OPERATIONS PLAN (300-296 Remote Soil Excavation 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

P.O. Box 1600
Richland, Washington 99352

Approved for Public Release:
Further Dissemination Unlimited
TRADEMARK DISCLAIMER
Reference herein to any specific commercial product, process, or service by tradename, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof or its contractors or subcontractors.

This report has been reproduced from the best available copy.

Printed in the United States of America

Total pages: 56

<table>
<thead>
<tr>
<th>Revision</th>
<th>Description of Change – Replace, Add, and Delete Pages</th>
<th>Authorized for Release</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Entire document was revised to reflect current approach for remote excavation of soil from beneath B-Cell in the 324 building.</td>
<td>X</td>
</tr>
<tr>
<td>2</td>
<td>Entire document was revised to reflect current approach for remote excavation of soil from beneath B Cell in the 324 building.</td>
<td>X</td>
</tr>
<tr>
<td>3</td>
<td>Sections 3.8 thru 5.5: Corrected figure numbers and text references. Section 3.4: Deleted optional use of reverse boom crane to place the Upper Remote Excavator Arm (REA) within the Airlock. Due to weight of the REA, only the rail cart system can be used to place this equipment within the Airlock. Section 3.7: Deleted description of connecting utilities to to floor saw, which is redundant to description in Section 5.2. Section 3.9: Expanded description of method for attaching REA Bin Lifting Tool to REA. Section 5.2: Deleted optional use of reverse boom crane to place floor saw within Airlock. Due to weight of the floor saw, only the rail cart system can be used to place this equipment within the Airlock. Section 5.3: Deleted optional use of reverse boom crane to place the Lower REA within the Airlock. Due to weight of the REA, only the rail cart system can be used to place this equipment within the Airlock.</td>
<td>2/30/18</td>
</tr>
</tbody>
</table>
Executive Summary

The 300-296 Remote Soil Excavation Project (RSEP) will conduct remote excavation of the highly contaminated soil from underneath B-Cell in the 324 Building located in the 300 Area of the U.S. Department of Energy Hanford Site. Soil will be removed from beneath B-Cell to the point where the remaining contaminated soil can be removed by conventional open-air methods\(^1\) or to a maximum depth of approximately 12 ft, which is the limit of the remote excavation equipment design capability\(^2\). The highly contaminated debris in B-Cell and underlying soil will be remotely removed and transferred to A, C, and D-Cells within the 324 Building, then solidified in place. The cells will be completely filled with grout as part of the 324 Building remediation actions slated for future completion after the 300-296 RSEP is complete.

This Operations Plan contains a description of the scope, technical approach, and process integration for remotely excavating soil from beneath B-Cell. This Operations Plan is intended to be a living document that will be reviewed and updated as necessary to incorporate additional details as the project progresses.

Section 1.0 provides an overview of the project and information on the extent of the radiological contamination in the soil beneath B-Cell. Section 2.0 discusses the modifications to the 324 Building as precursors to installing soil removal equipment discussed in Section 3.0. Section 4.0 discusses the use of a Mockup for testing equipment and training personnel to accomplish soil removal equipment installation and operations, which are described in Section 5.0.

\(^1\) PRC-SRP-CN-O-00108, 300-296 Soil Removal Project, Total Alpha-Emitting Radionuclide Concentration vs. Elevation, concludes soil needs to be excavated to approximately 6 ft below the B-Cell floor to support future, conventional open-air excavation.
## Contents

1.0 Project Overview ............................................................................................................... 4  
  1.1 Extent of Radiological Contamination Beneath B-Cell .............................................. 6  
  1.2 Scope of Work ........................................................................................................... 6  
  1.3 Technical Approach ................................................................................................. 7  

2.0 Remediation Preparation ................................................................................................... 11  
  2.1 Structural Stabilization of B-Cell ........................................................................... 12  
  2.2 Interferences Removal ............................................................................................ 12  
  2.3 Penetration Sealing ............................................................................................... 13  
  2.4 Core Drilling .......................................................................................................... 13  
  2.5 Removal of Loose Debris from the Airlock and Cells ........................................... 14  
  2.6 D-Cell Floor Plug Removal ................................................................................... 16  
  2.7 Removal of Geoprobes .......................................................................................... 17  

