings, Cautions, Notes, and Reference Materials**			
8.1.3-1	**Parallel Display with Procedure Step**			
	The warnings and cautions applicable to a single step (or to a series of steps) should be displayed when the step(s) is on the screen.			X
8.1.3-2	**Position Before Action Steps**			
	Warnings, cautions, and notes should be presented so that they will be read before the applicable action steps.			X
8.1.3-3	**Action References**			
	Warnings, cautions, and notes should not include implied or actual action steps.			X
8.1.3-4	**Distinction from Other Procedure Elements**			
	Warnings, cautions, and notes should be uniquely presented, so that they are easily distinguished from each other and from other display elements.			X
8.1.3-5	**Supplementary Information**			
	All supplementary information (such as tables and figures) required for a procedure step and available to the CBP should be shown on the screen concurrently with the step, or on another easily viewed display.			X

Guideline #	Review Criteria	Yes	No	N/A
8.1.4	**Lists**			
8.1.4-1	**Appropriate Application of Lists**			
	Groups of three or more related items (e.g., actions, conditions, components, criteria, systems) should be presented as a list.			X
8.1.4-2	**Distinction from Other Procedure Elements**			
	Formatting should be used to differentiate items in a list from other procedure elements.			X
8.1.4-3	**Identification of Precedence**			
	The presence or absence of precedence among items in lists should be indicated.			X
8.1.4-4	**List Overviews**			
	Overviews should introduce each list.			X
8.1.4-5	**Assuring Users' Attention**			
	The method for assuring that each item in a list has received the users' attention should be consistent.			X
8.1.5	**Organization of Procedures**			
8.1.5-1	**Hierarchical, Logical Organization**			
	The procedures should be organized in a hierarchical, logical, consistent manner.			X
8.1.5-2	**Organization of Procedure Steps**			
	Each procedure should be organized into sections of related steps.			X
8.1.6	**Formatting and Screen Layout**			
8.1.6-1	**Organization Format of Procedures**			
	The procedure's format should reflect its organization.			X
8.1.6-2	**Format of Procedures**			
	A consistent format should be used to display procedures.			X
8.1.6-3	**Partitioning Procedures**			
	A consistent approach to partitioning procedures should be used.			X
8.1.6-4	**Organization of Display Screen**			
	Each display screen should locate information and HSI features consistently.			X
8.1.6-5	**Continuously Presented Procedure Information**			
	The procedure's title and identification should be continuously presented.			X
8.1.6-6	**Continuously Presented Status of High-Level Goals**			
	The status of high-level procedure goals should be continuously presented.			X
8.2	**Functional Capabilities**			
8.2.1	**Procedure Supervision and Control**			
8.2.1-1	**Users' Control of Procedure Path**			
	Users should be in control of the sequence of steps that are followed.			X
8.2.1-2	**Users' Control of Pace of Procedures**			
	Users should be in control of the pace at which procedure steps are followed.			X

Guideline #	Review Criteria	Yes	No	N/A
8.2.1-3	**Understandability of Analysis of Procedure Steps**			
	The methods by which CBPs analyze procedure steps should be consistent with the methods by which users analyze steps in procedure logic steps, so that the results are understandable.			X
8.2.1-4	**Users' Verification of CBP Information**			
	The users should be able to verify the system's assessment of plant status.			X
8.2.1-5	**Users' Override of CBP**			
	Users should be able to override any CBP information, calculation, evaluation, or assessment.			X
8.2.2	**Procedure Monitoring and Assessment**			
8.2.2-1	**Automatic Identification of Procedures**			
	The CBP should alert users when entry conditions to a procedure are satisfied.			X
8.2.2-2	**Automatic Monitoring of Plant Parameters and Equipment Status**			
	The CBP should automatically provide accurate and valid information on the values of parameters and status of equipment, when they are available to the system.			X
8.2.2-3	**Frequent Monitoring**			
	The CBP should frequently monitor procedure-defined parameters.			X
8.2.2-4	**Automatic Calculation of Procedure-Referenced Values**			
	The system should undertake calculations, such as subcooling margin, that are required when using procedures.			X
8.2.2-5	**Analysis of Step Logic**			
	The CBP should evaluate the logic of each procedure step and show the results to the user.			X
8.2.2-6	**Continuous Analysis of Non-Current Step Logic**			
	Steps of continuous applicability, time-dependent steps, and process-dependent steps should be monitored by the CBP and the user should be alerted when conditions in those steps become effective.			X
8.2.2-7	**Coding of Logical Analysis**			
	When procedure's step logic indicates a violation of the step, the information should be coded to make that step more salient to users.			X
8.2.2-8	**Analysis of Cautions**			
	The conditions described in cautions should be automatically monitored by the CBP system, and the user should be alerted when the caution is in effect.			X
8.2.2-9	**Coding Applicable Cautions**			
	CBPs should use coding to indicate when a caution is in effect.			X
8.2.2-10	**Users' Acknowledgment of Procedure Analyses**			
	Users should make some form of acknowledgment of procedure steps and recommendations for terminations and transitions.			X
8.2.2-11	**Identification of User Input Requirements**			
	The CBP should provide users with clear, timely indications when they need to input any information not available to it.			X

Guideline #	Review Criteria	Yes	No	N/A
8.2.2-12	**Adjustable Level of Detail**			
	Users should be able to choose the level of detail with which procedures are presented.			X
8.2.2-13	**Context-Specific Guidance**			
	Procedure guidance should be context sensitive where possible.			X
8.2.2-14	**Assessment of High-Level Goal Status**			
	The CBP should continuously assess and present the status of higher-level safety goals, such as critical safety functions, and alert the user to any challenges.			X
8.2.2-15	**Assessment of Conditions Terminating a Procedure**			
	The CBP should automatically identify when conditions are met for transitioning or exiting from a procedure.			X
8.2.3	**Monitoring of User Actions**			
8.2.3-1	**Monitoring Users**			
	User responses to procedures should be monitored and recorded by the CBP.			X
8.2.3-2	**Alert Users to Deviations in Procedure**			
	Users should be alerted if their input is incorrect, or when their actions are not consistent with CBP evaluations.			X
8.2.4	**Planning and Implementation**			
8.2.4-1	**Display of Action Status**			
	The status of procedure-related actions should be displayed by the CBP.			X
8.2.4-2	**Timing of Procedures**			
	The CBP's timing, such as status update rates, screen changes, and navigation features, should be consistent with the time demands of the task.			X
8.3	**User-System Interaction**			
8.3.1	**Path Monitoring**			
8.3.1-1	**Monitoring Step Status**			
	There should be an indication of whether or not a step was completed.			X
8.3.1-2	**Alert User to Incomplete Procedure Steps**			
	Users should be alerted to incomplete procedure steps.			X
8.3.1-3	**Coding Current Location**			
	The current procedure step(s) should be indicated.			X
8.3.1-4	**Automatic Path Monitoring**			
	The pathway taken through procedures should be stored and made available to users.			X
8.3.1-5	**Indication of Multiple Active Procedures**			
	The user should be informed when multiple procedures or multiple procedure steps are to be followed concurrently. A list of all currently active procedures should be available.			X

Guideline #	Review Criteria	Yes	No	N/A
8.3.2	**Navigation**			
8.3.2-1	**Flexible Navigation**			
	Navigation support should allow users to freely and easily move between procedure steps, to other parts of the same procedure, and to other procedures.			X
8.3.2-2	**Support Parallel Access to Information**			
	The CBP should have the ability to access more than one piece of information at once.			X
8.3.2-3	**Navigational Links to Related Information**			
	Navigational links to cross-referenced information and to notes, cautions, warnings, reference material, and communication and help facilities should be provided.			X
8.3.2-4	**Access to Contingency Actions**			
	Users should be able to easily access appropriate contingency actions.			X
8.3.3	**Help**			
8.3.3-1	**Explanation Facilities**			
	CBPs should have facilities to enable the user to determine how CBP functions are performed.			X
8.3.3-2	**Help Facilities**			
	Help for performing procedure specified activities should be provided.			X
8.3.3-3	**Note Taking**			
	There should be a way for users to record their notes and comments in the CBP.			X
8.4	**CBP Hardware**			
8.4-1	**Number of VDUs**			
	The number of VDUs on which CBP information is displayed should be sufficient to provide all the procedure-related information needed for a procedure step, including cautions and reference material.			X
8.5	**Backup for CBPs**			
8.5-1	**Paper-Based Procedure Availability**			
	PBPs should be available in the event of CBP failure.			X
8.5-2	**Consistency of PBPs and CBPs**			
	The content and presentation of procedure information in PBPs and CBPs should be consistent.			X
8.5-3	**Support for Transfer to PBPs**			
	Upon transfer to PBPs, a means should be provided to support the user's determination of currently open procedures, location in the procedures, completed and not completed steps, and currently monitored steps.			X
8.6	**CBP Integration with Other HSI Elements**			
8.6-1	**Consistency with HSI**			
	The detailed CBP design should be fully consistent with the rest of the HSI.			X

Guideline #	Review Criteria	Yes	No	N/A
9	**COMPUTERIZED OPERATOR SUPPORT SYSTEM**			
9.1	**General**			
9.1-1	**Consistency with User Task Requirements**			
	The support provided by the COSS should be consistent in content and format with the cognitive strategies and mental models employed by the user.			X
9.1-2	**Consistency with General HSI**			
	The COSS should be fully integrated with and consistent with the rest of the HSI.			X
9.1-3	**Interaction With Ongoing Tasks**			
	Use of the COSS should not require canceling ongoing tasks.			X
9.1-4	**Critical Information Alert**			
	If critical information becomes available during COSS utilization, the system should alert the user to the critical information.			X
9.1-5	**Minimize Querying of User**			
	COSS querying of the user for information should be minimized.			X
9.1-6	**Dialogue Sequencing Flexibility**			
	The user-COSS dialogue should be flexible in terms of the type and sequencing of user input the COSS will accept.			X
9.1-7	**Strategy Planning Capability**			
	The COSS should provide the capability to plan a strategy for addressing a problem.			X
9.1-8	**User Supported Strategy Selection**			
	When the COSS is capable of a range of problem-solving strategies, it should be capable of accepting direction from the user in terms of which strategy to employ.			X
9.1-9	**Simulation Mode Command and Identification**			
	If the COSS has a simulation mode, entering the simulation mode should require an explicit command and result in a distinguishable change in system output.			X
9.1-10	**Explanation Capability**			
	The COSS should be capable of interactively explaining its rules, knowledge base, and problem solutions at any point during a user-COSS transaction.			X
9.1-11	**User Control of Explanation Detail**			
	The level of detail of information presented as part of an explanation or justification should be under the control of the user.			X
9.1-12	**Indication of Certainty**			
	The COSS should represent its certainty in the correctness of analyses and provide the rationale underlying the certainty estimation.			X
9.1-13	**Inadequate Knowledge Alert**			
	The COSS should alert the user when a problem or situation is beyond its capabilities.			X

