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**RELEASE**    Radiological Record

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Release  
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Design Authority

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# Functional Design Requirements for 324 Disposition Project

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

Contractor for the U.S. Department of Energy  
Hanford Field Office under Contract 89303320DEM000030



**P.O. Box 1464**  
**Richland, Washington 99352**

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# Functional Design Requirements for 324 Disposition Project

Document Type: FDC      Program/Project: 324 Disposition Project

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Date Published  
March 2026

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## Abbreviations and Acronyms

|        |  |
|--------|--|
| ACI    | American Concrete Institute  |
| AISC   | American Institute of Steel Construction                             |
| ALARA  | As Low as Reasonably Achievable                                      |
| ANSI   | American National Standards Institute                                |
| ASCE   | American Society of Civil Engineers                                  |
| ASME   | American Society of Mechanical Engineers                             |
| AWS    | American Welding Society   |
| BTH    | Below-the-Hook Lifting Device  |
| CDF    | Controlled Density Fill  |
| CERCLA | Comprehensive Environmental Response, Compensation and Liability Act |
| CFM    | Cubic Feet per Minute  |
| CFR    | Code of Federal Regulations  |
| CPCO   | Central Plateau Cleanup Company                                      |
| CTA    | Container Transfer Area  |
| D4     | Deactivation, Decontamination, Decommissioning, and Demolition       |
| DA     | Design Authority   |
| DAC    | Derived Air Concentration  |
| DOE    | U.S. Department of Energy  |
| DOT    | U.S. Department of Transportation                                    |
| DSA    | Documented Safety Analysis   |
| EPA    | U.S. Environmental Protection Agency                                 |
| ERDF   | Environmental Restoration Disposal Facility                          |
| HEPA   | High-Efficiency Particulate Air                                      |
| HLV    | High-Level Vault   |
| HMIS   | Hanford Mission Integration Solutions                                |
| HRA    | High Radiation Area  |
| ISMS   | Integrated Safety Management System                                  |
| LLV    | Low-Level Vault  |
| MAR    | Material at Risk   |
| NEC    | National Electric Code   |
| NEMA   | National Electrical Manufacturers Association                        |
| NFPA   | National Fire Protection Association                                 |
| NRTL   | Nationally Recognized Testing Laboratory                             |
| OSHA   | Occupational Safety and Health Administration                        |
| PAPR   | Powered Air Purifying Respirator                                     |
| PNNL   | Pacific Northwest National Laboratory                                |
| REC    | Radiochemical Engineering Complex                                    |
| ROD    | Record of Decision   |
| RTD    | Remove, Treat, and Dispose   |
| SMACNA | Sheet Metal and Air Conditioning Contractors National Association    |

|      |   |
|------|---|
| SMF  | Shielded Materials Facility                               |
| SOW  | Statement of Work   |
| SSC  | Structure, System, and Component                          |
| TWRE | Temporary Waste Retrieval Enclosure                       |
| UL   | Underwriters Laboratory                                   |
| USQ  | Unreviewed Safety Question                                |
| VFD  | Variable Frequency Drive                                  |
| VHRA | Very High Radiation Area                                  |
| WAC  | Waste Acceptance Criteria, Washington Administrative Code |

## 1.0 INTRODUCTION

This document establishes the functional requirements, design criteria, and design constraints for dispositioning the Hanford Site 324 Building hot cells and vaults, and remediation of the 300-296 waste site underlying the building. It is intended to be implemented as part of a design and construction contract for the work.

### 1.1 Background

The Chemical Materials Engineering Laboratory, more commonly known as the 324 Building, supported research on radioactive materials from 1966 to 1996. In 2009, workers discovered a visible breach in the stainless-steel liner at the floor of the Radiochemical Engineering Complex (REC) B-Cell sump. Subsequent characterization of the soil underlying B Cell confirmed high levels of cesium-137 and strontium-90 with dose rates up to 12,870 Rad/hr directly below the B Cell floor expansion joints. A design in-progress at the time to fill the concrete hot cells and vaults with grout, wire-cut them into segments (“monoliths”), and lift them out onto a large transporter to transfer the monoliths to the Environmental Restoration Disposal Facility (ERDF) located in the Central Plateau area of the Hanford Site was halted after this discovery.

The area impacted by the spill was designated as the 300-296 waste site. In 2013, remedial actions for the 300-296 waste site were established in the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) Hanford Site 300 Area Record of Decision for 300-FF-2 and 300-FF-5, and Record of Decision Amendment for 300-FF-1*, hereinafter referred to as the 2013 Record of Decision (ROD) (EPA et al., 2013). The cleanup remedy selected for 300-296 was to safely remove, treat as necessary, and dispose (RTD) the waste site materials using a “coupled approach” utilizing the 324 Building hot cells, equipment, and containment as necessary to support excavation and handling of the highly contaminated soil below the cell. Specifically, the approach was to:

- Clean-out debris within the B-Cell
- Remove the concrete floor and stainless-steel liner
- Use remote excavator arms to remove the contaminated soil under the cell
- Use existing building cranes to lift and place the soil into waste bins located in A-, C-, and D-Cells
- Fill the remainder of A-, C-, and D-Cells with grout.

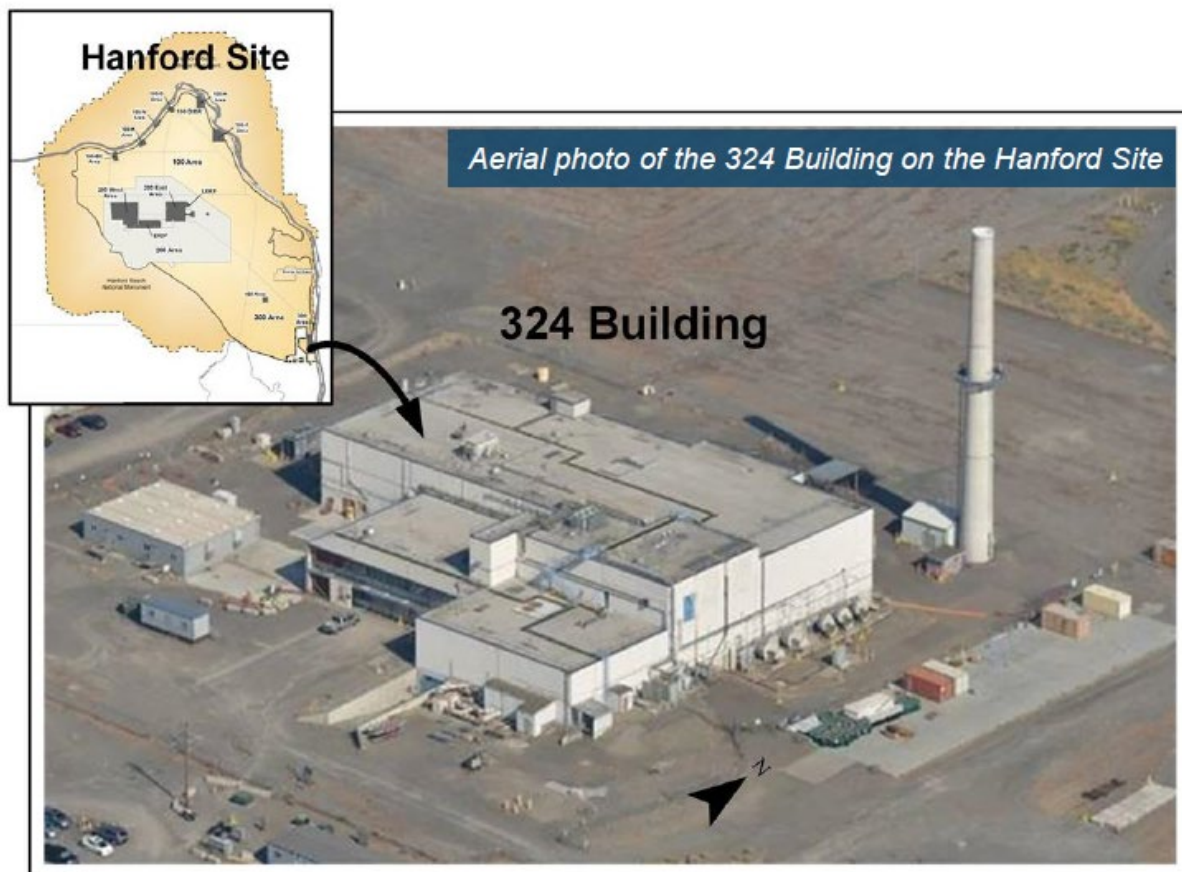
After completion of the project, a follow-on project would cut the REC and the Shielded Materials Facility (SMF) South Cell into monoliths and transport them into the ERDF for disposal.

In 2022 and 2023, as crews readied the 324 Building for soil cleanup, the extent of soil contamination under the building was measured beyond the planned remote excavation area. Based on this new information, along with challenges to sufficiently structurally stabilize the 324 Building to enable excavation via installation of micropiles and drill casings, and occurrence of multiple failures of the existing building cranes, the ability of the selected approach to achieve the CERCLA criteria was put in question. The U.S. Department of Energy (DOE) and the U.S. Environmental Protection Agency (EPA) determined the cleanup plan as originally envisioned and outlined in the 2013 ROD could not be executed.

An amendment to the 2013 ROD allowing use of other cleanup approaches to remediate the 300-296 waste site is currently in review by regulators and stakeholders. Assuming amendment approval, the 324 Building hot cells and vault demolition and the 300-296 waste site remediation are being merged into one scope to be implemented under a design and construction contract governed by the requirements in this document.

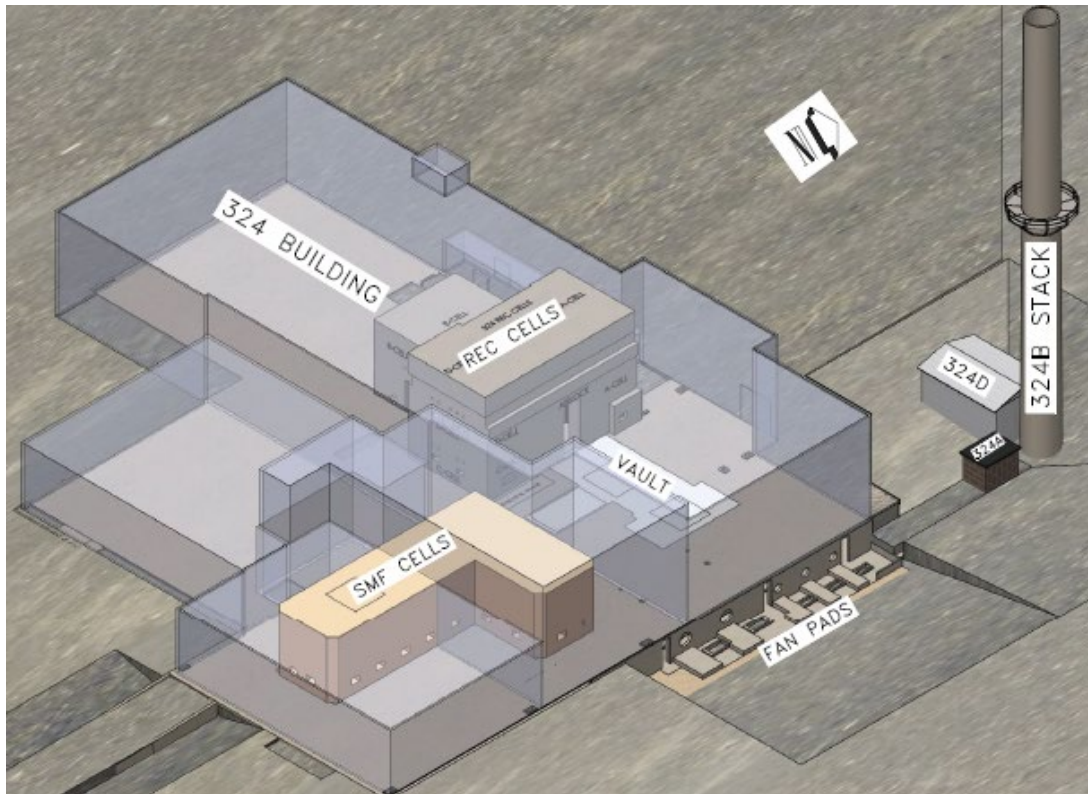
## 1.2 Facility Location and Description

The 300 Area is located in the southeast portion of the Hanford Site along the Columbia River. The site included an approximately 400-acre industrial complex where fuel manufacturing operations took place during the plutonium production years of 1944 to 1989 and experimental studies were conducted in laboratory facilities (see Figure 1-1). CERCLA removal actions and remedial actions have been previously implemented in the 300 Area to demolish most of the facilities that supported the 300 Area mission and clean up most of the waste sites resulting from historical operational releases or waste management practices.



**Figure 1-1, Hanford 324 Building Site**

The 324 Building, is a concrete and steel structure constructed from 1964 to 1966 with a partial basement and first, second, and partial third floors surrounding an engineering hot cell complex (Figure 1-2). The building was designed to allow performance of complex and varied experiments on highly radioactive materials.