3.0 Equipment Installation ..................................................................................................... 18  
  3.1 Cameras and Lighting ............................................................................................ 18  
  3.2 Brokk® Installation ............................................................................................... 20  
  3.3 REA Through-Wall Support Installation ............................................................... 21  
  3.4 Upper REA Installation ......................................................................................... 22  
  3.5 REA Tools and Holders Installation ...................................................................... 23  
  3.6 Transfer Mechanism Installation ........................................................................... 26  
  3.7 Floor Saw Installation ............................................................................................ 27  
  3.8 A, C, and D-Cell Dams Installation ....................................................................... 28  
  3.9 Lifting Devices Installation ................................................................................... 28  
  3.10 HVAC Exhaust Dams and Snorkels Installation ................................................... 32  
  3.11 Water Delivery Hose Assembly Installation ......................................................... 33  

4.0 Mockup Testing and Training .......................................................................................... 34  

5.0 Operations .......................................................................................................................... 36  
  5.1 Grout and Fixed Debris Removal ........................................................................... 37  
  5.2 Floor and Liner Removal ....................................................................................... 39  
  5.3 Lower REA Installation ......................................................................................... 41  
  5.4 Soil Removal .......................................................................................................... 42  
    5.4.1 Soil Excavation Sequence .............................................................................. 45  
  5.5 Waste Box Loading ............................................................................................... 47  
  5.6 Grout Addition to B-Cell ....................................................................................... 49  

6.0 References .......................................................................................................................... 50
Figures

Figure 1. 324 Building 1st Floor General Arrangement ......................................................... 5
Figure 2. Geoprobe Locations Beneath B-Cell................................................................. 8
Figure 3. Excavation Showing Geoprobe Locations on Northside of 324 Building ............ 9
Figure 4. Dose Rate Measurements for Geopros Beneath B-Cell ...................................... 10
Figure 5. Seal Breaker/Lifting Device ............................................................................ 16
Figure 6. Mirion Model SC985-HR Camera .................................................................. 18
Figure 7. Mirion Model RCS3110 Camera Mounted to Bail and Carriage ...................... 19
Figure 8. Brokk® Model 160 Remote-Controlled Excavator ........................................... 21
Figure 9. REA Through Support Assembly on Installation Stand ..................................... 22
Figure 10. REA Hydraulic Power Units ......................................................................... 23
Figure 11. Hydraulic Hammer in Tool Holder ............................................................... 24
Figure 12. PowerGrip Bucket without Tool Holder ......................................................... 25
Figure 13. Long-Reach Bucket in Tool Holder ............................................................... 25
Figure 14. Hydraulic Shear without Tool Holder ............................................................ 26
Figure 15. Transfer Mechanism - Rail in Folded Position ................................................ 27
Figure 16. B-Cell Before Addition of Grout (30 March 2010) ........................................... 37
Figure 17. B-Cell After Grout Addition (7 April 2010) .................................................... 38
Figure 18. Self-Dumping Bin ......................................................................................... 39
Figure 19. Track-Mounted Concrete Saw ....................................................................... 40
Figure 20. Initial Configuration of Upper and Lower REAs in B-Cell ............................ 42
Figure 21. Conceptual Diagram of Radiation Detector for use with B-Cell Crane ............ 44
Figure 22. Prototype IP-2 Waste Package ....................................................................... 47
Figure 23. Cribbing in Waste Package for Six Bin Configuration .................................... 48

Tables

Table 1. Debris in Airlock and REC Cells Planned for Packaging and Disposal at ERDF ................................................................. 14
Table 2. Isotopic Analyzes for Soil Samples .................................................................. 43
Table 3. Estimated Number of Waste BinsFilled with Highest Radiological Contaminated Soil, Assuming Picture Frame Excavation ......................................................... 45
Table 4. Estimated Number of Waste Bins Filled Assuming Entire Area Beneath B-Cell is Excavated ................................................................. 45
1.0 Project Overview

The 324 Building is a non-reactor Category 2 Nuclear Facility located in the 300 Area of the U.S. Department of Energy (DOE) Hanford Site. The 324 Building was constructed from 1963 through 1966 to support materials and chemical process research and development activities ranging from laboratory/bench-scale studies to full engineering-scale pilot plant demonstrations with radioactive materials. The 324 Building is comprised of a shielded metallurgical facility, radiochemical engineering complex (REC), low-level canyon, tank vault, cold canyon, cask handling area (CHA), maintenance shops, laboratory area, administrative offices, and building support systems, as depicted in Figure 1. There are four cells in the REC labelled A through D with a connecting Airlock as shown in Figure 1. The REC cells, tank vault, and building support systems are currently operational with the remaining areas decommissioned.