Guideline #	Review Criteria	Yes	No	N/A
9.1-14	**Graphic Representation of Rules**			
	The COSS should be able to graphically represent system relationships, its rules network, and reasoning process.			X
9.1-15	**Highlight of Status Changes After COSS Utilization**			
	At the completion of a user-COSS session, the COSS should update and highlight changes in the status of important system information.			X
9.1-16	**Post Hoc Rule-Event Recall**			
	The COSS explanation facility should have the capability to recall each invoked rule and associate it with a specific event (i.e., question or conclusion) to explain the rationale for the event.			X
9.1-17	**Rapid Interaction Retrieval**			
	The system should permit rapid retrieval of previous exchanges between the user and the COSS.			X
9.1-18	**Hardcopy of COSS Utilization**			
	The user should be capable of requesting a hardcopy of data including screen displays (text or graphics), data employed during a consultation, summaries of consultations, lists of rules/facts invoked during a consultation, and summaries of hypotheses tested.			X
10	**COMMUNICATION SYSTEM**			
10.1	**General Communication Guidelines**			
10.1-1	**Accessibility**			
	Communications functions and/or equipment should be accessible from the user's normal working location.			X
10.1-2	**Instructions**			
	Instructions should be provided for use of each communication system, including suggested alternatives if a system becomes inoperable.			X
10.1-3	**Outgoing Emergency Messages**			
	Priority procedures should be established for the transmission of emergency messages from the control room by any of the communication systems.			X
10.1-4	**Incoming Emergency Messages**			
	Procedures should be established for handling communications during an emergency, and these procedures must be known by all users.			X
10.1-5	**Minimal User Actions**			
	Communication systems should be designed to minimize required user actions.			X
10.1-6	**Communication Flexibility**			
	Users should have flexibility in communications methods.			X
10.2	**Speech-Based Communication**			
10.2.1	**General Requirements**			
10.2.1-1	**Comfort**			
	Communication equipment to be worn should be designed to preclude discomfort.			X

Guideline #	Review Criteria	Yes	No	N/A
10.2.1-2	**Hands-Free Operation**			
	Communication equipment should be designed to permit hands-free operation.			X
10.2.1-3	**Frequency Response**			
	Microphones and associated amplification equipment should be designed to respond optimally to that part of the speech spectrum most essential to speech intelligibility (i.e., 200 to 6,100 Hz).			X
10.2.1-4	**Microphone Dynamic Range**			
	The dynamic range of a microphone used with a selected amplifier should be great enough to admit variations in signal input of at least 50 dB.			X
10.2.1-5	**Microphone Noise Shields**			
	When ambient noise is high (85 dB(A) or greater), the microphone should be put in a noise shield.			X
10.2.1-6	**Noise-Canceling Microphones**			
	In very loud, low frequency noise environments (100 dB overall), noise-canceling microphones should be used.			X
10.2.1-7	**Signal Processing**			
	If the environment or the speech transmission equipment is such that the signal-to-noise ratio of the speech is degraded, signal-processing techniques should be used to maintain speech intelligibility.			X
10.2.1-8	**Speaker Frequency Range**			
	Loudspeakers, earpieces, and headphone elements should respond uniformly (plus or minus 5 dB) over the range 100 to 4,800 Hz.			X
10.2.1-9	**Binaural Headsets For High Noise Environments**			
	If listeners will be working in high ambient noise (85 dB(A) or above), binaural headsets should be provided rather than monaural headsets.			X
10.2.1-10	**Loudspeakers for Multi-Channel Monitoring**			
	When several channels are to be monitored simultaneously by means of loudspeakers, the speakers should be mounted at least 10 degrees apart in the horizontal plane frontal quadrant, ranging radially from			X
10.2.1-11	**Volume Controls**			
	Accessible volume or gain controls should be provided for each communication receiving channel (e.g., loudspeakers or headphones) with sufficient electrical power to drive sound pressure level to at least 100 dB overall when using two earphones.			X
10.2.1-12	**Squelch Control**			
	When communication channels are to be continuously monitored, each channel should be provided with a signal-activated switching device (squelch control) to suppress channel noise during no-signal periods.			X
10.2.1-13	**Periodic Maintenance Tests**			
	Periodic tests should be performed on all communication systems to ensure that messages remain intelligible under changes in ambient noise levels that may have occurred since the last check.			X

Guideline #	Review Criteria	Yes	No	N/A
10.2.2	**Conventional Telephone Systems**			
10.2.2-1	**Handset Size and Shape**			
	The size and shape of handsets should be compatible with user's hand size and mouth-ear distance (standard telephone dimensions are acceptable).			X
10.2.2-2	**Handset Design**			
	Handset earpieces should maintain firm ear contact while the transmitter is positioned in front of the mouth.			X
10.2.2-3	**Retractable Handset Cords**			
	Cords should be of nonkink or self-retracting type.			X
10.2.2-4	**Handset Cord Length**			
	Cords should be of sufficient length to permit reasonable user mobility.			X
10.2.2-5	**Handset Cord Position**			
	Cords should be positioned so as to avoid entangling critical controls or endangering passing traffic.			X
10.2.2-6	**Handset Cradles**			
	Vertically mounted handset cradles should be designed and located to prevent the handset from being knocked out of the cradle by passing traffic.			X
10.2.2-7	**Multiple Instruments**			
	Where multiple telephone instruments are located close together (e.g., on a single desk), they should be coded to indicate circuit or function.			X
10.2.2-8	**Press-to-Talk Button**			
	If a press-to-talk button is used, the button should be convenient to both left-and right-hand operation.			X
10.2.2-9	**Switching Mechanism**			
	Switching should be designed and/or programmed to minimize delay in making desired connections under both normal and emergency conditions.			X
10.2.2-10	**Telephone Ringing**			
	The volume of ringing should be adjustable at the individual telephone instrument.			X
10.2.2-11	**Announcing Use**			
	The transmitter should be compatible with the rest of the announcing system when used as the microphone input to the announcing system.			X
10.2.3	**Sound-Powered Telephone Systems**			
10.2.3-1	**Feedback**			
	Within engineering constraints imposed by sound-powering, the system should provide in-phase feedback to the user.			X
10.2.3-2	**Ringing**			
	If ringing is not installed, the user should be able to switch the sound-powered transmitter to the paging system so that a desired party can be called to the line.			X

Guideline #	Review Criteria	Yes	No	N/A
10.2.3-3	**Jack Provisions**			
	Plug-in jacks for the sound-powered system should be provided within the control room.			X
10.2.3-4	**Switching**			
	When used, patch panels should be conspicuously marked and located in reasonably accessible places.			X
10.2.3-5	**Cushioning of Earpieces**			
	Earphone cushioning to provide comfort for extended periods of wear.			X
10.2.3-6	**Fit of Earpieces**			
	Earpieces should cover the outer ear without causing uncomfortable pressure.			X
10.2.3-7	**Fit of Headsets**			
	The headset should be held firmly in place, yet be easy to remove			X
10.2.3-8	**Storage of Headsets**			
	A well-marked and accessible place should be provided for headset stowage			X
10.2.4	**Portable Radio Transceivers**			
10.2.4-1	**Appropriate Use**			
	Walkie-talkies should be used in both emergency and normal operations for two-way communications beyond the range of installed telephone connections or as a convenient alternative to the sound-powered telephone.			X
10.2.4-2	**Sound Quality**			
	Walkie-talkies should realize the same quality desired throughout all of the communications systems within the engineering constraints imposed by radio frequency spectrum availability and by design for easy portability.			X
10.2.4-3	**Area Coverage**			
	Modulation and a radio frequency should be chosen, as FCC regulations permit, to provide broad-area walkie-talkie communication to the control room.			X
10.2.4-4	**Portability**			
	To the extent permitted by design for effective electrical/radio frequency function, walkie-talkies should be small, light, and easy to carry. The microphone should be integrated into the transceiver package.			X
10.2.4-5	**Party Identification**			
	Procedures should provide for unambiguous identification of the speaker when there are more than two parties on a channel operating at separate locations.			X
10.2.4-6	**Battery Replenishment**			
	A supply of fresh replacement batteries should be stowed in an accessible, well-marked space.			X

Guideline #	Review Criteria	Yes	No	N/A
10.2.5	**Announcing Systems**			
10.2.5-1	**Intelligibility and Coverage**			
	The system should provide rapidly intelligible messages to all areas where personnel subject to a page may be located.			X
10.2.5-2	**Microphone Characteristics**			
	If the powered telephone system is used to provide microphone input to the announcing system, the telephone system should contain transmitters of quality compatible with that of the announcing system.			X
10.2.5-3	**Loudspeaker Location**			
	Speakers should be provided in the control room and other areas where personnel might be (e.g., restrooms, eating areas, and locker rooms).			X
10.2.5-4	**Speech Clarity**			
	Since proper speech over an announcing system differs from normal conversation, users should be familiarized with the proper way to speak on the announcing system.			X
10.2.5-5	**Loudspeaker Volume**			
	Speaker volume should be adjusted to ensure that speaker communications will not prevent detection of auditory alarms.			X
10.2.5-6	**Priority**			
	Control room inputs to the plant announcing system should have priority over any other input.			X
10.2.6	**Other Communications Systems**			
10.2.6-1	**Fixed-Base UHF Transceivers**			
	A fixed-base UHF transceiver may be used for normal emergency communications between the control room and the following locations similarly equipped with fixed-base transceivers: Dispatcher, Security, and Utility Headquarters (if within UHF range).			X
10.2.6-2	**Point-to-Point Intercom Systems**			
	Intercom systems should be provided to interconnect the control room with important plant areas and other areas where control room or operating personnel might be.			X
10.2.7	**Emergency Communications**			
10.2.7-1	**Backup Equipment**			
	Provisions should be made to assure complete internal and external communications capabilities during emergencies.			X
10.2.7-2	**Equipment Usability**			
	Communications equipment should be usable by personnel wearing protective gear without impediment to their tasks.			X
10.2.7-3	**Voice Communications with Masks**			
	Emergency facemasks should be equipped with diaphragms that are specially designed to transmit speech.			X

Guideline #	Review Criteria	Yes	No	N/A
10.3	**Computer-Based Communication**			
10.3.1	**General**			
10.3.1-1	**Interactive Communication**			
	Users should be able to communicate interactively with other users who are currently using the same system.			X
10.3.1-2	**Interaction With Ongoing Tasks**			
	Users should be able to communicate with each other without canceling ongoing tasks.			X
10.3.1-3	**Functional Integration**			
	Computer-based communications should be integrated with other information handling functions within a system.			X
10.3.1-4	**Consistent Procedures**			
	Procedures for sending and receiving messages should be consistent from one transaction to another.			X
10.3.1-5	**Control by Explicit User Action**			
	Both sending and receiving messages should be accomplished by explicit user action.			X
10.3.1-6	**Automatic Queuing**			
	The computer should provide automatic queuing of outgoing messages pending confirmation of transmission, and incoming messages pending their review and disposition.			X
10.3.1-7	**Interrupt**			
	Users should be able to interrupt message preparation, review, or disposition, and then resume any of those tasks from the point of interruption.			X
10.3.1-8	**Message Highlighting**			
	Software capabilities should be provided to annotate transmitted data with appropriate highlighting to emphasize alarm/alert conditions, priority indicators, or other significant information that could affect message handling.			X
10.3.1-9	**Automatic Record Keeping**			
	A log of data transmissions should be automatically maintained.			X
10.3.2	**Preparing Messages**			
10.3.2-1	**Automatic Message Formatting**			
	When message formats should conform to a defined standard or structure, prestored formats should be provided to aid users in message preparation.			X
10.3.2-2	**Message Composition Compatible with Data Entry**			
	Procedures for composing messages should be compatible with general data entry procedures, especially those for text editing.			X
10.3.2-3	**Variable Message Length**			
	Users should be able to prepare messages of any length.			X