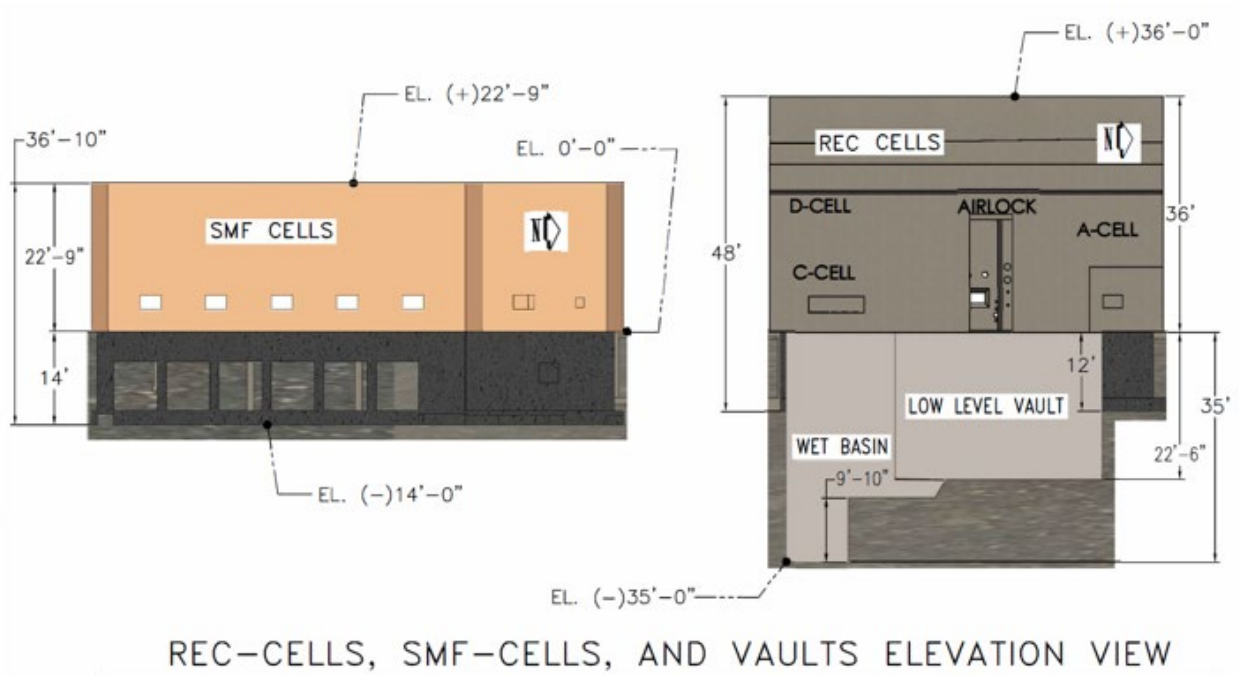
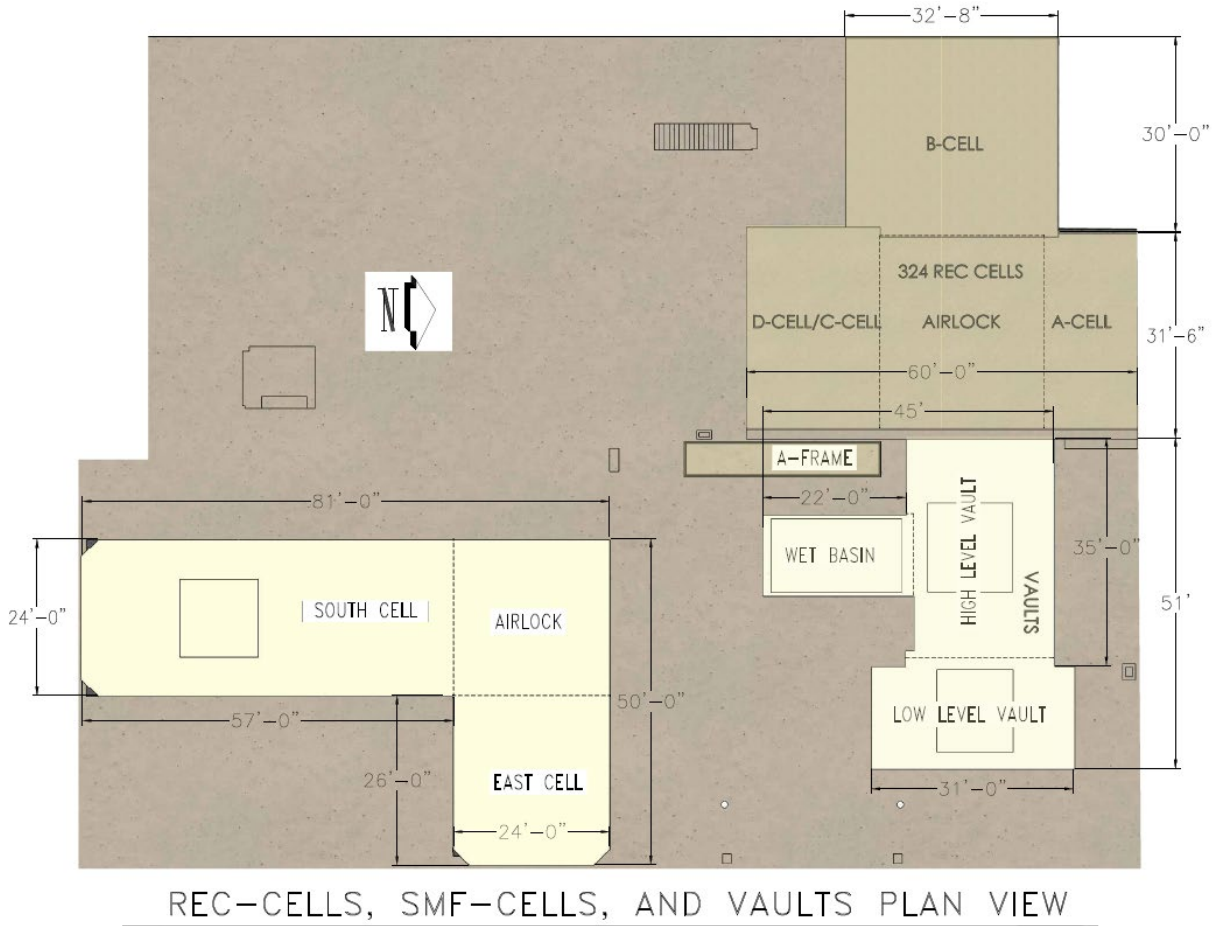
**Figure 1-2, Cells and Vaults Location Within the 324 Building**

The 324 Building housed two areas that contained hot cells used for work with highly radioactive materials, the REC and the SMF. The REC (A-, B-, C-, D-Cells, and Airlock) and SMF (South- and East-Cells, and Airlock) were used for high activity radiological experiments involving aqueous and solid material requiring heavily shielded walls and windows. The hot cells were constructed with 3 to 5-foot thick concrete walls, with rebar at six-inch centers in many areas. The cells were equipped with remotely operated bridge cranes, through wall manipulators, oil filled lead glass windows, shield doors, and had various services including air, water, steam, and electrical power.

Located to the east of the REC cells are two subsurface vaults [the High Level Vault (HLV) and Low Level Vault (LLV)] equipped with tanks for the temporary storage of radioactive liquid wastes and other building generated solutions. Also located subsurface in this area is the Wet Basin, and the A-Frame Pit which housed filters that served as pre-filters to the 324 Building's High-efficiency particulate air (HEPA) filter bank.

The REC cells and vaults interior walls, floors, and ceilings are lined with 0.12" (typical) stainless steel. The SMF interior and exterior walls are lined with carbon steel ranging from 0.25"- 0.375" thickness.

Figure 1-3 shows plan and elevation views of the cells and vaults. Refer to sketches; SK-324DP-100 through 140 and SK-324DP-400 through 440 for additional detail on 324 facility structures.



**Figure 1-3, Plan and Elevation Views of 324 REC and SMF Cells and Vaults**

## **2.0 SITE INITIAL CONDITIONS**

The Contractor should expect the site conditions described in the below sections. Activities described in this section have been or will be performed by Central Plateau Cleanup Company (CPCCo).

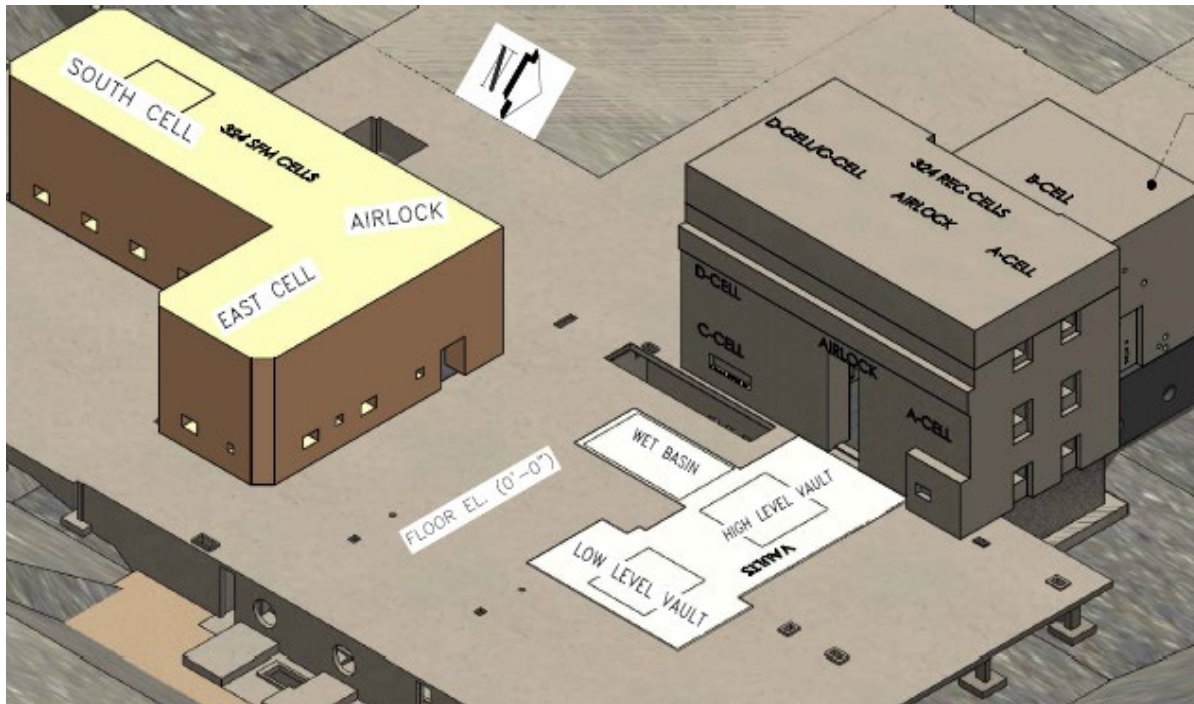
### **2.1 324 Building Deactivation (Cold and Dark)**

Prior to superstructure demolition, a Cold and Dark process will systematically isolate the 324 Building with the overriding purpose of providing a work environment safe from hazardous energy and materials. All existing process systems and utilities will be deactivated, removed, or isolated. These include electrical, water, and sewer utilities; compressed air and chillers; and heating, ventilation, and air conditioning systems. Deactivation of utilities and systems will include draining of free liquids; removal of bulk hazardous chemicals/materials, including oils, greases, hydraulic fluids, asbestos, and lead; removal or disconnection of manipulators on cell externals wall; deactivation of fire detection and alarm systems; and configuration for eventual demolition. Configuration may include a positive air gap, valves left open, handles removed, blanks installed, fuses removed, systems/tanks vented, etc., depending on the system type and or location of the isolation point. The baseline boundary for underground system isolation will be the building's fence. Utilities external to the 324 facility that are active or deactivated are detailed in sketches; SK-324DP-300 through 340.

### **2.2 324 Building Superstructure Demolition**

Following Cold and Dark activities, disposition of the 324 facility will begin with demolition of the superstructure. The superstructure is the above grade portion of the facility that encloses administrative areas, laboratory space, maintenance and testing areas, and operating galleries around the REC and SMF hot cells. Concrete slabs at grade and subgrade areas are expected to remain as-is. The expected as-left condition is shown in Figure 2-1. Materials, construction, hazards, and radioactive contamination levels of the superstructure support removal using conventional demolition methods. During this phase exhaust system structures (324A, 324B, and 324D) will be demolished as well. All gantry cranes located in the cells will be left in place and will be part of the project disposition process.

A weather-tight boundary will be installed on the SMF South Cell and Airlock door; REC cells, Airlock, and A-Frame; LLV; and HLV (i.e., a Line X or RHINO Liner) durable enough to withstand most impacts from demolition of superstructure as well as provide weathertight boundaries after demolition.