Records indicate that in October 1986, approximately 516 L of a concentrated liquid waste stream containing cesium-137 (\(^{137}\text{Cs}\)) and strontium-90 (\(^{90}\text{Sr}\)) was spilled onto the floor of the 324 Building B-Cell. It is estimated that this spill contained approximately 1.3 million curies of radioactivity. An unknown quantity of the spill was lost into the subsurface beneath the 324 Building B-Cell through a leak in the sump in the floor of B-Cell. Unknown quantities of water were used immediately after the spill, and at various other times following the spill, to wash items contained in B-Cell. Wastes being removed from B-Cell were also grouted and in the course of the grouting activities, sufficient grout was spilled on the floor of the B-Cell to completely fill the sump with solidified grout (PNNL-21214, *Numerical Modeling of\(^{90}\text{Sr}\) and \(^{137}\text{Cs}\) Transport from a Spill in the B-Cell of the 324 Building, Hanford Site 300 Area*).

The breach in the B-Cell sump was discovered in November 2009 during deactivation and stabilization activities. A system of geoprobes, consisting of horizontal closed-end steel access pipes, were installed in a fan-shaped pattern under B-Cell. Exposure rates and temperature measurements were made in these access pipes to provide an estimate of the nature and extent of the contamination under the B-Cell. Exposure rates in excess of 10,000 R/hr have been detected. The peaks in the measured exposure rates approximately underlie the locations of the expansion joints in the B-Cell floor. The current interpretation is that the leak from the B-Cell sump spread laterally along a felt liner between the floating B-Cell floor and the cell foundation. It is estimated that there is approximately 1.557E+05 curies of \(^{137}\text{Cs}\) and 6.842E+04 curies of \(^{90}\text{Sr}\) contained in the soil beneath B-Cell based on modelling of the radiation dose rate measurements obtained along the length of each geoprobe (0300X-CA-N0140, *Characterization of the Soil Contamination Under 324 B Cell*).
Figure 1. 324 Building 1st Floor General Arrangement
1.1 Extent of Radiological Contamination Beneath B-Cell

Sixteen geoprobes were installed at depths varying from approximately 3 to 7 ft beneath B-Cell as shown in Figure 2 and Figure 3. Radiation (blue) and temperature (red) measurements were obtained every 1 ft for each geoprobe with these measurements summarized in Figure 4 (CHPRC-03504, 300 Area, 324 Building B-Cell Geoprobe Surveys). The highest levels of radiological contamination (i.e., greater than 10 R/hr.) beneath B-Cell is generally confined to an area approximately 2 ft on either side of the expansion joint in the B-Cell floor. However, there are a few hot spots of contamination further away from the floor expansion joint. Also, no geoprobes were installed beneath the south-eastern Section of the B-Cell floor due to the inability to access this area. The area north of the 324 Building that was excavated to install these geoprobes has been backfilled and will be re-excavated to support removal of the geoprobes.

1.2 Scope of Work

The selected technical approach for soil removal is to remove the existing debris and approximately 6 in. of grout on top of the B-Cell floor, removal of the floor, then remote excavation of the underlying contaminated soil. Structural modifications will be performed to support the B-Cell prior to commencing remote excavation of the underlying contaminated soil. Additionally, facility modifications will also be performed to support installation of the remote excavation equipment.