Guideline #	Review Criteria	Yes	No	N/A
10.3.2-4	**Incorporate Existing Files**			
	Users should be able to incorporate an existing data file in a message, or to combine several files into a single message for transmission.			X
10.3.2-5	**Message Editing**			
	Users should be able to save and edit messages prior to transmission.			X
10.3.3	**Sending Messages**			
10.3.3-1	**Destination Selection**			
	Users should be able to specify the destination(s) to which messages will be transmitted.			X
10.3.3-2	**Address Directory**			
	Users should be provided with a directory showing all acceptable forms of message addressing for each destination in the system, and for links to external systems.			X
10.3.3-3	**Aids for Directory Search**			
	Computer aids should be provided so that a user can search an address directory by specifying a complete or partial name.			X
10.3.3-4	**Extracting Directory Addresses**			
	Users should be able to extract selected addresses from a directory or select a distribution list for direct insertion into a header in order to specify the destination(s) for a message.			X
10.3.3-5	**Automatic Addressing of Reply**			
	The appropriate address(es) should be provided automatically for users responding to messages.			X
10.3.3-6	**Assignment of Priority**			
	When messages will have different degrees of urgency, the sender of a message should be allowed to designate its relative priority.			X
10.3.3-7	**Information About Communication Status**			
	Users should be allowed access to status information concerning the identity of other system users currently on-line, and the availability of communication with external systems.			X
10.3.3-8	**Sender Identification**			
	When a message is sent, the computer should show the sender's address, and the date and time of message creation and/or transmission.			X
10.3.3-9	**Deferring Message for Automatic Transmission**			
	Users should be able to defer the transmission of prepared messages, to be released by a later action.			X
10.3.3-10	**Automatic Feedback**			
	Automatic feedback for data transmission confirming that messages have been sent or indicating transmission failures should be provided to permit effective user participation in message handling.			X
10.3.3-11	**Saving Undelivered Messages**			
	If message transmission is not successful, automatic storage of undelivered messages should be provided.			X

Guideline #	Review Criteria	Yes	No	N/A
10.3.3-12	**Message Cancellation**			
	Users should be able to recall any message whose transmission has been initiated, if it has not yet been received by its addressee(s).			X
10.3.3-13	**User Review of Data Before Transmission**			
	When human judgment may be required to determine whether data are appropriate for transmission, users (or a system administrator) should be provided some means to review outgoing messages and confirm their release before transmission.			X
10.3.3-14	**Saving Transmitted Data Until Receipt is Confirmed**			
	A copy of any transmitted message should be saved automatically until correct receipt has been confirmed.			X
10.3.4	**Receiving Messages**			
10.3.4-1	**Message Notification at Logon**			
	When users log on to a system, they should be notified of any transmissions received since their last use of the system.			X
10.3.4-2	**Display of Messages**			
	The display of messages from other users should be visually and spatially distinct from the display of system messages.			X
10.3.4-3	**Nondisruptive Message Notification**			
	Notification of incoming messages should be nondisruptive.			X
10.3.4-4	**Indicating Priority of Received Messages**			
	Where incoming messages will have different degrees of urgency, recipients should be notified of message priority and/or other pertinent information.			X
10.3.4-5	**Filters for Message Notification**			
	Users should be able to specify "filters" based on message source, type, or content, that will control what notification is provided for incoming messages.			X
10.3.4-6	**Time-Stamp Messages**			
	Messages should be time-stamped.			X
10.3.4-7	**Indicate Message Size**			
	Some indication of message size should be included at the beginning of each message.			X
10.3.4-8	**Indication of Message Overflow**			
	The user should be informed when a message has been truncated, such as when a message exceeds the available space.			X
10.3.4-9	**Message Storage and Retrieval**			
	Messages should be stored in a message queue that is available to the user.			X
10.3.4-10	**Information about Queued Messages**			
	Users should be able to review summary information about the type, source, priority, and size of queued incoming messages.			X

Guideline #	Review Criteria	Yes	No	N/A
10.3.4-11	**User Selection of Messages**			
	The user should be allowed to select any message from an ordered queue with a simple action.			X
10.3.4-12	**Annotating Received Messages**			
	Users should be able to append notes to a received message, and ensure that the annotation will be displayed so that it will be distinct from the message itself.			X
10.3.4-13	**Specifying Device Destination**			
	Users should be able to choose the method of receipt, i.e., what device (file, display, printer) will be the local destination. If a specified receiving device is not operable, such as a printer that is not turned on, the user should be advised.			X
11	**WORKSTATION DESIGN**			
11.1	**Workstation Configuration**			
11.1.1	**Stand-Up Console Dimensions**			
11.1.1-1	**Console Height to See Over**			
	Console height (with or without annunciator panels) should not exceed 58 inches when it is necessary for a user standing at the console to see over its top.			X
11.1.1-2	**Control Height**			
	The highest control on a stand-up console should be within the highest reach of the 5th percentile female without stretching or using a stool or ladder, while the lowest controls should be within the lowest reach of the 95th percentile male without bending or stooping, as shown in Table 11.1.			X
11.1.1-3	**Benchboard Slope**			
	The benchboard slope, in conjunction with its depth, should result in all controls being within the reach radius of the 5th percentile female, as shown in Table 11.1 and illustrated in Figure 11.1.			X
11.1.1-4	**Minimum Distance of Controls from the Front Edge of the Console**			
	Controls should be set back a minimum of 3 inches from the front edge to protect against accidental activation.			X
11.1.1-5	**Maximum Distance of Controls from the Front Edge of the Console**			
	Controls should be no more than 25 inches from the front edge of the console.			X
11.1.1-6	**Display Height and Orientation**			
	All displays, including alarm indicators, should be within the upper limit of the visual field (75 degrees above the horizontal line of sight) of the 5th percentile female (see Table 11.1), and should be mounted so that the interior angle between the line of sight and the display face is 45 degrees or greater (see			X

Guideline #	Review Criteria	Yes	No	N/A
11.1.1-7	**Location of Frequently Monitored Displays**			
	Displays that require frequent or continuous monitoring, or that may display important (e.g., alarm) information, should be located not more than 35 degrees to the left or right of the user's straight-ahead LOS, and not more than 35 degrees above and 25 degrees below the user's horizontal LOS, measured from the normal workstation.			X
11.1.1-8	**Location of Infrequently Monitored Displays**			
	Displays that do not require frequent or continuous monitoring, and that will not display important (e.g., alarm) information, should be located not more than 95 degrees to the left or right of the user's straight- ahead LOS, as measured from normal workstations.			X
11.1.1-9	**Lateral Spread of Controls and Displays**			
	The maximum lateral spread of controls and displays at a single-user workstation should not exceed 72 inches.			X
11.1.1-10	**Foot Room**			
	Enough foot room should be provided to allow the user to get close to the board without leaning.			X
11.1.2	**Sit-Down Console Dimensions**			
11.1.2-1	**Console Height to See Over**			
	Console height should be no more than approximately 27 inches above the seat to accommodate the 5th percentile adult female when a seated user must see over the console. Assuming seat height is adjusted to 18 inches, maximum console height therefore should be 45 inches above the floor.			X
11.1.2-2	**Control Height**			
	All controls on a sit-down console should be within the reach radius of the 5th percentile female, as shown in Table 11.1 and illustrated in Figure 11.3.			X
11.1.2-3	**Benchboard Slope**			
	The benchboard slope, in conjunction with its depth, should be such that all controls are within the functional reach radius of the 5th percentile female (as shown in Table 11.1 and illustrated in Figure 11.3) and all displays and markings can be read.			X
11.1.2-4	**Minimum Distance of Controls from the Front Edge of the Console**			
	Controls should be set back a minimum of 3 inches from the front edge to protect against accidental activation.			X
11.1.2-5	**Display Height and Orientation**			
	All displays, including alarm indicators, should be within the upper limit of the visual field (75 degrees above the horizontal line of sight) of the 5th percentile female (see Table 11.1), and should be mounted so that the interior angle between the line of sight and the display face is 45 degrees or greater (see			X

Guideline #	Review Criteria	Yes	No	N/A
11.1.2-7	**Location of Infrequently Monitored Displays**			
	Displays that do not require frequent or continuous monitoring, and that will not display important (e.g., alarm) information, should be located not more than 95 degrees to the left or right of the user's straight- ahead LOS, as measured from normal workstations.			X
11.1.2-8	**VDU Viewing Distance**			
	The viewing distance should be 13-30 inches (33 to 80 cm), with 18-24 inches (46-61 cm) preferred.			X
11.1.2-9	**Lateral Spread of Controls and Displays**			
	All necessary controls and displays needed for critical or frequently performed activities should be within the maximum extended reach and viewing range of a seated user from a single reference point as shown in Table 11.1 and illustrated in Figure 11.5.			X
11.1.2-10	**Leg and Foot Room**			
	Sufficient leg and foot room should be provided to enable seated users to avoid awkward and uncomfortable positions. Figure 11.6 shows the dimensions involved and gives minimums and ranges necessary to accommodate the 5th percentile female and 95th percentile male, as defined in			X
11.1.2-11	**Writing Space on Consoles**			
	If writing space is needed by users working at consoles, an area at least 16 inches deep and 24 inches wide should be provided, where these dimensions in the total configuration would fit users' reach capabilities.			X
11.1.2-12	**Use of Procedures and Other Reference Materials at Consoles**			
	Provision should be made so that the procedures, manuals, and other reference materials can be consulted easily while task sequences are performed at the consoles.			X
11.1.3	**Sit-Stand Workstations**			
11.1.3-1	**Appropriate Use**			
	Sit-stand combinations should be used when users need mobility to monitor large panel areas but also need the stability of seated operation for precise task sequences.			X
11.1.3-2	**Control and Display Positioning**			
	The height and lateral limits for controls and displays should conform to the guidelines given for stand-up consoles (see Section 11.1.1, Stand-Up Console Dimensions).			X
11.1.3-3	**Seat Height**			
	The user should be provided with a high seat so that the seated eye height is approximately the same as standing eye height.			X
11.1.3-4	**Knee Room**			
	Knee room and comfortable foot support should be provided.			X

Guideline #	Review Criteria	Yes	No	N/A
11.1.4	**Vertical Panels**			
11.1.4-1	**Control Height**			
	Controls should be placed in an area between 34 inches and 70 inches above the floor. Controls requiring precise or frequent operation and emergency controls should be placed in an area between 34 inches and 53 inches above the floor (see Figure 11.7).			X
11.1.4-2	**Display Height**			
	Displays should be placed in an area between 41 inches and 70 inches above the floor. Displays that must be read frequently or precisely should be placed in an area between 50 inches and 65 inches above the floor (see Figure 11.8).			X
11.1.5	**Desk Dimensions**			
11.1.5-1	**Working Space**			
	Desks should provide enough clear working space for all materials required for task performance.			X
11.1.5-2	**Chair Positions**			
	The desk should allow for different chair positions as required, with adequate knee space.			X
11.1.5-3	**Comfort**			
	The relationships of working surface height and area, knee room, and chair height should allow users to work comfortably.			X
11.1.5-4	**Dimensions**			
	Desk dimensions should conform to those shown in Figure 11.9.			X
11.1.6	**Chairs**			
11.1.6-1	**Mobility**			
	Chairs should pivot so that operators can readily adjust position.			X
11.1.6-2	**Backrests**			
	Chairs should support at least the lower back curvature (lumbosacral region).			
11.1.6-3	**Armrests**			
	Where personnel may remain seated for relatively long periods, chairs with armrests should be provided.			X
11.1.6-4	**Cushioning**			
	The seat and backrest should be cushioned with at least 1 inch of compressible material, enough so that some resilience remains when the chair is occupied.			X
11.1.6-5	**Seat Dimensions**			
	The seat should be at least 18 inches wide and between 15 and 17 inches deep.			X
11.1.6-6	**Seat Adjustability**			
	For chairs at sit-down stations, seat height should generally be adjustable from 16 to 20.5 inches. For chairs at sit-stand stations, seat height should be adjustable from 26 to 32 inches.			X