**Figure 2-1, Expected Footprint at Start of Work**

### 2.3 Grouting and Stabilization of Cells, Vaults, and Pits

Activities to step out of the current nuclear safety basis by stabilizing the radiological material within and on the cells and vaults via fogging, painting, spraying fixatives, foaming, and/or placement of grout will be complete. (Ref: CPCC-00870, *Safety Basis Step-Out Criteria for the 324 Facility*, CPCC-SRP-00039, *324 Building Grout and Fixative Stabilization Design*). Grouted locations in the 324 facility are detailed in sketches; SK-324DP-500 through 560. Specific grout datasheets used for the cells and vaults can be found in the governing Statement of Work (SOW). The following is a summary of the stabilization activities to have been performed in these areas:

#### Common to A, B, C, and D Cells

Interior surfaces of the cells (including walls, ceilings, floors, airlock, and pipe trench) and the ductwork between the cells will have been coated with fixative (<sup>a</sup>ABC Asbestos Binding Compound ®) to fix contamination in place.

#### A-Cell

A-Cell (High Bay Cell) holds most of the radiologically contaminated debris within the 324 Building. Eight (8) grout containers, six (6) waste bins, and other various waste items were placed inside of A-Cell. These will have been encapsulated with controlled density fill (CDF). It is estimated that the height of the grouted debris in A-Cell is 10 feet. A-Cell interior walls above 10 feet will have fixative applied. The exhaust inlets within A-Cell will have been plugged or blocked off.

<sup>a</sup>ABC Asbestos Binding Compound® is a product of Fiberlock Technologies, Inc.

### B-Cell

Most of the debris in B-Cell (Low Bay Cell) was removed and relocated, leaving only various remaining equipment components and a small amount of rubble requiring stabilization. CDF was placed on the floor of the cell, including trench and sump, up to roughly 12 inches above the floor. The B-Cell in-cell filters have been encased in grout within the cell. B-Cell walls, ceiling, and floor were coated with fixative.

### C-Cell

No grouting activities were performed inside C-Cell (Pyro Cell). Remaining equipment and surfaces have been coated with fixative.

### D-Cell

Four bins of B-Cell debris were placed inside of D-Cell (Mechanical Cell) and filled to the top with CDF. Other remaining equipment and surfaces have been coated with fixative.

### HLV

Vault interior approximately 9.5 feet from vault floor and all of tank 105 was previously grouted in 2010 (Mix 354258 Internal Shielding IM, 132.4 lb/ft<sup>3</sup>). The remaining HLV interior height and tanks (104, 106, 107) will have been grouted (Mix 301611490V, 123.29 lb/ft<sup>3</sup>) up to the bottom of the cover blocks.

### LLV

Vault interior up to approximately 9.5 feet from vault floor and all of tank 103 was previously grouted in 2010 (Mix 354258 Internal Shielding IM, 132.4 lb/ft<sup>3</sup>). The remaining LLV interior height and tanks (101, 102, 108) will have been grouted (Mix 301611490V, 123.29 lb/ft<sup>3</sup>) up to the bottom of the cover blocks.

### A-Frame Filter Pit

All ductwork exiting the REC cells and the HLV/LLV ran to a central location known as Room 15 or the A-Frame Filter Pit. The filters within this pit will have been fully encapsulated in grout, blocking the primary ventilation flow paths that went from the REC and HLV/LLV to the exhaust stack.

### SMF

SMF stabilization activities were completed in 2010. Most of the SMF South Cell was grouted to a level near the bottom of the cell windows. Compartment one (1) within South Cell was filled with grout to the top of the cell windows. The north end of the South Cell contains two lead shielded vaults, approximately 3-1/2 feet square, of which the east vault contains a capped pipe nipple containing a Cs-137 fragment that read > 19,000 and 2,070 R/hr at 1 inch and 30 cm respectively. Material remaining in South Cell was placed on the floor prior to grouting. SMF grout design datasheet (Mix 354258 Internal Shielding IM, 132.4 lb/ft<sup>3</sup>) can be found in the governing SOW. The South Cell exhaust filters were incorporated into the grout. Fixative was applied to remaining South Cell interior surfaces for contamination control, as well as interior

surfaces of East Cell. East Cell and the airlock have various equipment remaining on the floor and the dose rates within these areas are low.

### Basements, Crawl Spaces, and Ductwork Beneath the Cells

The following subgrade areas are planned to be left as-is during superstructure demolition:

- Crawl spaces and ductwork under A-Cell, C-Cell, and the Airlock.
- The ventilation exhaust duct in the north wall of the REC B-Cell.
- The pipe trench in the REC Airlock.
- Below-grade areas adjacent to B-Cell and the 300-296 Waste Site (i.e. Rooms 18 through 21).
- Below-grade rooms, walkways, and pits of the 324 Building away from B-Cell, the SMF, and the 300-296 Waste Site.
- The basement of the SMF area.

## **2.4 Removal or Remediation of Transfer and Sewer Lines**

The Transfer Line for the 300-265 Waste Site, the Process sewer line(s), the Radioactive Liquid Waste System, and the Crib Waste Sewer System connected to the facility will have been mechanically isolated (i.e., capped, plugged). Process lines are detailed on sketches; SK-324DP-300 through 340.

## **2.5 Removal of 324 Building Ventilation Stack**

The 324 Building ventilation stack and foundation (see Figure 1-2) will have been demolished and removed prior to field work encompassed by this document.

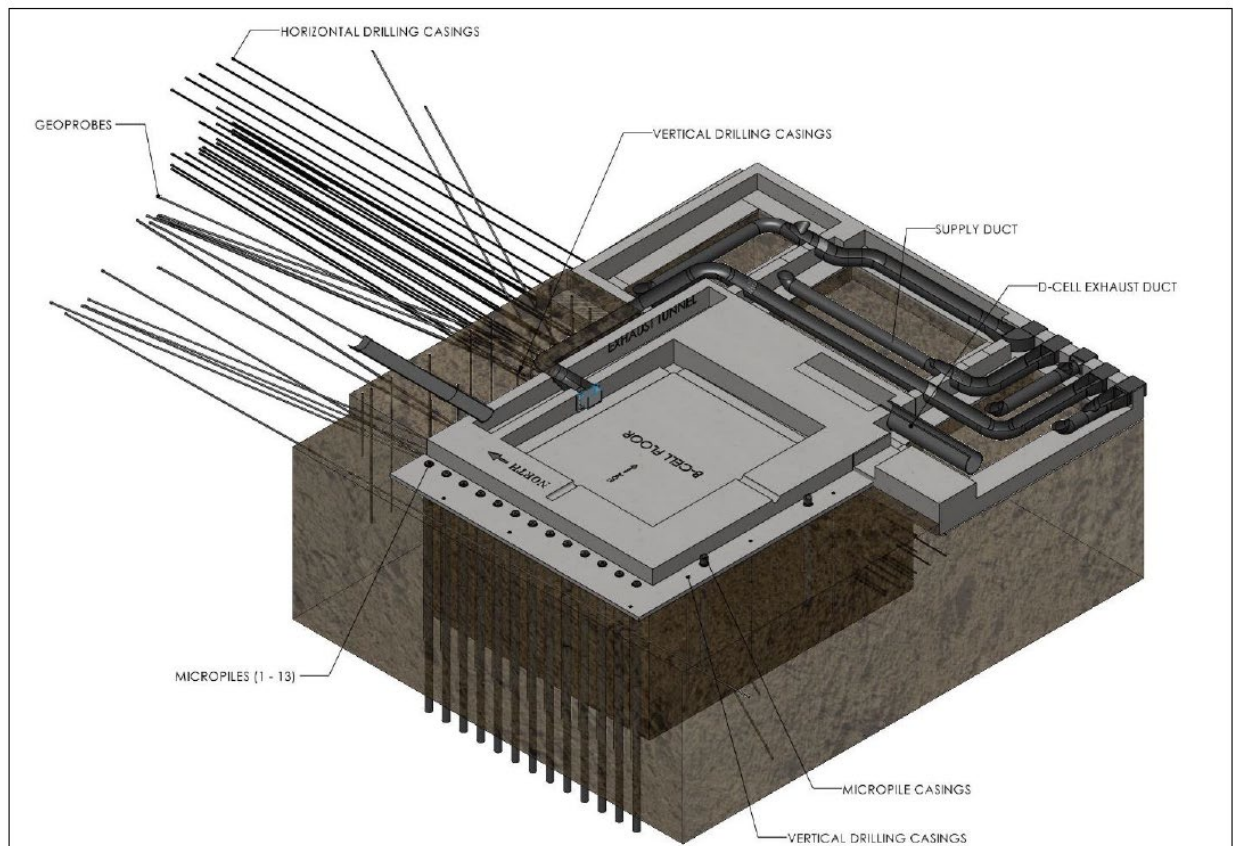
## **2.6 Below-Grade Obstructions**

Micropiles, vertical drilling casings, and horizontal drilling casings were installed to provide structural stability of the REC when remediation of the soil below B-Cell was going to occur from within B-Cell (a remediation method that has been discarded). For details and locations see sketches; SK-324DP-600 through 620. The following were installed into the soil outside the B-Cell walls as shown in Figure 2-2:

- Thirteen (13) micropiles are installed west of the B-Cell wall and two (2) pilot holes (which only contain exterior drill casing) were installed south of the B-Cell wall. The micropile steel casing have a 9.625 in. outer diameter and 0.545 in. wall thickness. An inner 3 in. diameter, Grade 150 threaded bar runs through the center of the casing. Each micropile casing is filled with 5,000 lb/in<sup>2</sup> grout. The top of each casing is at the -10 ft elevation and extends to -40 ft, 9.5 in.
- Twenty (21) vertical casings were installed outside of the B-Cell walls. Three (3) casings are installed south, three (3) casings are installed west, and fifteen (15) casings are installed

north of the B-Cell walls. Casings are 2.875 in. in outer diameter and have a wall thickness of 0.25 in., with varying lengths. The empty casings are made of heat-treated 38-40 Rockwell C steel.

- Thirty (30) to forty (40) horizontal casings were installed along the outside of the B-Cell east and north walls. Casings are 2.625 in. in outer diameter with a wall thickness of 0.4375 in., with varying lengths. The empty casings are made of heat-treated 38-40 Rockwell C steel.
- From historical radiological characterization of the 300-296 waste site, several characterization casings that could not be removed remain in the waste site. Casings have outer diameters ranging from 2.25 to 2.75 in. and wall thickness from 0.25 to 0.375 in.



**Figure 2-2, Micropiles, Vertical and Horizontal Drilling Casings Installed Outside B-Cell (B-Cell Shown Removed to -8 ft below grade)**

The geology below B-Cell consists of coarse gravels, cobbles, and potential boulders. Clasts as large as 30 in. were observed during sampling activities.

No facility piping exists under B-Cell, but underground piping systems are present around the perimeter of the current 324 Building. These include underground steam lines, storm drain piping, condensate return lines, sanitary sewer piping, radioactive/retention process sewer, radioactive liquid waste sewer/retired radioactive liquid waste sewer, crib waste sewer, and water

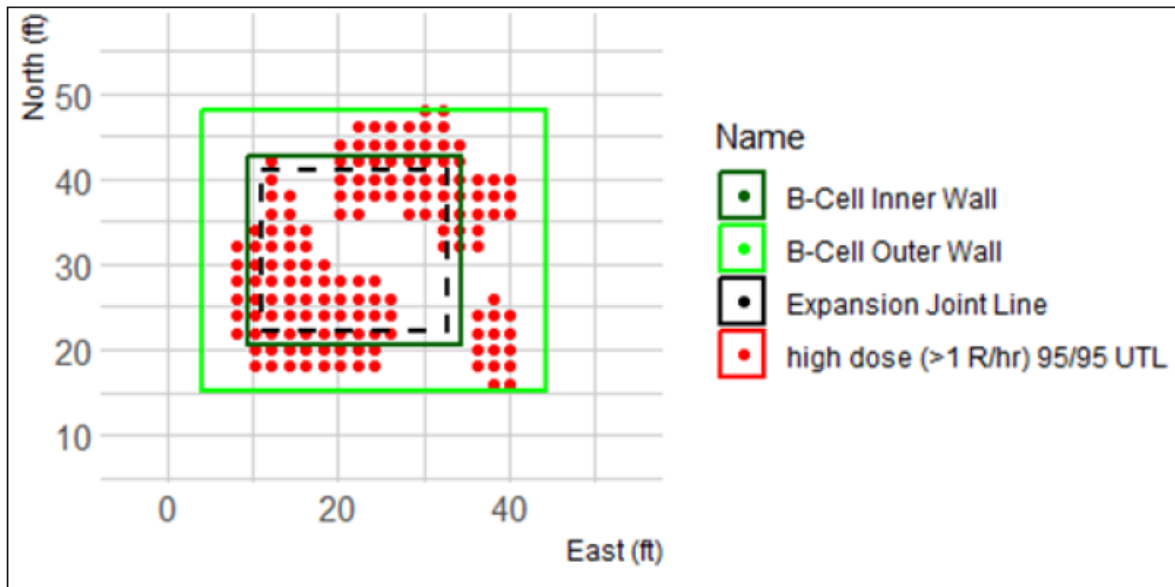
lines. In addition, electrical lines are present. Utilities servicing the building will have been isolated outside the building fence by CPCCo.