Once the existing B-Cell concrete floor with stainless-steel liner is removed, the soil will be remotely excavated approximately 2 to 3 ft to either side of the expansion joint (20 in. from the cell wall) and to the point where the remaining contaminated soil can be removed by conventional open-air methods or to a maximum depth of approximately 12 ft, which is the limit of the remote excavation equipment design capability (PRC-SRP-00141, 300-296 Remote Soil Excavation Project – Impacts of Extending Remote Soil Excavation to 15-ft. Beneath 324 Building B-Cell Foundations). The excavation, which will extend beneath each of the B-Cell walls, is focused on the removal of the highly radioactive soil beneath the expansion joint. After soil is excavated from underneath each of the B-Cell walls, a sample of the soil will be obtained to verify the requisite cleanup levels were obtained (PRC-SRP-00130, End State Criteria for Meeting TPA Milestone M-016-85A and Gaining Backfill Concurrence Authorization for B Cell in Preparation of 324 Facility Demolition and Final Remediation of the 300-296 Waste Site). Following removal of the soil underneath the B-Cell walls, other highly radioactive soil will be remotely excavated as necessary to enable future open-air remediation of the remaining contaminated soil, which will be performed by a separate project. The excavation will be filled with grout up to the former height of the B-Cell floor.

The more highly contaminated soil and debris will be relocated to A, C, and D-Cells in the REC. If the debris and soil meets waste acceptance criteria, it will be packaged in waste boxes, grout added to fill the void space, and the waste boxes transported to the Environmental Restoration Disposal Facility (ERDF). Otherwise, the debris and soil will be grouted in place within the REC cells. After completing the project to excavate the soil remotely from beneath B-Cell, the future building demolition project will completely fill each of the cells with grout, then cut the cells into monoliths to be removed and shipped to ERDF for disposal.
A Plant Forces Work Review (PFWR) was prepared in December 2011 by the DOE Labor Standards Board in accordance with the Davis-Bacon Act Determination (WCH Interoffice Memo 163455, Labor Board Determination: 8850-003-12, rev. 0- Remediation of 324 Building B-Cell Waste Site). The PFWR assessed the planned work scope for modifying the 324 Building, and installing and operating the soil removal equipment. The Davis-Bacon Act has been determined to be applicable to the scope of work described in the PFWR. Therefore, construction personnel will accomplish the modifications to the 324 Building, and install and operate the soil removal equipment.

1.3 Technical Approach

The technical approach for soil remediation was developed based on the assessment of a number of alternate options (WCH-503, Remediation Alternatives Evaluation for Contaminated Soil Beneath the 324 Building), arriving at the following key elements of the technical approach. This approach has continued to be further refined during the assessment, planning, and design activities:

• Construction of structural supports for the west and east walls of B-Cell to support the cell while undermining the footing during soil removal.

• Employment of Remote Excavator Arms (REAs) mounted in B-Cell to remove the debris, liner, floor, and contaminated soil.

• Installation of a transfer mechanism to allow movement of waste bins into and out of B-Cell without cycling the B-Cell door each time.

• Use of specially designed waste bins for moving the soil and debris from B-Cell into the other receiving cells or disposal boxes.

• Existing contaminated equipment and debris in B-Cell will be moved to A-Cell and encapsulated in grout. The higher contaminated soil from beneath B-Cell will be loaded into waste bins and placed in A, C and D-Cells. Grout will be added to each layer of waste bins in each cell. The less contaminated soil and debris may be packaged in waste boxes and shipped to ERDF. Grout will be added to the waste boxes to fill the void space and provide stability.

Given the “First of a Kind” nature of some aspects of this project, details of some evolutions will be further defined and progressively elaborated as the project unfolds. Further detail is provided in the following sections of this Operations Plan.
Figure 2. Geoprobe Locations Beneath B-Cell
Figure 3. Excavation Showing Geoprobe Locations on Northside of 324 Building
Figure 4. Dose Rate Measurements for Geoprobes Beneath B-Cell
2.0 Remediation Preparation

An assessment was completed in July 2014 of the 324 Building conditions to support the planned removal of the B-Cell floor and excavation of the radiologically contaminated soil (KUR-1782F-RPT-001, 300-296 Soil Remediation Project Phase I & II Assessment Report). While this assessment report does not reflect the current contracting strategy, this report contains useful information regarding the condition of existing systems, structures, and components within the 324 Building. Systems, structures, and components assessed were:

- Structural
- REC Cranes and Alternative Handling Equipment
- Master-Slave-Manipulators (MSMs)
- Heating Ventilation and Air Conditioning (HVAC) Systems
- Inventory of debris and equipment contained in REC
- Electrical and Lighting
- Cell Doors and Seals
- Existing Fire Protection
- Geotechnical
- Radiological Contamination
- Radiological Monitoring Systems and Capabilities
- Other items