Guideline #	Review Criteria	Yes	No	N/A
11.1.6-7	**Footrests**			
	An adjustable footrest or heel catch should be provided to support the feet at a level no more than 18 inches below the seat surface.			X
11.2	**Control and Display Device Layout**			
11.2.1	**General Layout**			
11.2.1-1	**Proximity**			
	A visual display that will be monitored during control manipulation should be located sufficiently close that a user can read it clearly and without parallax from a normal operating posture.			X
11.2.1-2	**Obscuration**			
	Controls and displays should be located so that displays are not obscured during control operation.			X
11.2.2.1	**Multiple Controls, Single Display**			
11.2.2.1-1	**Controls Mounted Below Display**			
	Multiple controls should be mounted below the single display.			X
11.2.2.1-2	**Alternative Control Position**			
	If it is not feasible to mount multiple controls directly below the single display, controls should be mounted to the right of the display.			X
11.2.2.1-3	**Controls Centered on Display**			
	Multiple controls should be centered on the single display.			X
11.2.2.1-4	**Grouping of Controls**			
	Multiple controls should be grouped in a line or matrix.			X
11.2.2.1-5	**Arrangement of Controls**			
	Where there is a normal order of use, multiple controls should be arranged for use in left-to-right, top-to- bottom, or other natural sequence.			X
11.2.2.1-6	**Enhancement of Control Layout**			
	Layout enhancement techniques should be employed where the above techniques cannot apply, or where for other reasons the relationships are not readily apparent.			X
11.2.2.2	**Single Control, Multiple Displays**			
11.2.2.2-1	**Displays Located Above Control**			
	Multiple displays should be located above the single control.			X
11.2.2.2-2	**Alternative Position for Displays**			
	If it is not feasible to mount multiple displays above the single control, they should be mounted to the left of the control.			X
11.2.2.2-3	**Control Centered Below Displays**			
	The single control should be placed as near as possible to the display, and preferably underneath the center of the display array.			X
11.2.2.2-4	**Grouping of Displays**			
	Multiple displays should be arranged horizontally or in a matrix.			X
11.2.2.2-5	**Arrangement of Displays**			
	Where there is a normal order of use, multiple displays should read from left-to-right, top-to-bottom, or in other natural sequence.			X

Guideline #	Review Criteria	Yes	No	N/A
11.2.2.2-6	**Visibility During Control Manipulation**			
	Multiple displays should not be obscured during control manipulation.			X
11.2.2.2-7	**Enhancement of Display Layout**			
	Layout enhancement techniques should be employed where the above techniques cannot apply, or where for other reasons the control-display relationship is not clearly apparent.			X
11.2.2.2-8	**Display Selector Motion**			
	The display selector control should move clockwise from OFF (if appropriate) through settings 1, 2, 3...n.			X
11.2.2.2-9	**Display Selector Sequence**			
	The display selector control position sequence should conform to the display sequence.			X
11.2.2.2-10	**Display Selector Labeling**			
	Display selector control position indications should correspond with display labels.			X
11.2.2.2-11	**Display Selectors Scale**			
	Displays should read off scale, not zero, when not selected, especially if zero is a possible parameter displayed.			X
11.2.2.3	**Dynamic Control-Display Relationships**			
11.2.2.3-1	**Rotary Controls**			
	Rotary controls should turn clockwise to cause an increase in parameter value. Associated display movements should be: (1) analog scales, up or to the right; (2) digital displays, increasing in value; (3) strings of indicator lights, bottom-to-top or left-to-right; and (4) circular meter pointers, clockwise.			X
11.2.2.3-2	**Linear Controls**			
	Linear controls should move up or to the right to cause an increase in parameter value. The associated display relationships should be: (1) analog scales, up or to the right; (2) digital displays, increasing in value; and (3) strings of indicator lights, bottom-to-top or left-to-right.			X
11.2.2.3-3	**Display Response Time Lag**			
	When there is a time lag between control actuation and ultimate system state, there should be an immediate feedback indication of the process and direction of parameter change.			X
11.2.2.3-4	**Precision of Control**			
	Controls should provide a capability to affect the parameter controlled easily, with the required level of precision.			X
11.2.2.3-5	**Resolution of Display**			
	Displays should provide a capability to distinguish significant levels of the system parameter controlled.			X
11.2.2.3-6	**Excess Precision**			
	The precision of displays and controls should not greatly exceed that required.			X

Guideline #	Review Criteria	Yes	No	N/A
11.2.2.3-7	**Feedback**			
	Feedback from the display should be apparent for any deliberate movement of a control.			X
11.2.3	**Between-Group and Within-Group Relationships**			
11.2.3-1	**Functional Grouping**			
	Multiple controls or displays related to the same function should be grouped together.			X
11.2.3-2	**Sequence of Use**			
	Sequence of use should be as follows: (1) left to right, (2) top to bottom, or (3) the above combined (normal reading order).			X
11.2.3-3	**Display Above Each Control**			
	The preferred configuration is with the display above each control.			X
11.2.3-4	**Controls and Displays in Rows**			
	Displays may be arrayed in rows as the upper portion of a panel, matched to controls arrayed in similar rows below (see Figure 11.12).			X
11.2.3-5	**Multi-Row Displays with Single-Row Controls**			
	Two or more rows of displays may be arranged above a single row of controls (see Figure 11.13).			X
11.2.3-6	**Consistent Practice**			
	Arrangements of functionally similar controls and displays should conform to the same convention throughout the control room.			X
11.2.3-7	**Control/Display Packages**			
	Modules should be selected and arranged to achieve maximum conformity with the principles described above.			X
11.2.3-8	**Separated Controls and Displays**			
	Where displays are on separated panels, they should be on the adjacent upper panel from their associated controls.			X
11.2.3-9	**Facing Panels**			
	Related controls and displays should not be located on separate panels that face each other.			X
11.3	**Labeling and Demarcations**			
11.3.1	**Labels**			
11.3.1.1	**Labeling Principles**			
11.3.1.1-1	**Need for Labeling**			
	Controls, displays, and other equipment items that must be located, identified, or manipulated should be appropriately and clearly labeled to permit rapid and accurate human performance.			X
11.3.1.1-2	**Hierarchical Scheme**			
	A hierarchical labeling scheme should be used to reduce confusion, search time, and redundancy.			X

Guideline #	Review Criteria	Yes	No	N/A
11.3.1.1-3	**Content of Hierarchical Labels**			
	Major labels should be used to identify major systems or workstations, subordinate labels should be used to identify subsystems or functional groups, and component labels should be used to identify each discrete panel or console element.			X
11.3.1.1-4	**Letter Size in Hierarchical Labels**			
	Labels should be graduated in letter size such that system/work station labels are about 25 percent larger than subsystem/functional group labels, subsystem/functional group labels are about 25 percent larger than component labels, and component labels are about 25 percent larger than control position labels.			X
11.3.1.2	**Label Location**			
11.3.1.2-1	**Normal Placement**			
	Labels should be placed above the panel element(s) they describe.			X
11.3.1.2-2	**Panel Labeling**			
	The placement of labels on control panels should conform to the principles in Section 11.3.1.1, Labeling Principles.			X
11.3.1.2-3	**Labeling Elements Above Eye Level**			
	Labels for elements located above eye level should be positioned to ensure label visibility.			X
11.3.1.2-4	**Proximity**			
	Labels should be placed close to the panel element.			X
11.3.1.2-5	**Labels on Controls**			
	Labels should not appear on the control itself when an adjustment or manipulation is required that causes the user's hand to obscure the label for an extended time period.			X
11.3.1.2-6	**Adjacent Labels**			
	Adjacent labels should be separated by sufficient space so that they are not read as one continuous label.			X
11.3.1.2-7	**Integrity**			
	Labels should be mounted in such a way as to preclude accidental removal.			X
11.3.1.2-8	**Surface**			
	Labels should be mounted on a flat surface.			X
11.3.1.2-9	**Horizontal Orientation**			
	Labels should be oriented horizontally so that they may be read quickly and easily from left to right.			X
11.3.1.2-10	**Curved Patterns**			
	Curved patterns of labeling should be avoided.			X
11.3.1.2-11	**Other Information Sources**			
	Labels should not cover any other information source or detract from or obscure figures or scales that must be read by the user.			X

Guideline #	Review Criteria	Yes	No	N/A
11.3.1.2-12	**Concealment**			
	Labels should not be covered or obscured by other units in the equipment assembly.			X
11.3.1.2-13	**Controls**			
	Labels should be visible to the user during control actuation.			X
11.3.1.2-14	**Cleaning**			
	Administrative procedures should be in place for the periodic cleaning of labels.			X
11.3.1.3	**Label Content**			
11.3.1.3-1	**Principal Function**			
	Labels should describe the function of equipment items.			X
11.3.1.3-2	**Wording of Instruction Labels**			
	The label should briefly and simply express the intended action.			X
11.3.1.3-3	**Commonly Used Terms and Symbols**			
	Terms, abbreviations, and symbols used on panel labels should have commonly accepted meanings for all intended users.			X
11.3.1.3-4	**Distinguishability**			
	Symbols should be unique and distinguishable from each other.			X
11.3.1.3-5	**Consistency**			
	Labels should be consistent within and across panels in their use of words, acronyms, abbreviations, and part/system numbers.			X
11.3.1.3-6	**Agreement with Procedures**			
	There should be no mismatch between nomenclature used in procedures and that printed on the labels.			X
11.3.1.3-7	**Administrative Control**			
	A list of standard names, acronyms, abbreviations, and part/system numbers should be in place and administratively controlled.			X
11.3.1.3-8	**Label Similarity**			
	Words and abbreviations of similar appearance should be avoided where an error in interpretation could result.			X
11.3.1.3-9	**Functional Relationship**			
	Labels should be used to identify functionally grouped controls or displays.			X
11.3.1.3-10	**Label Location**			
	Labels should be located above the functional groups they identify.			X
11.3.1.3-11	**Control Position Labels**			
	All discrete functional control positions should be identified.			X
11.3.1.3-12	**Direction**			
	Direction of motion (increase, decrease) should be identified for continuous motion rotary controls.			X
11.3.1.3-13	**Visibility**			
	Control position information should be visible to the user during operation of the control.			X

Guideline #	Review Criteria	Yes	No	N/A
11.3.1.3-14	**Access Opening Labeling**			
	Access openings should be labeled to identify the functions of items accessible through them.			X
11.3.1.3-15	**Danger, Warning, and Safety Instruction Labels**			
	All danger, warning, and safety instruction labels should be in accordance with appropriate safety standards.			X
11.3.1.4	**Temporary Labels and Tagouts**			
11.3.1.4-1	**Necessity**			
	Temporary labels should be used only when necessary.			X
11.3.1.4-2	**Visibility**			
	Temporary labels should not obscure prior permanent labels unless the old label is to be replaced.			X
11.3.1.4-3	**Identification**			
	Tag-out labels should clearly identify out-of-service components and equipment.			X
11.3.1.4-4	**Mounting**			
	Tag-outs should be securely affixed.			X
11.3.1.4-5	**Obscuration**			
	Tag-outs should not obscure the label associated with the non-operable device.			X
11.3.1.4-6	**Activation**			
	Tag-outs should be designed to physically prevent actuation of a control.			X
11.3.1.4-7	**Adjacent Devices**			
	Tag-outs should not obscure any adjacent devices or their associated labels.			X
11.3.1.4-8	**Administrative Procedures**			
	The use of temporary labels should be administratively controlled.			X
11.3.1.4-9	**Review Procedures**			
	The use and control of temporary labels should be periodically reviewed.			X
11.3.1.5	**Label Lettering**			
11.3.1.5-1	**Character Height**			
	Character height should subtend a visual angle of 15 minutes (viewing distance multiplied by 0.004) as a minimum; a visual angle of 20 minutes (viewing distance multiplied by 0.006) is preferred.			X
11.3.1.5-2	**Contrast**			
	Colors should be chosen for maximum contrast against the label background.			X
11.3.1.5-3	**Character Selection**			
	Labels should be prepared in capital letters with letters and numerals without flourishes or serifs.			X