## 2.7 Radiological Conditions

### 2.7.1 Extent of 300-296 Waste Site Contamination

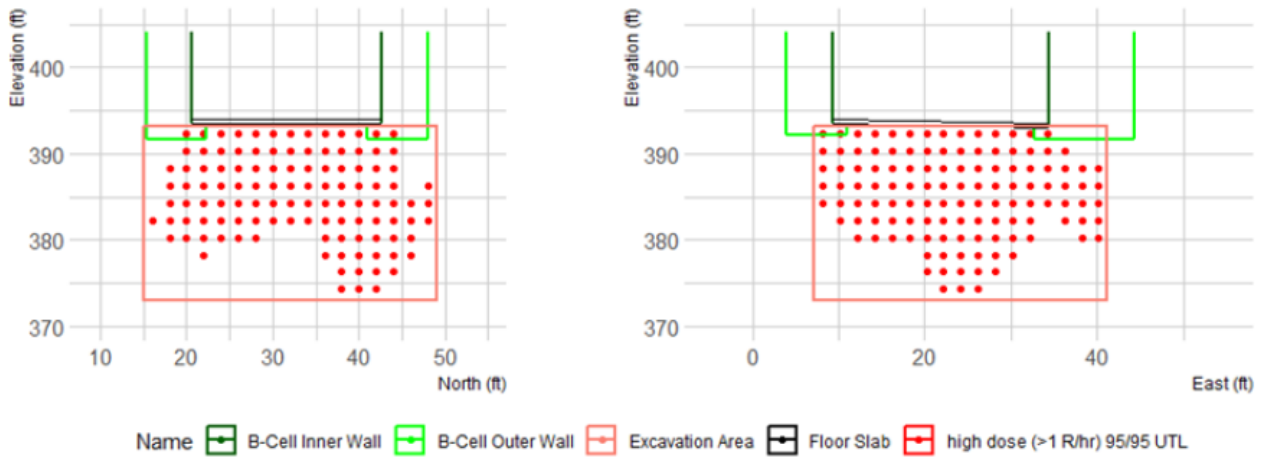
While executing the 324 Building structural stabilization design in 2022 and 2023, soil contamination was measured beyond the planned remote excavation area, although it is still believed to have originated from the same release source in B-Cell. Forty-five boreholes were installed at various orientations into the vadose zone soil under B-Cell. These boreholes and other investigation activities provided more than 2,200 measurements of dose rate, moisture, and temperature (WCH, 2015, *Characterization of the Soil Contamination Under 324 B-Cell*; and PNNL-34866, *A Geostatistical Assessment of the Extent of Radioisotope Contamination Under Building 324 in the Hanford 300 Area*). Dose rates exceeding 1 R/hr were recorded for about 660 of the 2,200 total measurements and were recorded up to 20 ft below the bottom of the B-Cell floor (or approximately 32 ft below ground surface). Similar dose rates were observed laterally beyond the B-Cell foundation, but still within the 324 Building footprint. The soil contamination has significantly elevated (hundreds to thousands of R/hr) hot spots of localized contamination surrounded by areas of moderate contamination (less than 10 R/hr). Dose rates approaching 1,000 R/hr were measured over 10 ft below B-Cell.

Results shown in Figures 2-3 and 2-4 were obtained from PNNL-34866. Accounting for the 20 ft vertical extension and 34 ft lateral extent in northing and easting directions, the total volume that would need to be excavated to remove the box thus defined in Figure 2-4 is 23,120 bank ft<sup>3</sup>.



Note: Contamination is expected outside the volumes labeled with red spheres, which only indicate where levels exceed 1 R/hr with the probability and confidence described above.

**Figure 2-3, Plan View of Extent of Contamination (> 1 R/hr) Under and Around B-Cell**



Note: Contamination is expected outside the volumes labeled with red spheres, which only indicate where levels exceed 1 R/hr with the probability and confidence described above.

**Figure 2-4, North and East Elevation Views of Extent of Contamination (>1 R/hr) Under and Around B-Cell**

In addition to the contamination discussed in PNNL-34866, there were soil contamination conditions found under the REC crawl space that may have been caused by a reported significant leak under C and D Cells that occurred in September 1977. While chemical and/or radiological information on the results of this leak is limited, the fact that it occurred and that it caused a reasonably large issue with facility management at the time is well documented.

### 2.7.2 Radiological Reference Documents

CPCC-SRP-00040, *324 Facility & 300-296 Waste Site Radiological Conditions Summary*; summarizes the radiological conditions expected to be encountered in the cells and vaults (including airlocks, pipe trench, and A-Frame filter pit) that will remain after 324 Building superstructure demolition and in the 300-296 Waste Site soil. For further details on the radiological conditions, see the following documents:

- ECF-324-BLDG-17-0086, *Total Effective Dose Equivalent Calculation for D4 of the 324 Facility*.
- TE-WL-17-001-07, *324 Building Characterization, Workplace Air Monitoring, and Dosimetry Technical Evaluation*.
- CPCC-324DP-26-00002, *324 Disposition Project Radiological Options Analysis*
- Letter, PNNL (Bruce Rathbone) to B&W Hanford Company (Armin Vogt), February 2, 1999, 324 Building Dosimetry Support (Contract 619, Release 9). [Measured radiation exposure in the HLV & LLV waste tanks].

## 2.8 Available Site Utilities & Interfaces After Building Demolition

### 2.8.1 Water

- a. Project shall interface with Pacific Northwest National Laboratory (PNNL) water distribution system for potable water.
- b. The interface for the potable water systems shall be with PNNL distribution system, in compliance with HNF-58243, *PNNL, CPCCO, and HMIS for 300 Area Utility Systems and Services*. Drawing H-3-60706 Sheet 19 details fire hydrants surrounding the 324 facility (FH-47, FH-48, FH-49, FH-50) as available for use. Hydrants provide roughly 1500 gpm @ 115 psig.

### 2.8.2 Electrical

- a. Project shall interface with the existing temporary power distribution system. This system is currently managed and distributed by the City of Richland, WA.
- b. The interface for the electrical distribution system shall be with the City of Richland in compliance with 2303122, *City of Richland 300 Area Electrical Services Interfaces and Responsibilities Agreement*. Specific existing electrical power sources are referenced in CPCC-01522, *324 Building Temporary Electrical Power Plan*; 1000kVA (13.8kV/480V) transformer.

### 2.8.3 Existing Roadways

- a. Project shall interface with existing Hanford roadways, managed by Hanford Mission Integration Solutions (HMIS).
- b. The interface for the Hanford roadways shall be in compliance with HNF-59706, *Hanford Site Roads Master Plan*.

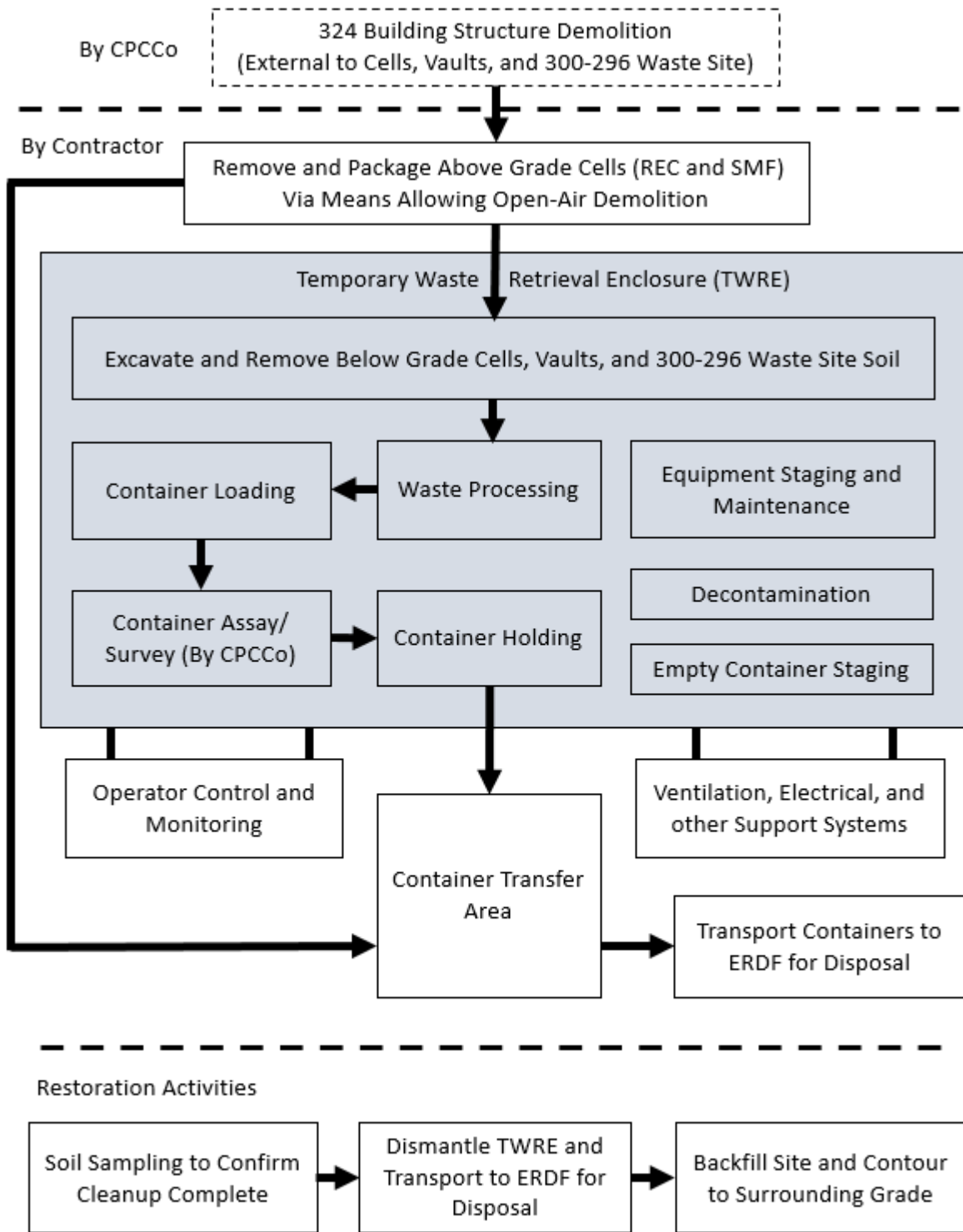
## 3.0 PROCESS DESCRIPTION AND ASSUMPTIONS

### 3.1 Process Description

The anticipated process of dispositioning the Hanford Site 324 Building hot cells and vaults, and remediating the 300-296 waste site underlying the building includes the activities listed below. Repetitive activities such as loadout and packaging are only listed once for clarity. Consistent with EPA et al., 2013, *Hanford Site 300 Area Record of Decision for 300-FF-2 and 300-FF-5, and Record of Decision Amendment for 300-FF-1*, and DOE and regulator recommendations, only remove, treat, and dispose (RTD) soil removal process options are allowed. There may be variation of sequence (and when a Temporary Waste Retrieval Enclosure (TWRE) needs to be installed over the activity) versus that listed below depending on the chosen methods and equipment. Block Diagrams A and B (Figures 3-1 and 3-2) visually depict two versions of the process flow however, the sequence, method, and controls for removal of the cells and vaults may be manipulated to achieve the safest and most efficient means based on the criteria in this document and the radiological conditions and controls described in CPCC-324DP-26-00002, *324 Disposition Project Radiological Options Analysis*.