Guideline #	Review Criteria	Yes	No	N/A
11.3.1.5-4	**Character Width**			
	Letter width-to-height ratio should be between 1:1 and 3:5. Numeral width-to-height ratio should be 3:5 except for the numeral "4," which should be one stroke width wider, and the numeral "1," which should be one stroke in width.			X
11.3.1.5-5	**Stroke Width**			
	Stroke width-to-character height ratio should be between 1:6 and 1:8.			X
11.3.1.5-6	**Spacing**			
	The minimum space between characters should be one stroke width. The minimum space between words should be one character width. The minimum space between lines should be one-half of the character height.			X
11.3.2	**Demarcations**			
11.3.2-1	**Use**			
	Lines of demarcation can be used to enclose functionally related controls and displays, and group related controls and displays (see Figure 11.15).			X
11.3.2-2	**Contrast**			
	Lines of demarcation should be visually distinctive from the panel background.			X
11.3.2-3	**Permanence**			
	Lines of demarcation should be permanently attached.			X
11.3.2-4	**Consistency**			
	The color coding scheme should be used consistently throughout the control room.			X
11.3.2-5	**User Expectations**			
	Color should be dedicated to specific functions or conditions throughout the control room in order for the code to elicit the expected user response.			X
11.4	**Panel Layout**			
11.4.1	**General Panel Layout**			
11.4.1-1	**Grouping by Task**			
	Controls and displays should be assigned to work stations based on the tasks the user must carry out.			X
11.4.1-2	**Grouping by System Function**			
	Within the constraints of grouping by task sequence, controls and displays should be assigned to panels in functional groups related to system structure.			X
11.4.1-3	**Grouping by Importance and Frequency of Use**			
	Controls and displays should be assigned to panels depending on their importance and frequency of use, within the constraints of grouping by task sequence and system function.			X
11.4.1-4	**Less Important Controls/Displays**			
	Controls or displays that are neither important to plant safety nor frequently used should be installed in ancillary panel locations.			X

Guideline #	Review Criteria	Yes	No	N/A
11.4.1-5	**Spacing**			
	Additional Information: Spacing consists of physically separating groups of components on a panel with enough space between groups so that the boundaries of each group are obvious.			X
11.4.1-6	**Color Shading**			
	When color shading is used, colors should provide adequate contrast and should be consistent with other color coding in the control room.			X
11.4.1-7	**Emergency Controls**			
	Distinctive techniques should be used to enhance the recognition and identification of emergency controls.			X
11.4.2	**Layout Arrangement Factors**			
11.4.2-1	**Sequence**			
	Controls and displays should be grouped together when they are observed/operated in a specified sequence.			X
11.4.2-2	**Frequency of Use**			
	Frequently used controls and displays should be near the center of the preferred visual and manual areas.			X
11.4.2-3	**Functional Considerations**			
	Functionally related controls and displays should be grouped together when they are used together to perform tasks related to a specific function or are identical in purpose.			X
11.4.2-4	**Order and Labeling**			
	Components should be arranged left-to-right and/or top-to-bottom and identified in alphabetic or numeric sequence.			X
11.4.2-5	**Other Expectations**			
	Components should be arranged to match other user expectations when these can be identified.			X
11.4.2-6	**Inter- and Intra-Panel Consistency**			
	The location of arrangement of recurring functional groups and individual components of those groups should be similar from panel to panel or within a panel.			X
11.4.2-7	**Repeated Functions**			
	The layout of identical control or display sets should be consistent at all locations.			X
11.4.2-8	**Mirror-Imaging**			
	Layouts of repeated functions should not be mirror-imaged (see Figure 11.17).			X
11.4.2-9	**Panel-to-Panel Standardization**			
	Standardization should be maintained where similar functions or panels are located at several workstations or units.			X
11.4.2-10	**Simulator-to-Control Room Standardization**			
	Standardization should be maintained where simulator or procedures trainers are used that simulate the actual operational equipment.			X

Guideline #	Review Criteria	Yes	No	N/A
11.4.3	**Specific Panel Layout Design**			
11.4.3-1	**Access**			
	Control access should not be impeded by any position of an adjacent control.			X
11.4.3-2	**Inadvertent Actuation**			
	Control actuation should not result in inadvertent actuation of an adjacent control.			X
11.4.3-3	**Simultaneous Actuation**			
	It should be possible to simultaneously actuate adjacent controls (where required).			X
11.4.3-4	**Orientation**			
	Horizontal rows of displays should be used rather than vertical columns.			X
11.4.3-5	**String Length**			
	Strings of similar small displays should not exceed 20 inches on the control board.			X
11.4.3-6	**Number of Components**			
	No more than five similar components should be laid out in an unbroken row or column.			X
11.4.3-7	**Coordinate Axes for Matrices**			
	Large matrices of similar components should have the coordinate axes labeled for identification of any single component within the grid.			X
11.4.3-8	**Labeling Large Matrices**			
	The left and top sides of large matrices should be used for labeling.			X
11.4.3-9	**Demarcation of Large Matrices**			
	Large matrices should be subdivided by appropriate demarcation.			X
12	**WORKPLACE DESIGN**			
12.1	**Control Room**			
12.1.1	**Control Room Configuration**			
12.1.1.1	**Accessibility of Instrumentation/Equipment**			
12.1.1.1-1	**Present in the Control Room**			
	Control room instrumentation and equipment should include all controls and displays needed for (1) detection of abnormal conditions, and (2) bringing the plant to a safe shutdown condition.			X
12.1.1.1-2	**Arranged to Facilitate Coverage**			
	Users should not have to leave their principal work areas to attend to instrumentation on back panels during operational sequences in which continuous monitoring or the timing of control actions may be critical.			X
12.1.1.2	**Consistency of Staffing with Equipment Layout**			
12.1.1.2-1	**Coverage**			
	Control room staffing and task assignments should ensure complete and timely coverage of controls, displays, and other equipment required during all modes of operation.			X

Guideline #	Review Criteria	Yes	No	N/A
12.1.1.2-2	**Utilization of Additional Personnel**			
	When additional onsite or offsite personnel are needed to augment the normal crew complement under certain conditions (e.g., refueling), activities, and task assignments should be planned to ensure proper coordination.			X
12.1.1.2-3	**Nonessential Personnel**			
	Provision should be made to limit the access and movement of nonessential but authorized personnel to prescribed areas within the control room.			X
12.1.1.3	**Furniture and Equipment Layout**			
12.1.1.3-1	**Viewing**			
	Desks and consoles should permit users at those desks and consoles full view of all control and display panels (including alarm displays) in the main control room.			X
12.1.1.3-2	**Communications**			
	Desk and console placement should facilitate voice communications from users seated at those workstations to any point in the main operating area.			X
12.1.1.3-3	**Access to Workstations**			
	Users should be able to get to any workstation without having to overcome obstacles such as tripping hazards, poorly positioned filing cabinets or storage racks, and maintenance equipment.			X
12.1.1.3-4	**Circulation Patterns**			
	The control room arrangement should facilitate efficient, unobstructed movement and communication.			X
12.1.1.3-5	**Maneuvering Space**			
	Adequate space should be allowed between the back (user's position) of a desk or console and any surface or fixed object behind the user for the user to get into and out of a chair freely or to turn in the chair to view the equipment behind.			X
12.1.1.3-6	**Equipment-to-Opposing-Surface Distance**			
	Enough space should be allowed so that personnel can perform all required tasks.			X
12.1.1.3-7	**Openings**			
	Panels should be laid out and maintained, and equipment enclosures designed, so that there are no unguarded openings through which unwanted objects can be introduced.			X
12.1.1.4	**Document Organization and Storage**			
12.1.1.4-1	**Accessibility**			
	All procedures and other documents that may be needed for ready reference should be kept in the control room in places where they are easy to locate and extract for use.			X

Guideline #	Review Criteria	Yes	No	N/A
12.1.1.4-2	**Location Aids**			
	Clearly visible title labels should be provided to identify specific documents. Labels should distinguish documents as much as possible.			X
12.1.1.4-3	**Convenience of Use**			
	Documents should not be fixed in racks; it should be possible to remove documents for use.			X
12.1.1.4-4	**Bound Documents**			
	Documents should be bound so that they can be opened fully and will remain open at the desired place without holding.			X
12.1.1.4-5	**Protection**			
	Documents should be protected from wear so that they do not become dog-eared, dirty, loose, torn, and difficult to read.			X
12.1.1.4-6	**Dedicated Sets of Procedures**			
	Sets of procedures should be stored separately for each unit in a multiunit control room.			X
12.1.1.5	**Spare Parts, Operating Expendables, and Tools**			
12.1.1.5-1	**Supply**			
	There should be an adequate supply of expendables and spare parts (e.g., fuses, bulbs, ink and inking pens, recorder charts, and printer paper).			X
12.1.1.5-2	**Accessibility**			
	Expendables and spare parts should be readily accessible.			X
12.1.1.5-3	**Tools**			
	All necessary or special replacement tools should be available as needed to install expendables and spare parts.			X
12.1.1.5-4	**Storage Space**			
	There should be adequate storage space for expendables and spare parts.			X
12.1.1.5-5	**Coding**			
	When different types, sizes, or styles of expendables and spare parts are required, they should be clearly and distinctively marked to avoid misapplication.			X
12.1.1.5-6	**Inventory**			
	Records should be kept as to the status of expendables and spare parts.			X
12.1.1.6	**Supervisor Access**			
12.1.1.6-1	**Access**			
	The shift supervisor's office should be located so as to permit prompt physical access to the control room under all conditions, including control room isolation.			X
12.1.1.6-2	**Communications**			
	Dedicated communications links should be provided between the main operating area and the shift supervisor's office when the shift supervisor's office is not within the control room boundary.			X