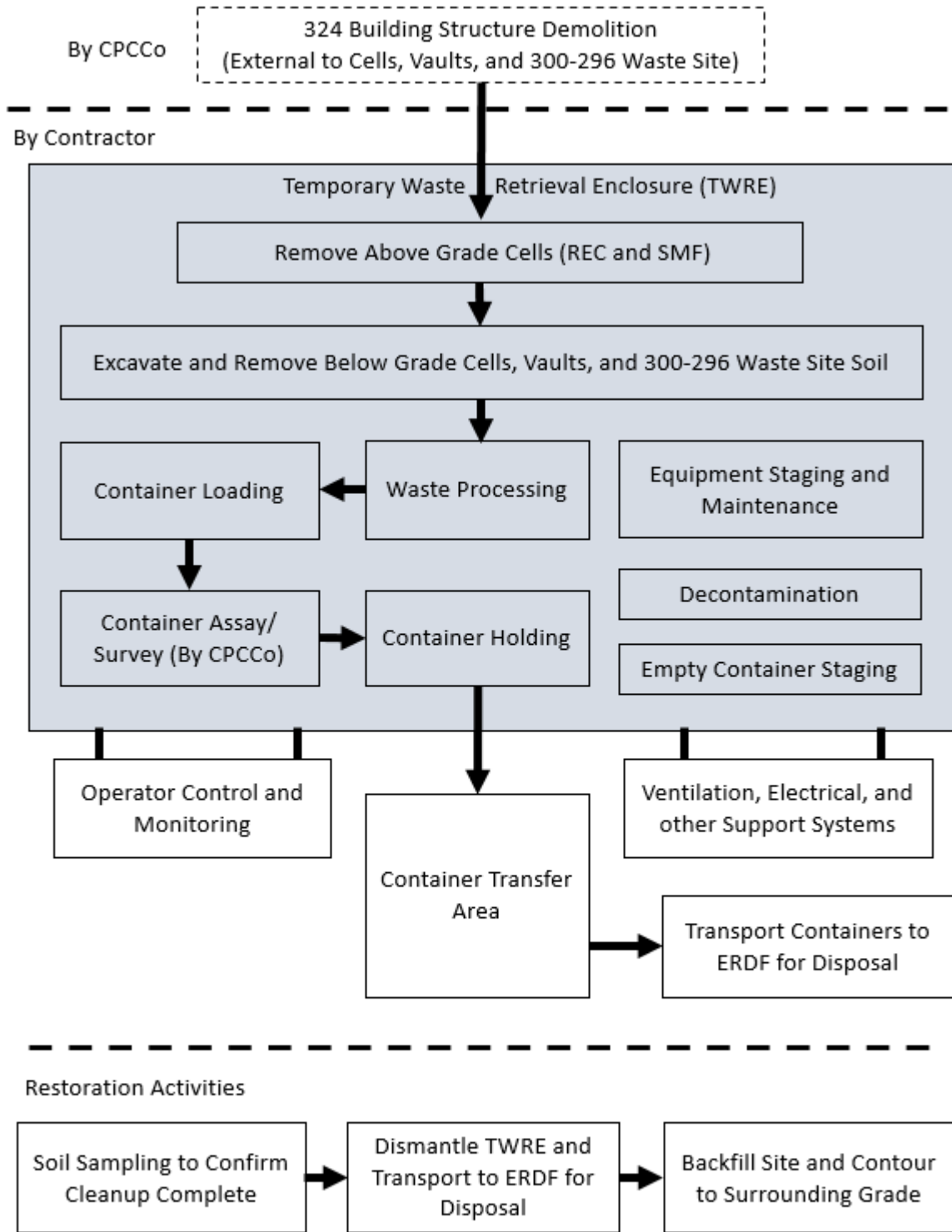
- a. Erect TWRE over demolition/excavation areas
- b. Add grout to cells, if necessary

- c. Complete disposition (removal, demolition, size reduction) of all remaining 324 facility structure above and below grade, including:
  - o REC cells
  - o SMF cells
  - o HLV/LLV
  - o A-Frame filter pit
  - o Basements, crawl spaces, and ductwork beneath the cells.
  - o Facility pipelines as they encroach on subgrade demolition laybacks
- d. Excavate soil and obstructions (micropiles, soil stabilization, and soil characterization casings) as necessary to facilitate below grade cell, vault, and 300-296 waste site removal
- e. Excavate and remove 300-296 waste site (contaminated soil below grade).
- f. Package the waste (i.e., blocks, debris, and/or soil) into a DOT compliant shipping configuration.
- g. If required, add consolidation material and/or grout or other filler material for shielding and/or void fill of packages
- h. Perform radiation assay/survey of waste packages (by CPCCo)
- i. If necessary, remove excess high dose rate material from and/or add consolidation material to waste packages, then re-assay/survey
- j. Move waste packages to Container Transfer Area (CTA) outside TWRE
- k. Weigh waste packages to confirm they do not exceed allowed weight.
- l. Load waste packages onto transporter.
- m. Transport standard sized waste packages to ERDF in the Central Plateau area of the Hanford Site (by CPCCo), OR, if specialty packages, Contractor transport to ERDF via abnormal transporter and offload.
- n. Collect soil samples and have them analyzed to confirm 2013 ROD action objectives have been met
- o. Remove and dispose of TWRE
- p. Backfill and compact excavated areas with clean soil
- q. Contour site to match surrounding grade and minimize ponding over the remediated waste site.



Block Diagram A – Means Suited to Open-Air Demolition of Above Ground Cells

Figure 3-1



Block Diagram B – Means Not Suited to Open-Air Demolition of Above Ground Cells

Figure 3-2

## 3.2 Assumptions

As a basis for the requirements delineated in this document, the following enabling assumptions are made:

- 3.2.1 Site Initial Conditions (with minor variance) will be as described in Section 2.0 at start of field work activities
- 3.2.2 One or more large ventilated TWREs will need to be placed over the REC and SMF cell areas (including HLV, LLV, and 300-296 waste site footprint) to prevent contamination spread to the environment during demolition, excavation, loadout, and packaging activities.
- 3.2.3 Dose rates encountered in the REC and SMF cell areas, HLV, LLV, and 300-296 soil are identified in CPCC-SRP-00040. Contact dose rates exceeding 20,000 mrem/hr have been observed inside the REC, SMF, and HLV with exterior dose rates below 0.5 mrem/hr. Dose rates exceeding 20,000 mrem/hr may be observed during 300-296 remediation.
- 3.2.4 Remote operations will be required when dose rates are  $> 1$  R/hr (on contact) or higher. Past 300 Area D4/soil remediation experience has shown that radiological control can adequately be managed using conventional remediation techniques when exposure rates on soil are below this level.
- 3.2.5 As described in PNNL-34866, characterization data for the soil beneath and adjacent to the B-Cell indicates that, at minimum, 23,120 bank ft<sup>3</sup> of contaminated soil, much of it having a dose rate exceeding 1 R/hr, will require excavation and disposal. Similar dose rates have been observed laterally beyond the B-Cell foundation, but still within the 324 Building footprint. The volume of contaminated soil that exists beyond the  $> 1$  R/hr delineated regions described in PNNL-34866 and requiring disposal at ERDF is not defined.
- 3.2.6 A new nuclear safety basis covering the 324 Building hot cell/vault disposition and 300-296 waste site remediation will be in place prior to cell demolition activities. SSCs and activities are expected to be classified as General Service.
- 3.2.7 Soil sampling activities will not necessitate the design of special sampling equipment and/or containers.
- 3.2.8 If waste is unable to be packaged in a way that keeps it from being classified as transuranic (TRU) waste, that waste will be managed by CPCCo in accordance with TRU program procedures.

## 4.0 FUNCTIONAL REQUIREMENTS

### 4.1 Process Requirements/Constraints

- 4.1.1 Consistent with EPA et al., 2013, *Hanford Site 300 Area Record of Decision for 300-FF-2 and 300-FF-5, and Record of Decision Amendment for 300-FF-1*, and DOE and regulator recommendations, only process approaches that remove, treat, and dispose (RTD) the cells, vaults, and waste site soil are acceptable.

- 4.1.2 Demolition methods that may produce more than 0.2 times the total derived air concentration (DAC) of airborne radioactivity in occupied areas where individuals are not in respiratory protection, or more than 200 times the total DAC in occupied areas where individuals are in respiratory protection shall be performed within a ventilated confinement enclosure.
- 4.1.3 Disposition of the REC, SMF and HLV/LLV using conventional demolition (shear/processor) methods requires utilization of a ventilated TWRE, whereas wire cutting and monolithic removal of these structures may be performed in the absence of a TWRE. For more guidance refer to CPCC-324DP-26-00002, *324 Disposition Project Radiological Options Analysis*.
- 4.1.4 Below grade 300-296 waste site soil excavation shall be performed within a ventilated TWRE.
- 4.1.5 Dust suppression water during demolition shall be managed to avoid migration of 300-296 contaminants further toward the water table. Contaminant transport modelling is being performed to generate limitations for release to the ground during various phases of demolition. This will be available prior to initiation of design.
- 4.1.6 Water applied to the 300-296 waste site for dust suppression, equipment decontamination, drilling, lubrication/cooling of equipment and/or other functions shall be minimized and not exceed a maximum of 740 gal/day to protect groundwater. Systems that recycle water to stay below this limit are acceptable. Sluicing is not an acceptable method of excavation.
- 4.1.7 Micropiles, drilling casings, and other below grade obstacles encountered in the soil within the zone of cell, vault, and soil removal excavation shall be removed and disposed of at ERDF.

## 4.2 Production Requirements

- 4.2.1 Waste container/package size and configuration shall be selected to optimize throughput of loading, addition of shielding and/or void fill material, handling, and transporting to ERDF. The estimated number of waste packages and trips to ERDF, along with the time required to load and transport packages, shall be analyzed and factored into selection.
- 4.2.2 The design shall provide data as needed to support a CPCCo throughput analysis to demonstrate that production rate requirements can be met with the Contractor's design.

## 4.3 Process Controls

Requirements specific to process control, not identified elsewhere in this document, are listed below.

- 4.3.1 Equipment that will operate in areas where dose rates may be  $> 1$  R/hr (on contact) or higher shall utilize remote controls and monitoring.
- 4.3.2 The capability to weigh waste packages/containments before transport to ERDF shall be provided.

- 4.3.3 A camera/video monitoring system shall be provided capable of monitoring process flow activities identified within the TWRE. Refer to Section 5.3.2 for specific camera system requirements.
- 4.3.4 Dust suppression capability shall be provided to minimize soil/rubble particle dispersion during demolition activities and to assist with remote visual observations.
  - a. If chemical constituents are used for suppression they shall facilitate a low permeability rate through the soil column.
- 4.3.5 Have radiation monitoring system capable of remotely monitoring, at minimum:
  - a. Radiation levels at heavy equipment end effectors and in manned cabs located in high radiation areas.
  - b. Radiation levels in process equipment where dose rates may increase over time (e.g. slurry recovery and filtration systems, exhaust ventilation HEPA filter housings).
  - c. Radiation levels in locations expected to be a high radiation area (HRA) or very high radiation area (VHRA). For specific requirements on HRA and VHRA refer to; 10 CFR 835, *Occupational Radiation Protection* and CPCC-00175, *Central Plateau Cleanup Company Radiological Control Manual*.
- 4.3.6 Have environmental monitoring system capable of monitoring at minimum:
  - a. Area within TWRE for temperature and fire detection.
  - b. Airspace pressure within TWRE to ensure negative pressure is maintained during operations.

#### 4.4 Temporary Waste Retrieval Enclosure (TWRE) and Ancillary Structures

Requirements specific to TWRE and support systems not identified elsewhere in this document are listed below. Specific requirements applicable to civil/structural design, ventilation, electrical, and other support systems are primarily located within Section 5.0.

##### 4.4.1 General Requirements

- a. TWRE shall enclose areas not suited for open-air demolition, excavation, loadout, and waste packaging activities.
- b. Specifications for the TWRE, including size, height, ventilation flow rate, shielding, etc. will be dictated by the cell/vault demolition method and soil removal process options selected.
- c. TWRE footprint shall be large enough to accommodate the overall project objectives but should be optimized to allow for simple demolition after project completion.
- d. TWRE shall adequately house support equipment and systems required for its mission, such as camera monitoring, dust suppression, ventilation, heating and cooling (where required), radiological monitoring, temperature monitoring, fire protection, etc.

- e. Temperature in regularly occupied spaces within the TWRE (areas where people spend more than one hour of continuous time per person per day) shall be maintained between 40°F and 80°F during operations.
- f. TWRE design shall provide sufficient radiological shielding to protect personnel outside and inside the enclosure in accordance with the requirements of this document.
- g. TWRE entry/exits (e.g., doors, airlocks, hatches, etc.) shall be designed to minimize spread of contamination.
- h. TWRE shall have interior and exterior lighting of applicable design and output to provide sufficient visibility for operation of all controls and equipment in both daytime and nighttime conditions.
- i. TWRE shall be capable of being maintained at a differential pressure of equal or greater (more negative) than 0.1 inch wg relative to the atmosphere.
- j. When feasible, TWRE operational support equipment (ventilation systems – fans, filters, electrical disconnects and panels, hydraulic skids, etc.) shall be located external to the enclosure for As Low as Reasonably Achievable (ALARA), safer maintenance, adjustment, or replacement.

**4.4.2** Process Areas – The following detail the basic process areas anticipated to be located within the TWRE.

- a. Retrieval/Excavation Area - Area comprising of the waste site footprint including zone of excavation necessary to reach subgrade areas.
- b. Waste Processing Area – Area where retrieved/excavated waste is moved to be size reduced or consolidated if necessary (e.g., high radiological soil mixed with clean or low radiological soil).
- c. Container Loading Area – Area where solid waste is packaged and individual waste containers are filled with waste, shielding and/or void fill materials (i.e., grout or other), lidded, and secured.
- d. Container Assay/Survey Area – Area where CPCCo will perform radiological assay/survey of waste packages/containers to verify radiological levels meet site waste transportation and ERDF requirements prior to proceeding further.
- e. Container Holding Area – Area where assayed/surveyed waste packages/containers are temporarily held prior to movement out of the TWRE to the Container Transfer Area (i.e., end of shift or abnormal conditions).
- f. Container Staging Area – Area inside or adjacent dedicated to storing empty waste containers for the demolition process.
- g. Equipment Decontamination Area – Area inside or adjacent where internal equipment and/or vehicles can be decontaminated to the extent possible by personnel prior to servicing.
- h. Equipment Staging/Maintenance Area – Area where internal equipment and vehicles are staged when not operating and can be serviced and or maintained by personnel.

- i. Operator Control and Monitoring – If specified in the design to be located within the TWRE.

## **4.5 Demolition and Retrieval**

Requirements specific to demolition and retrieval not identified elsewhere in this document, are listed below.

- 4.5.1** Remote operated demolition and retrieval equipment is required in areas with penetrating dose rates greater than 1 R/hr. The radiation tolerance and expected life of equipment construction materials deployed in high and very high radiation areas shall be determined during design.
- 4.5.2** Cables and/or hoses that run from stationary locations to mobile demolition and retrieval equipment shall have an engineered carrier, reel, or other management system designed to prevent wear and damage, minimize restriction to machine mobility, and optimize safety.
- 4.5.3** Remote operated demolition and retrieval equipment shall provide real-time feedback to the operator controlling the equipment.
- 4.5.4** Demolition and retrieval equipment shall be capable of removing excess material from a waste package if necessary or remove material loaded into a waste package which would cause the package to be non-compliant with DOT or ERDF requirements.
- 4.5.5** Demolition and retrieval systems that utilize water for cutting shall be designed to contain spray produced by the cutting to minimize spread of contamination. Contaminated water generated in such systems shall be recycled to the extent possible to minimize liquid waste.

## **4.6 Control and Monitoring Stations**

Requirements specific to control and monitoring stations, not identified elsewhere in this document, are listed below.

- 4.6.1** Remote process control for the equipment shall be operated and monitored from one or more Contractor supplied control stations or trailers.
- 4.6.2** Be in proximity to the TWRE, at a location meeting radiation safety requirements for personnel occupancy.
- 4.6.3** Have an operator station with required operator controls and seating capacity for minimum of 4 occupants.
- 4.6.4** Contain multiple video screens for visual observation of activities within the TWRE.
- 4.6.5** Enclosed control and monitoring stations or trailers shall meet state and local code requirements for human occupation.

## 4.7 Reliability and Maintenance Provisions

The high radiation within 324 Building cells/vaults and the 300-296 Waste Site soil can rapidly degrade materials thus impacting reliability and maintenance.

- 4.7.1 Equipment to be used in high or very high radiation areas shall be evaluated for potential degradation due to its expected radiation exposure. Electronics located in such areas shall be minimized, radiation hardened, and/or shielded to protect against degradation and failure.
- 4.7.2 Critical components shall be provided with redundancy or otherwise designed to minimize the risk that a single point failure will stop processing for an extended period, to the maximum extent practical.
- 4.7.3 Equipment shall be designed to use standard replacement parts and components to the extent possible.
- 4.7.4 The preferred approach to maintenance of equipment not routinely accessible shall be “run to failure” and replaced as a module. If component failure is expected, prior to completion of its mission, then redundant equipment shall be provided, or components shall be easily replaceable. Exceptions shall be subject to approval by the Design Authority (DA).
- 4.7.5 The design of facilities and the selection of materials shall include features that facilitate operations, maintenance, decontamination, and decommissioning.
- 4.7.6 Components that require maintenance (e.g. fans, filters, instrumentation, etc.) shall be located outside of the TWRE facility to the extent possible. If these components need to be located inside the TWRE they shall be in an area where human interaction imposes a low radiological risk.
- 4.7.7 System design shall facilitate ease of maintenance without requiring removal of safety guards or equipment shut down (e.g. fan bearing lubrication ports, remote vibration monitoring, remote bearing temperature monitoring, etc.).

## 4.8 Waste Packaging, Transportation, and Disposal at ERDF

- 4.8.1 Waste destined for ERDF disposal shall meet the requirements of ERDF-00011, *Environmental Restoration Disposal Facility Waste Acceptance Criteria* and ERDF supplemental waste acceptance criteria (ERDF-00003, *Supplemental Waste Acceptance Criteria for the Environmental Restoration Disposal Facility*).
- 4.8.2 Waste container design for packages intended to hold debris shall allow for interior voids to be filled in accordance with the requirements of ERDF-00003 Section 4.9.
- 4.8.3 Each packaging shall be designed and constructed so that, at a minimum, it meets the requirements of:
  - a. 49 CFR 173.410, “General Design Requirements”
  - b. 49 CFR 173.411, “Industrial Packages”

- 4.8.4** A Packaging Compliance Checklist (e.g. CPCC-00070, *Type IP-1 Packaging Compliance Checklist* or CPCC-00072, *Standard DOT 7A Type A Packaging Compliance Checklist*) shall be completed for each waste package design and approved by CPCCo prior to use.
- 4.8.5** Comply with DOE/RL-2001-36, *Hanford Sitewide Transportation Safety Document*, for packaging and transport.
- 4.8.6** Consolidation of waste shall be performed as necessary such that final packaging configurations are not transuranic or Greater-Than-Class-C. Consolidation is the practice of combining, mixing, or accumulating of radioactive wastes of different concentrations into a single waste stream, tank, or container to reduce exposure/risk, promote cost effective life-cycle management, or render the waste more suitable for storage, treatment or disposal consistent with DOE O 435.1, *Radioactive Waste Management*, guidance.
- 4.8.7** CPCCo will subject waste packages/containments to a gamma assay/survey to confirm acceptability prior to movement into the Container Transfer Area. Waste containments not of standard size and shape (such as cut concrete blocks which could be of various sizes) shall allow for proper placement of sensors remotely. Contractor's design shall provide radiological shielding between the assay/survey area and work area to ensure prevailing background exposure at sensor locations are ALARA.
- 4.8.8** CTA located outside of the TWRE shall accommodate receipt of waste packages/containments after exposure rate characterization measurement and facilitate loading onto transports.
- a. The CTA shall be graded and compacted to provide a firm, level surface for the safe loading and unloading of waste packages.
  - b. The CTA shall be located to facilitate ease of moving packages into and out of the area and loading of packages onto transports, allowing access for cranes or other handling devices.
  - c. The CTA shall be designed such that a combination of radiological shielding and distance standoffs (Jersey barriers or other) are sufficient to meet the requirements of this document.

## **4.9 Restoration**

Restoration activities are expected to commence after sampling and testing activities verify the 324 Building footprint soil cleanup is completed to the satisfaction of regulators (EPA/DOE/Ecology) and stakeholders.

Requirements specific to restoration not identified elsewhere in this document, are listed below.

- 4.9.1** TWRE and its support systems shall be removed once the cells, vaults, and waste site are remediated. These systems and structures should be designed understanding they will need to undergo decontamination (e.g., cleaning, spraying fixative, etc.), dismantling or demolition, then be packaged in waste containers and transported for burial at ERDF.

- 4.9.2** Waste sites shall be backfilled in lifts and compacted properly per design specifications. Additional fill should be added to ensure there are no areas for significant water accumulation. Backfill shall consist of non-contaminated native soil.

## **4.10 Environmental**

End point criteria for the CERCLA cleanup of the 300 Area Industrial Complex (including for the contaminated soil in the 300-296 Waste Site underneath the 324 Building) are defined in the 2013 Record of Decision (EPA et al., 2013). RCRA closure plan requirements for the 324 Building (REC cells A, B & D, HLV and LLV) are not yet approved.

- 4.10.1** Environmental aspects and impacts associated with construction, demolition, excavation, retrieval, restoration, and other activities within the work scope shall be considered in the design phase.

## **4.11 Industrial Hygiene & Safety**

- 4.11.1** Design criteria shall meet the basic health and safety requirements outlined in the CPCC-01126, *300 Area Health and Safety Plan*.
- 4.11.2** Occupational Safety considerations for design shall include expected safety hazards (elevated work, working clearances, tripping hazards, etc.) and mitigation methods (equipment guards, railings, safety showers, emergency stop buttons, etc.).
- 4.11.3** Equipment containing hazardous energy sources shall have locking features to support compliance with 29 CFR 1910.147, *Occupational Safety Health Standards – The Control of Hazardous Energy (Lockout/Tagout)* and DOE-0336, *Hanford Site Lockout/Tagout Program*.
- 4.11.4** Industrial Hygiene considerations for design shall include identification of industrial hygiene hazards, such as asbestos, lead, welding, thermal stress, ergonomics, and other relevant risks.
- 4.11.5** Design shall encapsulate lead or similar hazardous material used for shielding or other purposes to prevent radioactive contamination, facilitate safe maintenance and operational activities, and allow retrieval in uncontaminated condition. The material will be permanently marked as to its contents.
- 4.11.6** Design that incorporates sloping, shoring, trenching methods in manned excavation areas shall follow DOE-0344, *Hanford Site Excavating, Trenching, and Shoring Procedure* and WAC 296-155, *Safety Standards for Construction Work, Part N*. For remote excavations, protective system methods (shielding, shoring, sloping) are not required if no worker is to enter the trench. 300-296 soil excavation and extraction methods were previously identified and graded based on several criteria (e.g. water usage, environmental impact, complexity, etc.), refer to CPCC-01023, *Soil Removal Process Options for Remediation of Highly Contaminated Soil in Waste Site 300-296 Beneath 324 Building* for guidance.

## 4.12 Radiation Safety

- 4.12.1 Design shall meet the requirements of 10 CFR Part 835, *Occupational Radiation Protection Program*, and CPCC-00175, *CPCCo Radiological Control Manual*.
- 4.12.2 The design shall meet radiation exposure design objectives and acceptable external dose rates based on zone classification and occupancy in accordance with CPCC-PRO-RP-1622, *Radiological Design Review Process*.
- 4.12.3 The design shall maintain radiation exposure to workers and the general public ALARA. The primary method to assure occupational exposure is maintained ALARA shall be engineered features. (Examples: The use of exhaust ventilation, shielding, remote handling and control of debris movement.) Optimization methods shall be used in developing such features.
- 4.12.4 Administrative controls shall be employed only as supplemental methods to control radiation exposure where use of engineered features is demonstrated to be impractical.
- 4.12.5 Personnel exposure from external sources of radiation in areas of continuous occupational occupancy (2000 hours per year) shall not exceed an average of 0.5 mrem (5 microsieverts) per hour. Exposure rates for radiological workers, where occupancy differs from the above shall be ALARA and shall not exceed 20 percent of the applicable standards (10 CFR Part 835.202).
- 4.12.6 Regarding the control of airborne radioactive material, the design objective shall be, under normal conditions, to avoid releases to the workplace atmosphere and in any situation, to control the inhalation of such material by workers to levels that are ALARA. Confinement and ventilation shall normally be used (10 CFR 835.1002).
- 4.12.7 Access points to the TWRE and Control Room trailer shall be equipped with locks or other physical controls to prevent inadvertent or unauthorized access.
- 4.12.8 Radiation Safety considerations for design shall include expected radiological hazards (dose rates, contamination levels, airborne radioactivity levels, etc.), mitigation methods (shielding, containment, confinement, remote handling, etc.), and monitoring methods.

## 4.13 Nuclear Safety

The 324 Building site is a Hazard Category 2 facility in accordance with DOE-STD-1027-92, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports*. It is currently operated under an approved and implemented Basis for Interim Operation which will be replaced by a new Documented Safety Analysis (DSA) governing the 324 Building disposition and 300-296 Waste Site Remediation activities.

- 4.13.1 Activities conducted in support of 324 Building disposition and 300-296 Waste Site Remediation conducted within, or interface with, the 324 Building site shall be subject to the existing Unreviewed Safety Question (USQ) process to determine if the proposed activities are authorized. Activities conducted in support of debris transfer and isolation that require the use of packaging and shipping authorizations shall be reviewed by Transportation Safety.

#### **4.14 Criticality**

The 324 Building is an Exempt facility. No new fissile material shall be introduced.

#### **4.15 Fire Protection and Life Safety**

The current facility-specific fire protection and prevention document is CPCC-00015, *Fire Hazards Analysis for the 324 Building* (FHA). This will be replaced or revised as project planning proceeds to bound the activities planned for 324 Building Disposition and 300-296 Waste Site Remediation.

**4.15.1** Fire protection design shall be in accordance with CPCC-324DP-26-00001, *Fire Protection Functional and Operating Requirements for 324 Disposition Project*.

#### **4.16 Cybersecurity**

Cybersecurity requirements for electronic equipment and software are addressed in the governing SOW.

#### **4.17 Safeguards**

There are no nuclear safeguard accountability requirements. Consequently, no special Safeguards design features shall be required.

**4.17.1** Facilities (i.e. TWRE, Control Stations, or Trailers) shall be designed with the capability to be locked or otherwise restricted from access to the extent feasible by design.

#### **4.18 Quality Assurance Requirements**

The project's application of Quality Assurance is documented in CPCC-MP-QA-599, *Quality Assurance Program*, which implements DOE O 414.1D, *Quality Assurance*, and 10 CFR 830 Subpart A, *Quality Assurance Requirements*, imposed through CPCCo Prime Contract (89303320DEM000030). This Quality Assurance Program describes the quality requirements applicable to work performed by CPCC using a graded approach. CPCC-MP-QA-599 Attachment 2, *Key Quality Assurance Program Implementing Documents and ISMS Crosswalk* specifies implemented procedures.