Guideline #	Review Criteria	Yes	No	N/A
12.1.1.7	**Multiunit Control Rooms**			
12.1.1.7-1	**Equipment Arrangement**			
	Equipment should be arranged with movement and communication patterns in mind so that unit operations do not interfere with each other.			X
12.1.1.7-2	**Senior Operator Station**			
	Senior operators who supervise and assist operations of more than one unit should be stationed so that they can communicate effectively with operators in each unit and have an unobstructed visual path to the control boards of each unit.			X
12.1.1.7-3	**Sharing of Personnel**			
	Where operators may assist those of another unit, potential task loading should be evaluated to assure that each unit can be covered adequately in all situations.			X
12.1.1.7-4	**Sharing of Procedures**			
	Each unit should have its own set of procedures and other reference documents as required to make sure that references are easily available to personnel in each unit, and to avoid conflicting needs for the same reference.			X
12.1.1.7-5	**Shared Equipment**			
	When control of some plant equipment is shared by the control rooms of multiple-unit nuclear power plants, care must be taken to ensure that status and availability data for this equipment are available in each control room, and that equipment operation from the control room for one unit will not affect other unit operations.			X
12.1.1.7-6	**Dedicated Crews**			
	When mirror image control rooms exist, operational crews should be committed to one or the other unit and should not be allowed to alternate between the two mirrored units.			X
12.1.1.7-7	**Accentuate Differences**			
	The distinction between the mirrored units should be heightened as much as possible so that there will be no confusion about where one unit ends and the other begins.			X
12.1.1.8	**Emergency Equipment**			
12.1.1.8-1	**Types of Equipment**			
	Protective equipment should include protective clothing and breathing apparatus.			X
12.1.1.8-2	**Anthropometry**			
	Protective clothing and breathing equipment should be compatible with users' body sizes and tasks to provide adequate tactile sensitivity and ability to see, reach, move, communicate, and hear.			X
12.1.1.8-3	**Periodic Checks**			
	Protective equipment should be periodically checked to determine if it is in good condition.			X

Guideline #	Review Criteria	Yes	No	N/A
12.1.1.8-4	**Quantity**			
	There should be protective equipment available in sufficient quantities and sizes for the required number of users.			X
12.1.1.8-5	**Marking**			
	Protective clothing sizes should be clearly identifiable.			X
12.1.1.8-6	**Expendables**			
	There should be an adequate supply of personal protection equipment expendables, such as filters.			X
12.1.1.8-7	**Accessibility**			
	All protective equipment should be easily and readily accessible.			X
12.1.1.8-8	**Training**			
	Personnel should be well practiced in donning protective equipment.			X
12.1.1.8-9	**Procedures**			
	Instructions for donning, doffing, and controlling personal protective equipment should be provided.			X
12.1.1.8-10	**Periodic Checks**			
	All equipment should be periodically checked to determine if it is in good condition.			X
12.1.1.8-11	**Accessibility**			
	All equipment should be easily and readily accessible.			X
12.1.1.8-12	**Training**			
	Personnel should be trained in the use of all emergency equipment.			X
12.1.1.8-13	**Procedures**			
	There should be a written, administratively approved procedure for each type of emergency or combination of emergencies.			X
12.1.1.8-14	**Automatic Warning System**			
	There should be an automatic fire warning system for control room fires.			X
12.1.1.8-15	**Proper Storage**			
	Provision should be made for the orderly storage in the control room of emergency equipment that is needed by control room personnel.			X
12.1.1.8-16	**Storage Locations**			
	The storage location(s) may be away from the main operating area but should be accessible, clearly marked, and known to all personnel.			X
12.1.1.9	**Personal Storage**			
12.1.1.9-1	**Storage Locations**			
	There should be a suitable, out-of-the-way, but secure place in which control room personnel may keep their coats and other personal belongings.			X
12.1.1.9-2	**Storage Suitability**			
	If lockers are provided, they should be large enough to hold the items that might reasonably be expected to require storage.			X

Guideline #	Review Criteria	Yes	No	N/A
12.1.1.10	**Ambience and Comfort**			
12.1.1.10-1	**Decor**			
	Decor should create a pleasant working environment in the control room.			X
12.1.1.10-2	**Restroom and Eating Facilities**			
	A restroom and kitchen or eating area should be provided within (preferably) or near the control room isolation boundary.			X
12.1.1.10-3	**Rest Area/Lounge**			
	Consideration should be given to providing a rest area (possibly in conjunction with the eating area) conducive to relaxation and revitalization, especially where shifts are long.			X
12.1.1.11	**Crew Coordination**			
12.1.1.11-1	**Shared Information and Control Functions**			
	The HSI design should maximize the ability of users to share information and control functions among crew members if users are required to share the responsibilities for monitoring and control.			X
12.1.1.11-2	**Indication of Shared Control Capability**			
	If a control function is shared among users but only one user can operate it at a time, then a clear, unambiguous indication should be provided identifying which user has the control capability.			X
12.1.1.11-3	**Indication of Override of Shared Control Capability**			
	A clear, unambiguous indication should be provided prior to overriding the use of a shared control.			X
12.1.1.11-4	**Shared Display Devices**			
	When a display device is viewed by more than one person, its use should be regulated.			X
12.1.1.11-5	**User-Configured Displays**			
	When a display device can be configured by more than one user, the system should support the coordinated use of the displays.			X
12.1.1.11-6	**Soft Controls with Multiple Access**			
	The system should make each user aware of control inputs made by others, and ensure that the control actions of one user are not unknowingly reversing another user's actions.			X
12.1.1.12	**HSI Upgrades**			
12.1.1.12-1	**Consistent System Response**			
	The system's interpretation of a user input should not change as a result of an upgrade.			X
12.1.1.12-2	**Existing Skills Preserved**			
	Changes to HSI hardware or software should not force users to have to unlearn existing skills.			X
12.1.1.12-3	**Salient Changes**			
	If changes must be made to the HSI, they should be salient.			X

Guideline #	Review Criteria	Yes	No	N/A
12.1.2	**Control Room Environment**			
12.1.2.1	**Temperature and Humidity**			
12.1.2.1-1	**Comfort Zone**			
	The climate control system should maintain temperatures of 68-75°F in winter and 73-79°F in summer and relative humidity levels between 30% and 60%.			X
12.1.2.1-2	**Temperature Differential**			
	Air temperature at floor level and at head level should not differ by more than 10°F.			X
12.1.2.2	**Ventilation**			
12.1.2.2-1	**Air Quantity**			
	The ventilation system should be capable of introducing fresh air into the control room at a rate of at least 20 cubic feet per minute per occupant.			X
12.1.2.2-2	**Air Velocity**			
	Air velocities in the main operating area should not exceed 45 feet per minute measured at head level and should not produce a noticeable draft.			X
12.1.2.3	**Illumination**			
12.1.2.3-1	**Illumination Levels**			
	The illumination levels should be consistent with those listed in Table 12.1.			X
12.1.2.3-2	**Uniformity**			
	The level of illumination should not vary greatly over a given work station.			X
12.1.2.3-3	**Supplemental Light**			
	Supplemental lighting should be provided for personnel performing specialized visual tasks in areas where fixed illumination is not adequate.			X
12.1.2.3-4	**Task Area Luminance Ratios**			
	To ensure effective visual performance, the task area luminance ratios in Table 12.2 should not be exceeded.			X
12.1.2.3-5	**Shadows**			
	To reduce fatigue and eyestrain, shadows should be avoided.			X
12.1.2.3-6	**Glare**			
	Glare should not interfere with the readability of displays, labels, or indicators.			X
12.1.2.3-7	**Reflectance**			
	Reflectance should conform to the recommendations shown in Table 12.3.			X
12.1.2.3-8	**Color**			
	Surface colors should be recognizable under both normal and emergency lighting conditions.			X
12.1.2.3-9	**Ambient Illumination and VDUs**			
	The ambient illumination in the VDU area that is necessary for other visual functions (e.g., setting controls, reading instruments) should not degrade the visibility of signals on the VDU.			X

Guideline #	Review Criteria	Yes	No	N/A
12.1.2.3-10	**Use of Colored Ambient Illumination**			
	Colored ambient illumination should not be used if color coding is used in the workplace.			X
12.1.2.3-11	**Illuminance of Areas Immediately Surrounding VDUs**			
	There should be no light source (direct or reflected) in the immediate surrounding area of the VDU that is of greater luminance than the VDU.			X
12.1.2.4	**Emergency Lighting**			
12.1.2.4-1	**Automatic Action**			
	A control room emergency lighting system should be automatically activated and immediately available upon failure of the normal control room lighting system.			X
12.1.2.4-2	**Operability**			
	Failure of the normal control room lighting system should not degrade operability of the emergency lighting system.			X
12.1.2.4-3	**Emergency Lighting Levels**			
	The control room emergency illumination system should be designed to provide a minimum illumination level of 10 footcandles at all work stations in the main operating area.			X
12.1.2.5	**Auditory Environment**			
12.1.2.5-1	**General**			
	The acoustic design of the control room should ensure that verbal communications among personnel are not impaired; auditory signals are readily detected; and auditory distraction, irritation, and fatigue are minimized.			X
12.1.2.5-2	**Background Noise**			
	Background noise should not impair verbal communication between any two points in the main operating area.			X
12.1.2.5-3	**Background Noise Level**			
	Background noise levels should not exceed 65 dB(A).			X
12.1.2.5-4	**Further Reductions**			
	Where communications between the main operating area and other control room locations are necessary, and voice transmission systems are not provided, further reductions in background noise should be implemented.			X
12.1.2.5-5	**Noise Distractions**			
	Noise distractions generated either inside or outside the control room should be minimized.			X
12.1.2.5-6	**Reverberation Time and Sound Absorption**			
	The acoustical treatment of the control room should limit reverberation time to 1 second or less.			X

Guideline #	Review Criteria	Yes	No	N/A
12.2	**Local Control Stations**			
12.2.1	**Labeling**			
12.2.1.1	**Placement of Labels**			
12.2.1.1-1	**Labeling of Equipment**			
	Labels should appear on all components and systems with which personnel may interact.	X		
12.2.1.1-2	**Replacement of Labels**			
	When labels are affixed, earlier markings (such as labels applied during construction or acceptance, or informal labels) should be removed.			X
12.2.1.1-3	**Viewing Direction**			
	When equipment may be approached from more than one direction, labels should be placed on surfaces so that they are visible from each direction.			X
12.2.1.1-4	**Label Visibility**			
	Identifying labels should be placed so that they are readily visible at typical viewing distances and orientations.	X		
12.2.1.1-5	**Locator Labels**			
	Readily visible markings should be placed nearby to indicate the location and identity of components that are partially blocked from view.	X		
12.2.1.1-6	**Label Orientation**			
	Labels should be designed and mounted so that text is oriented horizontally for ease of reading.	X		
12.2.1.1-7	**Label Positioning**			
	Labels should be attached or positioned so as to unambiguously indicate the item being identified.	X		
12.2.1.1-8	**Redundant Labels**			
	When labels are placed on the doors of equipment cabinets, redundant labels should be placed inside so that they are visible when the door is open.			X
12.2.1.1-9	**Label Placement Conventions**			
	Specific conventions for label placement should be employed for each type of equipment (e.g., valves, motors).	X		
12.2.1.1-10	**Label Mounting**			
	Tags should be attached to components so as not to cause damage or interfere with operation.	X		
12.2.1.1-11	**Label Replacement after Maintenance**			
	Maintenance procedures should require personnel to check that labels are in place after components are reassembled or replaced.			X
12.2.1.1-12	**Means of Label Attachment**			
	Labels and tags should be securely attached in a manner appropriate to the equipment and environmental conditions.	X		