**4.18.1** The work encompassed by this document shall be performed in accordance with a documented Quality Assurance Program and implementing procedures that meet the requirements of ASME NQA-1-2008 with 2009 Addenda, *Quality Assurance Requirements for Nuclear Facility Application*.

**4.18.2** The Contractor shall implement a graded approach to quality aligning with CPCC-PRO-QA-259, *Graded Approach*, for quality program requirements based on safety classification and risk. The procurement quality level assigned to items and services shall be either QL-3 or QL-0 based on the risk and controls necessary to be implemented to ensure the item or service is acceptable for its intended purpose. [Exception: HEPA filters and their enclosures shall be procured as QL-1. See HNF-S-0552 and section 5.4 of this FDC].

## 5.0 DESIGN REQUIREMENTS

This section contains equipment requirements that apply to equipment and components being developed for the 324 Disposition Project. A common set of technical codes and standards that can be considered for use in engineering designs can be found in CPCC-324DP-26-00004, *324 Disposition Project Code of Record*. Use of voluntary consensus standards (i.e., industry codes and standards) is required by DOE O 252.1B, *Technical Standards Program*, when performing design, construction, testing, modification, etc. of U.S. Department of Energy (DOE) facilities and activities.

### 5.1 General Design Requirements

- 5.1.1 Human Factors shall be considered in the design per DOE-HDBK-1140-2001, *Human Factors/Ergonomics Handbook for the Design for Ease of Maintenance*.
- 5.1.2 Equipment shall be designed and installed to minimize ergonomic issues during operation and maintenance (minimizing manual lifting, overreaching, awkward positions, etc.).
- 5.1.3 Fastener threads (i.e. UNC, UNF) and pipe threads (i.e., NPT, NPTF) used in this design shall be of American origin. Use of metric or non-standard fasteners/threads is not permitted unless explicitly approved by CPCCo.
- 5.1.4 Equipment numbers and labeling shall be assigned in accordance with numbering conventions used by the facility in which the equipment will be placed or shall be assigned by the appropriate DA. Refer to CPCC-PRO-OP-40126, *Equipment and Piping Labeling* for guidance.
- 5.1.5 Labeling shall be easy to read and securely attached in a way that does not interfere with operation of the component. If outdoors, it shall be able to withstand the direct sunlight/UV and weather.
- 5.1.6 Systems, Structures, and Components (SSC) in all performance/design categories should be designed to withstand an ambient temperature range of -25°F to 115°F when not operating. SSCs not meeting this criteria shall be designed with heating or cooling to maintain manufacturer's recommended operating limits.
- 5.1.7 All SSCs located outdoors should be capable of operation in a solar radiation environment with a daily maximum of 900 langleys, refer to CPCC-PRO-EN-097, *Engineering Design and Evaluation (Natural Phenomena Hazard)* for guidance.

### 5.2 Electrical Requirements

#### 5.2.1 General

- a. Electrical design and equipment shall comply with the NFPA 70, *National Electrical Code* (NEC).
- b. Electrical equipment and devices (a general term including material, fittings, devices, appliances, luminaries [fixtures], apparatus, and the like, used as a part of, or in connection with, an electrical installation) for which there is a Nationally Recognized Testing Laboratory (NRTL) listing category shall be listed or labeled and/or recognized by Underwriters Laboratory (UL) or another organization currently recognized by the

Occupational Safety and Health Administration (OSHA) as an NRTL. Electrical equipment for which there is no listing category shall be evaluated or tested using a method submitted and approved by the CPCCo Authority Having Jurisdiction (AHJ) prior to delivery of the equipment.

- c. Electrical equipment shall be modular to the maximum extent practical for ease of assembly and disassembly. Wiring in high dose areas should have the ability to be disconnected using code approved wiring methods that follow ALARA principles.
- d. Electrical enclosures shall comply with NEMA Standard 250, *Enclosures for Electrical Equipment (1000V Maximum)*. Locations with the potential for spray of liquids shall use NEMA 4X enclosures. All other enclosures shall be suitable for outdoor environment in accordance with NEMA 250.
- e. Loss of electrical power shall shut down hydraulic power equipment, ensure equipment remains in safe condition supporting retrieval contents, and permit the equipment to be manually returned to start position if necessary.
- f. Electrical wiring and cables shall be protected from physical damage as required by NEC.
- g. Heat tracing for equipment and components shall follow NFPA 70.

### 5.2.2 Lighting/Illumination

- a. Exterior and interior lighting shall comply with IES, *The Lighting Handbook*.
- b. Emergency interior lighting shall comply with NFPA 101, *Life Safety Code*.

## 5.3 Instrumentation and Controls Requirements

### 5.3.1 General

- a. Instrumentation and controls shall conform to applicable American National Standards Institute (ANSI), Institute of Electrical and Electronics Engineers, and Instrument Society of America standards. Control equipment enclosures shall comply with NEMA Industrial Control and Systems requirements. Fabricated control panels shall be labeled indicating compliance with UL-508A, *Industrial Control Panels*.
- b. On loss of power, active process components shall assume a position or mode that will preclude an unsafe process condition. This "fail-safe" condition shall be specified in all design and operation documentation. Diverse methods of actuation and manual overrides shall be considered for control and monitoring systems having failure consequences important to facility or operator safety.
- c. Local instruments shall be provided where needed for personnel safety and troubleshooting and maintenance.
- d. Instrument selection shall consider the environment in which the instrumentation operates (e.g., radiation, high humidity, slurries, dust, temperature extremes, etc.).
- e. Instrumentation control cables shall be protected from physical damage per the NEC.

- f. Instruments shall be readily removable for calibration or accommodate calibration in place. NIST traceable documentation is required for all calibrated equipment.
- g. Datasheets (and setpoints if applicable) shall be provided for all specified project instrumentation.

### 5.3.2 Camera Systems

- a. Camera systems deployed should be capable of supporting continued observation through all phases of the process and shall be suitable for expected radiation levels at designated placement locations.
- b. Cameras shall be installed and connected by hardwire cabling on a separate isolated network.
- c. Cameras with wireless communications capabilities shall have the ability to disable wireless communications.
- d. Camera system shall include the following features:
  - i. Fitted with a color system having sufficient resolution to meet demolition activity requirements, supplied monitors, and have pan-tilt-zoom and autofocus capabilities.
  - ii. Global positioning system time and date for accurate time keeping
  - iii. Encrypted communication network and storage, and
  - iv. Minimum 30-day storage capacity for retention of video

## 5.4 HVAC Requirements

### 5.4.1 General Requirements

- a. TWRE unoccupied area ventilation system shall supply sufficient outside air (up to 100%) to accommodate the general exhaust, minimum ventilation rate, and provide filtration, into the facility.
- b. TWRE occupied area ventilation system may incorporate recirculation to accommodate heating, cooling, or humidification.
- c. TWRE ventilation systems should be monitored and controlled outside of the TWRE facility.
- d. TWRE ventilation system shall maintain building air pressure negative relative to the outside atmosphere (~0.1 in wg). System shall also include air locks and other barriers (e.g. isolation dampers) as required to separate ventilation zones with a measurable differential pressure between zones, maintain ventilation balance, control the spread of contamination, and maintain differential pressures. [DOE-STD-1269-2022, *Air Cleaning Systems in DOE Nuclear Facilities*].
- e. Ventilation flow shall cascade from lower contaminated areas toward higher contaminated areas.

- f. Mechanical HVAC equipment shall be designed to fail in a safe configuration (e.g. dampers close during fan motor power loss, etc.).

#### 5.4.2 Ductwork

- a. Ductwork design, construction, and testing shall comply with ASME AG-1, *Code on Nuclear Air and Gas Treatment*, ASME N511, *In-Service Testing of Nuclear Air Treatment, Heating, Ventilating, and Air-Conditioning System*, ANSI/SMACNA 006, *HVAC Duct Construction Standards – Metal and Flexible*, ANSI/SMACNA 002, *Rectangular Industrial Duct Construction Standards*, and ANSI/SMACNA 005, *Round Industrial Duct Construction Standards*.
- b. Piping used as HVAC ductwork shall have raised face flanges and fiber gaskets and be designed, fabricated, and leak-tested in accordance with ASME AG-1.
- c. Ductwork direction changes containing potentially contaminated air shall be minimized. Ductwork shall be sized appropriately to ensure sufficient velocity to minimize settling of particulate as described in DOE-HDBK-1169, *DOE Handbook: Nuclear Air Cleaning Handbook*.

#### 5.4.3 Fans

- a. Fans shall be designed in accordance with ASME AG-1, *Code on Nuclear Air and Gas Treatment*.
- b. Fans shall be designed to be driven via Variable Frequency Drives (VFD) to allow for the potential range of system flows.

#### 5.4.4 Supply Air

- a. Ventilation for contaminated and potentially contaminated process areas shall include backflow prevention (DOE-HDBK-1169)

#### 5.4.5 HEPA Filters and Enclosures

- a. HEPA filtration shall be provided for all radioactive and potentially radioactive exhausts. HEPA filters shall comply with the requirements in DOE-STD-3030-2015, *Specification for HEPA Filters Used by DOE Contractors*. HEPA filters shall be designed, fabricated, and tested in accordance with applicable ASME AG-1, *Code on Nuclear Air and Gas Treatment* Sections HA and FC. HEPA filters shall be arranged in a two-bank system for double filtration and protected at minimum by an upstream pre-filter.
- b. HEPA filters shall be procured following guidance from HNF-S-0552, *Procurement Specification for Standard, Nuclear Grade, High Efficiency Particulate Air Filters (For ASME AG-1 Compliant Filters)*.
- c. HEPA filter enclosure(s) shall be QL-1 and purchased by a vendor with an ASME NQA-1 program.

#### 5.4.6 Exhaust Stack

- a. Exhaust stack shall be designed in accordance with ASME STS-1, *Steel Stacks*. The exhaust stack shall be self-supported and should not utilize guy wires. The stack design shall include drains to remove moisture due to condensation and precipitation.
- b. Exhaust stack height shall be sufficient to disperse the exhaust gases to satisfy the exposure levels and emissions analyses in accordance with WAC 173-400, *General Regulations for Air Pollution Sources* and WAC 173-460, *Controls for New Sources of Toxic Air Pollutants*. Exhaust air systems shall be compliant with WAC 246-247, *Radiation Protection – Air Emissions*.
- c. Exhaust stack sample flow rates are required to be “isokinetic” per ANSI N13.1, *Sampling and Monitoring Releases of Airborne Radioactive Substances from the Stacks and Ducts of Nuclear Facilities*, as required by 40 CFR 61.93, *Emission Monitoring and Test Procedures*. Calculations shall determine isokinetic sample flow rates and guide judgments on whether sample flow rate adjustments are needed. Sample flow measurements are required to be accurate to  $\pm 10\%$  per DOE-EH-0173T, *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance*. Continuous sampling and monitoring are necessary to ensure early detection of breakthrough of radioactivity and to provide an auditable, continuing record of discharges. A continuous record is required by 40 CFR 61, Subpart H.

### 5.5 Mechanical Equipment

- 5.5.1 Mechanical equipment shall be designed with support systems and attachment points to install and remove the equipment in accordance with ALARA design requirements.
- 5.5.2 Include features to protect equipment from anticipated normal loads.
- 5.5.3 Mechanical equipment shall be designed to fail in a safe configuration.
- 5.5.4 Resonant frequencies specific to the pump or fan installation shall be analyzed and design features added to prevent damage to the TWRE structure and to eliminate the harmonics in the pumps or fans normal operating range.
- 5.5.5 If hydraulically powered equipment is required for operation, the hydraulic fluids utilized shall not be designated as hazardous material by state (WAC 173, *Department of Ecology*) or national (40 CFR 261, *Resource Conservation and Recovery Act of 1976*, RCRA) regulations.
- 5.5.6 Hydraulic fluids specified for equipment shall be factory mutual (FM) approved.

### 5.6 Piping, Hose, and Valve Requirements

- 5.6.1 Manual isolation valves shall be provided for all instruments, automatic valves, and pumps to allow removal and replacement. Manually operated valves shall have position indication either by handle position or other visual means.
- 5.6.2 Design of piping systems shall comply with ASME B31.3, *Process Piping*. Guidance from CPCC-STD-EN-52736, *Design, Inspection, Testing and Repair of ASME-Coded*

*pressure Systems and Pressure Relief Devices* shall also be followed in the design of pressure systems and vessels.

- 5.6.3 Color coding of piping should follow OSHA standards and at minimum contain the direction of flow, describe the fluid contained within along with an identification consistent with the Piping and Instrument diagram notation.
- 5.6.4 Piping systems connected to the 324-facility potable water supply shall have means of backflow prevention.
- 5.6.5 Piping systems shall have high point vents and low point drains for testing and maintenance purposes.
- 5.6.6 Piping systems and components shall be insulated and if necessary, heat traced if the internal fluid or gas is at risk of changing state.

## 5.7 Welding Design Requirements

### 5.7.1 General

- a. Structural steel welding shall comply with AWS D1.1/D1.1M, *Structural Welding Code – Steel*.
- b. Reinforcing structural steel welding shall comply with AWS D1.4/D1.4M *Structural Welding Code – Reinforcing Steel*.
- c. Stainless steel structural welding shall comply with the requirements of AWS D1.6/D1.6M, *Structural Welding Code – Stainless Steel*.
- d. Aluminum structural welding shall comply with the requirements of AWS D1.2/D1.2M, *Structural Welding Code – Aluminum*.
- e. Welding for Below-the-Hook Lifting Devices (BTH) shall be in accordance with AWS D14.1, *Specification for Welding of Industrial and Mill Cranes and Other Material Handling Equipment* or AWS D1.1/D1.1M, *Structural Welding Code – Steel* with inspection criteria of AWS D14.1.

## 5.8 Transport Requirements

### 5.8.1 General Transport

- a. All project equipment shall be designed for ease of equipment transport, installation in the field, and dismantling.
- b. Project equipment shall be of modular design, to the extent possible, and shall be designed to be transportable by public roadway to contract specific designation.
- c. Equipment shall be designed to be shipped in accordance with the applicable U.S. Department of Transportation standards and in an orientation ready for lifting. Additional handling of the equipment to orient it for lifting is not acceptable. Load handling instructions shall also be provided with the shipment and made available for the off-loading of the item.

- d. Items shall either be self-supporting or provided with adequate packaging and dunnage to ensure their stability and protection from damage.

### 5.8.2 Load Securement

- a. Load securement systems shall be designed in accordance with 49 CFR Part 393 Subpart I, *Protection Against Shifting and Falling Cargo*. This is a minimum requirement, if supplier has requirements that are more stringent, the supplier's requirements shall be applied.
- b. Transport and tie-down instructions and diagrams shall be provided.
- c. Transport tie-down attachment points shall be designed and/or evaluated. Lift points shall not be used for transport tie-downs. Transport tie-down attachment points shall be identified and marked.

### 5.8.3 Abnormal Transport

- a. Transporter shall be designed to support total expected load; gross weight of cargo, packaging frame, transporter weight. Design should also account for expected road rolling resistance, drawbar, road slope and radius, accelerating/breaking force (laterally, forward, rearward).
- b. Transporter shall be designed with a sufficient number of axles to distribute load and prevent supporting surface damage (i.e., road failure, soil bearing capacity failure, underground utility failure, etc.). Transporter axle loading shall be below HS 20-44 loading, reference AASHTO LRFD Bridge Design Specifications.
- c. Transporter shall be designed and capable of traveling from 324 project area to ERDF in a controlled and safe manner. Site travel obstacles will need to be evaluated such as underground utilities, overhead obstructions and powerlines, road widths, road slopes and radiuses.

## 5.9 Hoisting and Rigging (H&R) Requirements

### 5.9.1 General H&R

- a. All hoisting and rigging activities are to be designed, maintained, and operated in accordance with DOE/RL-92-36, *Hanford Site Hoisting and Rigging Manual* and ASME B30 series standard.
- b. All demolition, retrieval, and excavation equipment to enter the TWRE is to have remote accessible lifting or tugging points installed so that they can be removed from the work area without personnel involvement.
- c. Lift points/attachments shall not be used for transportation tie-downs.
- d. All mechanical equipment to be used during construction or demolition of the project shall be capable of being lifted and traversed with common rigging and handling equipment (i.e., slings, straps, hooks, or spreader bars) fitted to hoists without loss of material.

### 5.9.2 Cranes

- a. Mobile crane staging area(s) shall be designated for use throughout the life of the project, if determined necessary by project design features. The designated area(s) shall have adequate staging/working space, overhead clearance from obstructions and energized lines, and acceptable soil bearing capacity and settlement for anticipated loadings.

### 5.9.3 Below-the-Hook Lifting Devices (BTH)

- a. BTH shall be provided, as needed, for construction, maintenance, or operations of project equipment. Structural design of all below-the-hook lifting devices shall be in accordance with ANSI/ASME B30.20, *Below-the-Hook Lifting Devices*, ANSI/ASME BTH-1, *Design of Below-the-Hook Lifting Devices*, and DOE/RL-92-36, *Hanford Site Hoisting and Rigging Manual*.
- b. Lifting attachments shall be self-centering. Equipment which is required to be hoisted for installation or replacement shall hang in its normally installed orientation without the aid of tag lines or other assists. If below-the-hook lifting attachments are required for normal operation or maintenance of the equipment, dedicated storage (racks, wall mounts, etc.) for those attachments shall be provided as part of the design.
- c. Calculations are required for all project designed BTHs and associated equipment lifting points. BTHs shall be load tested to 125% of the rated capacity (+5%/-0%).
- d. All fabrication drawings prepared for lifters shall include the rated load and specific identification requirements (i.e., manufacturers name, lifter weight, load test date, etc.) as detailed in ASME B30.20. All below-the-hook lifting devices shall have structural calculations, load test reports, and operating & maintenance manuals (if applicable).

## 5.10 Civil/Structural Design Requirements

### 5.10.1 Natural Phenomena Hazards (NPH) & Design Loads

- a. Natural Phenomena Hazards (NPH) Design loads are provided in CPCC-PRO-EN-097, *Engineering Design and Evaluation (Natural Phenomena Hazard)*.
- b. IBC, *International Building Code* and ASCE 7, *Minimum Design Loads and Associated Criteria for Buildings and Other Structures*, shall be used to determine applied structural demands (e.g., wind design pressures, seismic response spectra and acceleration coefficients, roof snow loads, etc.).
- c. For analysis, the TWRE shall be classified as General Service, PC-1, Risk Category II structure in accordance with ASCE 7.
- d. Design of the TWRE shall ensure that maximum vacuum created by the ventilation system does not compromise the structural integrity of the facility structure.
- e. Design shall identify all required subsurface investigations (i.e., geotechnical report) to ensure the adequacy of soil conditions to withstand the loading associated with the TWRE as well as temporary loading associated with construction (i.e., vehicle axle loading, crane outriggers, etc.).

**5.10.2 Steel Design**

- a. Structural steel design, fabrication, and installation shall comply with the AISC 325, *Steel Construction Manual*.
- b. Where required, seismic design of steel structures shall satisfy AISC 341, *Seismic Provisions for Structural Steel Buildings*.
- c. Stainless steel structures shall comply with AISC Steel Design Guide 27, *Structural Stainless Steel*.

**5.10.3 Concrete Design**

- a. Construction of concrete structures shall comply with ACI 301, *Building Code Requirements for Structural Concrete*.
- b. Design of concrete structures shall comply with ACI 318, *Building Code Requirements for Structural Concrete*.

**5.10.4 Concrete Anchorage**

- a. Concrete anchorage shall be evaluated using ACI-318 and relevant ICC-ES evaluation reports (i.e., ESR reports). Additional guidance is provided in CPCC-PRO-EN-097.
- b. Anchor bolts of a minimum half inch in diameter are to be used regardless of calculated anchorage requirements.
- c. Anchor bolt material (e.g., carbon steel, stainless steel) shall be selected and evaluated to ensure suitability for the specific process and environmental conditions of the application.
- d. If vibratory and dynamic loading are to be encountered ensure that undercut anchors are used. Undercut anchors are required for fall protection, hoisting and rigging applications, all overhead applications, and non-vibration isolated mechanical equipment rated at 10hp, unless approved by CPCCO.
- e. Epoxy grouted anchors are not allowed in elevated temperature environments unless approved by the manufacturer. Epoxy grouted anchors shall not be used in overhead applications.

**5.10.5 Civil & Site Layout Requirements**

- a. Adequate vehicular access shall be provided in site layout for the appropriate vehicles that are expected to deliver and offload equipment. Access roads, aprons, and walkways shall be incorporated into the design. Design analysis shall be performed to determine whether existing roadways (e.g., travel path from 324 facility to ERDF) can accommodate the traffic and loading required to support the projects activities. Design shall also include evaluation of the compacted road surfaces leading to the disposal location within the ERDF. Maximum allowable slopes and minimum turning radiuses shall be provided for all road types at the ERDF. Road and Pavement design shall comply with WSDOT M22-01, *Design Manual*.
- b. Vehicle barriers shall be located around the TWRE facility and ancillary structures to prevent facility damage.

- c. Stormwater controls (e.g., soil berms, swales, ditches, etc.) shall be implemented into the design around the project area to reduce the amount of runoff percolating into the soil column around the 324 facility. Stormwater drainage systems shall be designed in accordance with WSDOE 18-10-044, *Stormwater Management Manual for Eastern Washington*, as determined by the final facility design and site layout.

## **6.0 REFERENCES**

### **CPCC Internal Documents**

- CPCC-00015, *Fire Hazards Analysis for the 324 Building (FHA)*
- CPCC-00070, *Type IP-1 Packaging Compliance Checklist*
- CPCC-00072, *Standard DOT 7A Type A Packaging Compliance Checklist*
- CPCC-00175, *Central Plateau Cleanup Company Radiological Control Manual.*
- CPCC-00870, *Safety Basis Step-Out Criteria for the 324 Facility*
- CPCC-01023, *Soil Removal Process Options for Remediation of Highly Contaminated Soil in Waste Site 300-296 Beneath 324 Building for guidance*
- CPCC-01126, *300 Area Health and Safety Plan*
- CPCC-01522, *324 Building Temporary Electrical Power Plan*
- CPCC-SRP-00039, *324 Building Grout and Fixative Stabilization Design*
- CPCC-SRP-00040, *324 Facility & 300-296 Waste Site Radiological Conditions Summary*
- CPCC-324DP-26-00001, *Fire Protection Functional and Operating Requirements for 324 Disposition Project*
- CPCC-324DP-26-00002, *324 Disposition Project Radiological Options Analysis*
- CPCC-324DP-26-00004, *324 Disposition Project Code of Record*
- ERDF-00003, *Supplemental Waste Acceptance Criteria for the Environmental Restoration Disposal Facility*
- ERDF-00011, *Environmental Restoration Disposal Facility Waste Acceptance Criteria*

### **CPCC Procedures**

- CPCC-MP-QA-599, *Quality Assurance Program*
- CPCC-PRO-EN-097, *Engineering Design and Evaluation (Natural Phenomena Hazard)*
- CPCC-PRO-OP-40126, *Equipment and Piping Labeling for guidance*
- CPCC-PRO-QA-259, *Graded Approach*
- CPCC-PRO-RP-1622, *Radiological Design Review Process*
- CPCC-STD-EN-52736, *Design, Inspection, Testing and Repair of ASME-Coded pressure Systems and Pressure Relief Devices*

### **Hanford Site Documents**

- DOE/RL-92-36, *Hanford Site Hoisting and Rigging Manual*

DOE/RL-2001-36, *Hanford Sitewide Transportation Safety Document*

DOE-0336, *Hanford Site Lockout/Tagout Program.*

DOE-0344, *Hanford Site Excavating, Trenching, and Shoring Procedure*

DOE-HRD-SH-51953, *Hanford Radiological Health and Safety*

HNF-58243, *PNNL, CPCCO, and HMIS for 300 Area Utility Systems and Services*

HNF-59706, *Hanford Site Roads Master Plan*

HNF-S-0552, *Procurement Specification for Standard, Nuclear Grade, High Efficiency Particulate Air Filters (For ASME AG-1 Compliant Filters)*

### **Department of Energy Specific Documents**

DOE O 252.1B, *Technical Standards Program*

DOE O 414.1D, *Quality Assurance*

DOE O 435.1, *Radioactive Waste Management*

DOE-EH-0173T, *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance*

DOE-HDBK-1140-2001, *Human Factors/Ergonomics Handbook for the Design for Ease of Maintenance*

DOE-HDBK-1169, *DOE Handbook: Nuclear Air Cleaning Handbook*

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

DOE-STD-1269-2022, *Air Cleaning Systems in DOE Nuclear Facilities*

DOE-STD-3030-2015, *Specification for HEPA Filters Used by DOE Contractors*

### **Other Documents**

PNNL-34866, *A Geostatistical Assessment of the Extent of Radioisotope Contamination Under Building 324 in the Hanford 300 Area*

0300X-CA-N0140, WCH 2015, *Characterization of the Soil Contamination Under 324 B-Cell*

ECF-324-BLDG-17-0086, *Total Effective Dose Equivalent Calculation for D4 of the 324 Facility*

TE-WL-17-001-07, *324 Building Characterization, Workplace Air Monitoring, and Dosimetry Technical Evaluation*

0087180, ROD, EPA, *Hanford Site 300 Area Record of Decision for 300-FF-2 and 300-FF-5, and Record of Decision (ROD) Amendment for 300-FF-1*

Letter, PNNL (Bruce Rathbone) to B&W Hanford Company (Armin Vogt), February 2, 1999,  
324 Building Dosimetry Support (Contract 619, Release 9). [Measured radiation exposure in the  
HLV & LLV waste tanks]