Guideline #	Review Criteria	Yes	No	N/A
12.2.1.2	**Label Design**			
12.2.1.2-1	**Label Material**			
	The material from which labels and tags are made should be appropriate to the equipment and environmental conditions.	X		
12.2.1.2-2	**Label Contrast**			
	Lettering and background colors should provide high contrast and high legibility.	X		
12.2.1.2-3	**Character Height**			
	Characters used on labels should be sized to take into account viewing distances and illumination conditions.	X		
12.2.1.2-4	**Stenciled Labels**			
	Stenciled labels should not be used.	X		
12.2.1.2-5	**Label Reflectance**			
	Surfaces of labels should have a non-reflective (i.e., matte) finish.	X		
12.2.1.3	**Label Content**			
12.2.1.3-1	**Label Information**			
	Labels should contain concise, descriptive noun names along with alphanumeric system and component identification codes.	X		
12.2.1.3-2	**Labeling Conventions**			
	Labeling conventions should be employed to ensure consistency of plant labeling with drawings and procedures.	X		
12.2.1.3-3	**Standard Label Format**			
	The format of presentation (e.g., order, position) of information should be consistent on all labels.	X		
12.2.1.3-4	**Abbreviations**			
	Abbreviations used on labels should be standardized and easily recognized.	X		
12.2.2	**Information Display**			
12.2.2.1	**Gauges/Meters**			
12.2.2.1-1	**Design**			
	The design of gauges and meters should conform to the relevant portions of Section 1.6.4, Meters.			X
12.2.2.2	**CRT Displays**			
12.2.2.2-1	**Design**			
	If CRT displays are employed, they should conform to the relevant portions of Section 1, Information Display.			X
12.2.2.3	**Valve Position Indication**			
12.2.2.3-1	**Alignment Marks**			
	Alignment marks should be used to indicate open and closed status of important manual valves.			X
12.2.2.3-2	**Visibility of Position Indication**			
	The location and size of the alignment marks should reflect the normal viewing distance, location, and ambient lighting.			X

Guideline #	Review Criteria	Yes	No	N/A
12.2.2.3-3	**Indication of Full Open/Closed Positions**			
	Alignment marks should show both the valve's fully open and fully closed positions.			X
12.2.2.3-4	**Design of Position Indication**			
	Alignment marks should be located to minimize parallax error.			X
12.2.2.3-5	**Indication of Direction of Rotation**			
	The direction of rotation for opening and closing of a valve control wheel should be indicated in cases where the direction is not obvious.			X
12.2.2.3-6	**Precision of Indication**			
	Alignment marks should be precise enough that the observers can tell when a valve is fully opened or closed.			X
12.2.2.3-7	**Alternate Means of Local Position Indication**			
	Indicators that are activated by valve limit controls should be used when alignment marks would not be appropriate.			X
12.2.3	**Controls**			
12.2.3.1	**General**			
12.2.3.1-1	**Design of Controls**			
	The design and operation of controls should conform to the guidelines in Section 3, Controls.			X
12.2.3.1-2	**Inadvertent Activation**			
	Controls should be protected against inadvertent actuation.			X
12.2.3.1-3	**Suitability for Use**			
	The operation of controls should be compatible with the use of protective clothing, if it may be required.			X
12.2.3.2	**Manual Valves**			
12.2.3.2-1	**Operating Labels**			
	Handwheels should be provided with double-ended arrows showing the direction of operations and labeled at each end to indicate the functional result (i.e., open and close).			X
12.2.3.2-2	**Turning Aids**			
	Knurling, indentation, high-friction covering, or a combination of these should be built into the handwheel to allow the application of the required torque.			X
12.2.4	**Communication**			
12.2.4.1	**Loudspeakers**			
12.2.4.1-1	**Range of Coverage of Loudspeakers**			
	Loudspeaker coverage should be such that members of the work force can be alerted under all plant conditions.			X
12.2.4.1-2	**Coverage Areas of Loudspeakers**			
	Loudspeaker coverage should be provided in all areas where the work force may be.			X
12.2.4.1-3	**Locations and Amplitudes of Loudspeakers**			
	Speakers should be placed within a space so that their number, location, and volume provide an intelligible signal to all workers therein.			X

Guideline #	Review Criteria	Yes	No	N/A
12.2.4.1-4	**Echoes**			
	Loudspeaker systems should not echo.			X
12.2.4.2	**Public Address/Pager Stations**			
12.2.4.2-1	**Locations of Page Stations**			
	Page stations should be located so that time required for access by personnel does not exceed 30 seconds.			X
12.2.4.2-2	**Shielding of Page Stations**			
	Sound shielding should be provided where ambient noise levels exceed 90 dB(A).			X
12.2.4.2-3	**Control of Page System**			
	Design features or administrative controls should limit unauthorized or excessive paging.			X
12.2.4.2-4	**Variable Amplitude Speakers**			
	A means of varying speaker amplitude should be provided when ambient noise levels may vary by more than 20 dB.			X
12.2.4.3	**High Noise Areas**			
12.2.4.3-1	**High Noise Environments**			
	Communications equipment should conform to guidelines in Section 10.2.1, General Requirements, relevant to high noise environments (i.e., Guidelines 10.2.1-5, 10.2.1-6, 10.2.1-9).			X
12.2.4.3-2	**Portable Alerting Devices**			
	Personal page devices should be provided and should be suitable for high-noise or remote areas.			X
12.2.4.4	**Two-Way Communication Systems**			
12.2.4.4-1	**Capacity Requirements**			
	A minimum of five communications channels should be provided to avoid excessive waiting for a free channel.			X
12.2.4.4-2	**Dedicated Emergency Circuits**			
	Dedicated lines should be provided for frequent or emergency communications.			X
12.2.4.4-3	**Signal Characteristics**			
	The signal transmission characteristics of the system should support good intelligibility.			X
12.2.4.4-4	**System Access Locations**			
	System stations should be located so that time and effort required for access by personnel is not excessive and so that stations are in areas of relative quiet.			X
12.2.4.4-5	**Portable Communication Devices**			
	Portable systems should be available to supplement installed systems.			X
12.2.4.4-6	**Radio Coverage**			
	Surveys should be conducted to identify areas in which radio communication is not possible, e.g., "dead spots" or areas near sensitive equipment.			X

Guideline #	Review Criteria	Yes	No	N/A
12.2.4.4-7	**Radio Repeaters**			
	Radio repeaters should be installed to eliminate "dead spots" if radio communication is relied upon.			
12.2.4.4-8	**Use with Special Garments**			
	Communication capability should be provided for personnel wearing protective clothing.			X
12.2.4.5	**Administrative Considerations**			
12.2.4.5-1	**Training in Communications Practices**			
	Communications training should be provided as a cost effective method of improving efficiency and reliability of communications.			X
12.2.4.5-2	**Periodic Surveillance Programs**			
	Administrative programs should provide for periodic system surveillance.			X
12.2.4.5-3	**Intelligibility Tests**			
	Determinations of speech intelligibility should be conducted for activities involving critical communications.			X
12.2.4.5-4	**Page System Capacity Upgrading**			
	Multiplexing should be added where needed to expand the number of page-party channels.			X
12.2.5	**Environment**			
12.2.5.1	**Heat**			
12.2.5.1-1	**Heat Stress**			
	The level of physical activity and required protective clothing, as well as temperature and humidity, should be considered when assessing the danger of heat exposure.			X
12.2.5.1-2	**Engineering Controls**			
	Engineering controls should be applied where heat may impair the effectiveness or threaten the well being of workers.			X
12.2.5.1-3	**Work Practices**			
	Work practices should be adopted to minimize risk due to heat exposure that cannot be eliminated by engineering controls.			X
12.2.5.1-4	**Water Replacement**			
	Water should be readily available in areas where the potential for heat stress exists.			X
12.2.5.2	**Cold**			
12.2.5.2-1	**Outdoor Equipment**			
	Equipment located outdoors should be sheltered from the elements as much as possible.			X
12.2.5.2-2	**Wind Chill**			
	When considering the effects of cold on performance, the effect of air velocity should be taken into account.			X
12.2.5.2-3	**Effects of Cold on Performance**			
	The potential for exposure to cold to affect task performance should be evaluated.			X

Guideline #	Review Criteria	Yes	No	N/A
12.2.5.2-4	**Engineering Controls**			
	Engineering controls should be applied where cold may impair the effectiveness or threaten the well being of workers.			X
12.2.5.2-5	**Work Practices**			
	Work practices should be adopted to minimize risk due to cold exposure that cannot be eliminated by engineering controls.			X
12.2.5.2-6	**Protective Clothing**			
	Insulated clothing, hats and gloves should be provided to workers who are exposed to cold.			X
12.2.5.3	**Noise**			
12.2.5.3-1	**Quieting the Work Process**			
	Steps should be taken to reduce noise at its source.			X
12.2.5.3-2	**Limiting Noise Transmission**			
	Steps should be taken to limit the transmission of noise.			X
12.2.5.3-3	**Limiting Noise Exposure**			
	Steps should be taken to protect workers from noise.			X
12.2.5.3-4	**Hearing Protection**			
	Ear protection devices should be available and required to be worn in areas where noise levels are 85 dB or more.			X
12.2.5.3-5	**Sound Attenuating Enclosures**			
	When workers may be required to remain in high noise areas for extended periods of time, appropriate sound attenuating enclosures should be provided.			X
12.2.5.3-6	**Auditory Capabilities of Users**			
	The hearing sensitivity of the work force should be monitored.			X
12.2.5.3-7	**Communications and Hearing Protection**			
	Communication equipment in high noise areas should be compatible with ear protection devices.			X
12.2.5.4	**Lighting**			
12.2.5.4-1	**Illumination Levels**			
	The illumination levels should conform to those listed in Table 12.10.			X
12.2.5.4-2	**Portable Lighting**			
	Easily used, portable lighting devices should be readily available nearby when permanent lighting (normal or emergency) may be inadequate.			X
12.2.5.5	**Accessibility**			
12.2.5.5-1	**Permanent Means of Access**			
	Permanent means of access to equipment requiring recurrent or emergency operation should be provided when it is beyond the normal standing reach of workers.			X
12.2.5.5-2	**Temporary Means of Access**			
	Temporary or movable access platforms to equipment should be available when the equipment is located beyond the normal standing reach of workers and permanent access provision is not feasible.			X

Guideline #	Review Criteria	Yes	No	N/A
12.2.5.5-3	**Appropriate Means of Access**			
	Catwalks, ladders, and other suitable means should be provided for workers to reach equipment.			X
12.2.5.5-4	**Sufficient Clearance**			
	Sufficient clearance should be provided in the vicinity of equipment in contaminated or high temperature areas to allow workers easy access despite the use of protective garments and associated gear.			X
12.2.5.5-5	**Impediments to Access**			
	Access to equipment to be operated should not be impeded by structural elements.	X		
12.2.5.6	**Vibration**			
12.2.5.6-1	**Vibration Levels**			
	The effects of vibration on visual and manual performance should be evaluated using Figure 12.4.			X
12.2.5.6-2	**Reducing Vibration**			
	Steps should be taken to reduce vibration at its source.			X
12.2.5.6-3	**Limiting Transmission of Vibration**			
	Steps should be taken to limit the transmission of vibrations to workers.			X
12.2.5.6-4	**Reducing the Effects of Vibration**			
	User interfaces should be designed to reduce the disruptive effects of vibration.			X
12.2.5.6-5	**Limiting Exposure to Vibration**			
	Steps should be taken to protect workers from excessive vibration.			X
13	**MAINTAINABILITY OF DIGITAL SYSTEMS**			
13.1	**General**			
13.1.1	**Minimizing Maintenance Demands**			
13.1.1-1	**Minimizing Testing and Servicing**			
	Requirements for periodic or repetitive testing and servicing of components should be avoided where the possibility of human errors may affect safety.			X
13.1.1-2	**Equipment Independence for Maintenance**			
	Units of equipment should be as independent as is practical, such that maintenance of one unit has minimal effects on the other equipment.	X		
13.1.1-3	**Minimize Maintenance Time**			
	Equipment should be designed to minimize the time required for maintenance if having the equipment out of service can affect safety.			X
13.1.1-4	**Ease of Fault Detection**			
	The design of equipment should facilitate rapid, positive fault detection and isolation of defective items.	X		
13.1.1-5	**Equipment Verification**			
	When feasible, equipment should permit verification of operational status before its installation and without the need for disassembly.	X		

CHPRC-03188
Revision 0

WESF Capsule Inventory - January 1, 2017

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

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

P.O. Box 1600
Richland, Washington 99352

Approved for Public Release;
Further Dissemination Unlimited

CHPRC-03188
Revision 0
EDC#: ECR-17-000120

WESF Capsule Inventory - January 1, 2017

Program/Project: WFMP

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Date Published
February 2017

Prepared for the U.S. Department of Energy
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P.O. Box 1600
Richland, Washington 99352

DATE:
Feb 14, 2017
HANFORD RELEASE

APPROVED
By Lana Perry at 7:24 am, Feb 14, 2017

Release Approval | Date | Release Stamp

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Printed in the United States of America

Total pages: 5

1.0 Background

The Waste Encapsulation and Storage Facility (WESF) was designed and constructed to encapsulate and store cesium (Cs) and strontium (Sr) separated from wastes generated during the chemical processing of defense fuel at the Hanford Site. Presently 1,936 capsules are stored in the WESF pool cells. There are 1312 standard cesium capsules, 23 Type-W cesium capsules, and 601 strontium capsules.

2.0 Purpose

The purpose of this document is to provide a documented location to obtain information related to the WESF capsule inventory. Appendix A contains capsule salt weight, pool cell heat load and pool cell inventory information. The pool cell heat load and inventory data is calculated using a decay date of January 1, 2017.

Capsule data used to support reliable management of the capsules is contained and controlled within the Encapsulation Database System. Information within this database was used to provide the information in Appendix A.

Capsule Salt Weight (kg) **Total kg**

PC1 Sr	PC3 Sr	PC 4 Sr	PC5 Sr	PC6 Sr	PC7 Sr	Total Sr
	391.2	416.1	325.9	356.9		1490.1
PC1 Cs	PC3 Cs	PC4 Cs	PC5 Cs	PC6 Cs	PC7 Cs	Total Cs
94.7	672.8	668.6	655.3	661.9	805.6	3558.9
PC1 Total	PC3 Total	PC4 Total	PC5 Total	PC6 Total	PC7 Total	Total Heat
94.7	1064.0	1084.7	981.2	1018.8	805.6	5049.0

Pool Cell Heat Load (kW) **Total kW**

PC1 Sr	PC3 Sr	PC 4 Sr	PC5 Sr	PC6 Sr	PC7 Sr	Total Sr
	27.0	20.8	22.0	22.4		92.2
PC1 Cs	PC3 Cs	PC4 Cs	PC5 Cs	PC6 Cs	PC7 Cs	Total Cs
4.1	30.6	28.7	28.3	28.3	34.8	154.7
PC1 Total	PC3 Total	PC4 Total	PC5 Total	PC6 Total	PC7 Total	Total Heat
4.1	57.5	49.5	50.3	50.7	34.8	246.9

Pool Cell Inventory (kCi) **Total kCi**

PC1 Sr	PC3 Sr	PC 4 Sr	PC5 Sr	PC6 Sr	PC7 Sr	Total Sr
	4,030	3,109	3,290	3,347		13,777
PC1 Cs	PC3 Cs	PC4 Cs	PC5 Cs	PC6 Cs	PC7 Cs	Total Cs
864	6,474	6,074	6,003	5,987	7,377	32,779
PC1 Total	PC3 Total	PC4 Total	PC5 Total	PC6 Total	PC7 Total	Total kCi
864	10,503	9,183	9,294	9,334	7,377	46,555

Total kCi with Daughter Products

Total Sr
27,554
Total Cs
63,722
Total kCi
91,275

Decay Date: 1/1/2017

CIS Inspection Frequency Justification

Requirement Description	Frequency	Inspection	Justification for Designated Inspection Frequency
General Facility			
Posted warning signs	Annually	Check hazardous waste warning signs for condition of the signs. Ensure signs are visible, in good condition, and verify the location of the signs.	Signs exposed to weather typically fade and may need to be replaced every one or two years. Based on experience with sign replacement, the use of metal signs, and best management practice, annual inspections are recommended.
Exterior Surfaces of the casks and Storage Pad	Annually	Check for deterioration, structural damage, and settlement.	The limiting temperature value for the concrete is 300°C (572°F). Based on the design of the CSS, the air being emitted from the vents during normal operations will be within 55°C (131°F) of the ambient air, which is well below the limiting factor. The pad is designed per seismic design parameters and maximum stress. Based on the concrete design, settlement is not expected. Based on the design life of the casks and storage pad, an annual inspection would be a best management practice to check for deterioration.
Two-way radios	Monthly	Verify that equipment is operational by checking for power and function.	Battery life for radios range from 18 to 24 months, depending on use, temperature, and battery type. As a best management practice, monthly inspections are recommended.
Casks			
Cooling Vents	Annually	Verify that cooling vents are clear of defects and obstructions.	Buildup of debris and obstructions in the cooling vents are monitored on facility work days through the monitoring of cask temperature, as obstructions could decrease the air flow through the cask and increase temperature. Based on the temperature inspections and to minimize the radiation exposure to personnel, inspections requiring physical access should occur annually.
Temperature Monitoring System Annunciator	Weekly	Visually verify that high temperature beacon is functional.	LED lights last ~50,000 hours, which equates to 5.8 years if continuously on. Based on the function of the beacon, a weekly inspection is a best management practice.

Cask Labels	Annually	Ensure labels are intact. Assess legibility of labels, note any impediments to visibility and off-normal condition of labels. Ensure labels visible and legible.	Cask labels will be made of engraved stainless steel with black weather resistant paint. Sign paint exposed to weather typically fades and may need to be replaced every one to two years. Based on experience with sign replacement and best management practice, annual inspections are recommended.
Temperature Monitoring	Daily	Verify that equipment is operational and within range.	Per WAC 173-303-680(2), permit terms and provisions must include those requirements that are appropriate for the miscellaneous units being permitted. In person weekly inspections within the CSA DWMU are not appropriate due to the presence of localized radiation fields. Localized radiation fields on the concrete pad are expected to be ≤40 mrem/hour, whereas doses at the CIS fence line are expected to be ≤0.05 mrem/hour. Workers on the Hanford Site are allowed 500 mrem/year. Weekly inspections within the CSA DWMU would cause unnecessary risk to the workers by exposing them to radiation fields. The TSCs and UCSs contain the capsules storing the mixed waste. They are constructed of 316L stainless steel, which are resistant to stress corrosion cracking. Completely blocked air vents would be the primary cause of an increase in cask temperature. Increased temperature is the only cause for concern for the storage of the waste. Buildup of debris and obstructions in the cooling vents is monitored through cask temperature, as obstructions could decrease the airflow through the cask and could cause an increase temperature. This scenario is only expected to occur during an extreme event, such as falling volcanic ash. To monitor for potential prolonged temperature increases, the frequency of inspecting the temperature monitoring system readings has been revised to facility work days.

Note: Inspection frequencies are defined by the following:

Daily – Once per facility work day

Weekly - once per calendar week with a period that runs from Sunday to Saturday

Monthly – Once per calendar month

Annually - Once per 12-month period ±30 days from the time of the last annual inspection

CIS Inspection Frequency Justification

Requirement Description	Frequency	Inspection	Justification for Designated Inspection Frequency
General Facility			
Posted warning signs	Annually	Check hazardous waste warning signs for condition of the signs. Ensure signs are visible, in good condition, and verify the location of the signs.	~~Best Management Practice~~ Signs exposed to weather typically fade and may need to be replaced every one or two years. Based on experience with sign replacement, the use of metal signs, and best management practice, annual inspections are recommended.
Exterior Surfaces of the casks and Storage Pad	Annually	Check for deterioration, structural damage, and settlement.	~~WAC 173-303-630 Due to localized radiation fields and protection of HHE, inspections requiring physical access are recommended to occur annually~~. The limiting temperature value for the concrete is 300°C (572°F). Based on the design of the CSS, the air being emitted from the vents during normal operations will be within 55°C (131°F) of the ambient air, which is well below the limiting factor. The pad is designed per seismic design parameters and maximum stress. Based on the concrete design, settlement is not expected. Based on the design life of the casks and storage pad, an annual inspection would be a best management practice to check for deterioration.
Two-way radios	~~At time of each inspection~~Monthly	Verify that equipment is operational by checking for power and function.	~~Best Management Practice~~Battery life for radios range from 18 to 24 months, depending on use, temperature, and battery type. As a best management practice, monthly inspections are ~~recommended.~~
Casks			
Cooling Vents	Annually	Verify that cooling vents are clear of defects and obstructions.	~~WAC 173-303-630Due to localized radiation fields and protection of HHE, inspections requiring physical access are recommended to occur annually~~ Buildup of debris and obstructions in the cooling vents are monitored on facility work days through the monitoring of cask temperature, as obstructions could decrease the air flow through the cask and increase temperature. Based on the temperature inspections and to minimize the radiation exposure to personnel, inspections requiring physical access should occur annually.

Commented [LRH1]: RCR #18

Commented [LRH2]: RCR #31

Temperature Monitoring System Annunciator	Weekly	Visually verify that high temperature beacon is functional.	LED lights last ~50,000 hours, which equates to 5.8 years if continuously on. Based on the function of the beacon, a weekly inspection is a best management practice.
Cask Labels	Annually	Ensure labels are intact. Assess legibility of labels, note any impediments to visibility and off-normal condition of labels. Ensure labels visible and legible.	~~WAC 173-303-630Due to localized radiation fields and protection of HHE, inspections requiring physical access are recommended to occur annually~~Cask labels will be made of engraved stainless steel with black weather resistant paint. Sign paint exposed to weather typically fades and may need to be replaced every one to two years. Based on experience with sign replacement and best management practice, annual inspections are recommended.
Temperature Monitoring	~~Weekly~~Daily	Verify that equipment is operational and within range.	~~WAC 173-303-630(6)~~ Per WAC 173-303-680(2), permit terms and provisions must include those requirements that are appropriate for the miscellaneous units being permitted. In person weekly inspections within the CSA DWMU are not appropriate due to the presence of localized radiation fields. Localized radiation fields on the concrete pad are expected to be ≤40 mrem/hour, whereas doses at the CIS fence line are expected to be ≤0.05 mrem/hour. Workers on the Hanford Site are allowed 500 mrem/year. Weekly inspections within the CSA DWMU would cause unnecessary risk to the workers by exposing them to radiation fields. The TSCs and UCSs contain the capsules storing the mixed waste. They are constructed of 316L stainless steel, which are resistant to stress corrosion cracking. Completely blocked air vents would be the primary cause of an increase in cask temperature. Increased temperature is the only cause for concern for the storage of the waste. Buildup of debris and obstructions in the cooling vents is monitored through cask temperature, as obstructions could decrease the airflow through the cask and could cause an increase temperature. This scenario is only expected to occur during an extreme event, such as falling volcanic ash. To monitor for potential prolonged temperature increases, the frequency of inspecting the temperature monitoring system readings has been revised to facility work days.

Note: Inspection frequencies are defined by the following:

Daily – Once per facility work day

W~~w~~eekly - once per calendar week ~~and~~with a period that runs from Sunday to Saturday

Monthly – Once per calendar month

~~a~~Annually - ~~o~~Once per ~~calendar year~~12-month period ±30 days from the time of the last annual inspection

Commented [LRH3]: RCR #35

Commented [LRH4]: RCR #31

Commented [LRH5]: RCR #36