The Assessment Report was used as input to develop the design for building preparations and the design for the soil removal equipment. The necessary building preparations to support the 300-296 Remote Soil Excavation Project (RSEP) include:

- Structural stabilization of REC (Section 2.1)
- Interferences removal for installation of soil removal equipment as well as to support waste packaging and placement in REC Cells (Section 2.2)
- Penetration sealing to mitigate spread of contamination from cells into the Airlock or gallery areas (Section 2.3)
- Core drilling cell walls for installation of the remote excavator arms, cameras and lighting, water delivery system, transfer mechanism (electrical), grout addition to a waste box, and grout filling cells (Section 2.4)
- Removal of loose debris from the Airlock and cells (Section 2.5)
- D-Cell floor plug removal (Section 2.6)
- Removal of geoprosbes to support access for contaminated soil removal actions (Section 2.7)

These building preparations are further defined in the following sections. Remote soil excavation equipment installation is discussed in Section 3.0.
2.1 Structural Stabilization of B-Cell

The structural integrity of the REC and adjacent remaining 324 Building structure is critical during the excavation of soil from beneath the B-Cell floor. Removal of soil from beneath B-Cell has the potential to undermine the building footings. If not stabilized, cracks could form in the walls of B-Cell and/or the cell shield doors may not be able to be fully closed or other adverse impacts to the facility structure or systems. The design for the RSEP includes structural stabilization of B-Cell to avoid structural instability of the REC.

Structural stabilization the REC will be accomplished by installing a foundation support system consisting of a series of jet grout and/or micropile supports. The foundation support system will include provisions for confining and retaining of existing soils to remain along the exterior face of B-Cell during excavation and removal of soil below existing B-Cell concrete wall footings down to EL –22'-6". Reinforced concrete wall column supports will be designed and installed at each foundation support location for vertical load transfer of the existing structure through bearing, where possible, directly into the foundation support system. Concrete column supports will be secured and tied into existing concrete walls and foundation supports for continuity and load transfer. All work related to installation of foundation and concrete wall column supports will be performed outside of and adjacent to the REC cells. The foundation support system will serve to provide primary structural support of the B-Cell and portions of the REC structure during excavation and removal of contaminated soils located under the B-Cell concrete slab-on-grade and concrete wall footings including additional weight from grout filling of the A, C, and D-Cells (PRC-SRP-00071, Performance Specification 300-296 Remote Soil Excavation Project Structural Modifications).

2.2 Interferences Removal

Some of the existing systems/equipment within the 324 Building is blocking access and requires removal to accommodate:

- Core drilling to install cameras, lighting, and the B-Cell remotely operated equipment or other necessary access
- Installation of structural supports
- Penetration sealing

The Sample Loadout Room and contained hood and zone II exhaust duct on the first floor (room 131) will be removed and penetrations isolated to allow access for core drilling penetrations to install the REAs. Piping and electrical components along the north exterior wall of A-Cell, the north and south exterior walls of B-Cell, and the south exterior wall of C-Cell on the first floor (room 131) will be removed to the extent necessary for core drilling penetrations to install the REAs (B-Cell only) and cameras and lighting. Piping and electrical components on the third floor (room 306) adjacent to the exterior of D-Cell will be removed as necessary for core drilling penetrations to install cameras and lighting.
The motor control center for the B-Cell crane located on the first floor (room 131) will be relocated to accommodate installation of structural supports adjacent to the northwest corner of A-Cell. The motor control center adjacent to the south west corner of C-Cell in the basement (room 18) will be relocated to accommodate installation of a structural supports. Piping and electrical components along the exterior walls of B-Cell in the basement (room 18) will be removed to the extent necessary for installation of the structural supports for B-Cell.

Junction boxes, wire-way, and conduit along the north exterior wall of A-Cell and the west exterior wall of D-Cell on the second floor (room 244) will be removed to allow access for penetration sealing.

Approved Work Control Documents (WCDs) will be prepared to facilitate field work execution for removal of these interferences by construction personnel in accordance with the PFWR.

2.3 Penetration Sealing

As described in Section 5.0, B-Cell debris, floor sections, and waste bins containing highly radioactive soil will be stacked in layers within A, C, and D-Cells with grout added between layers to provide a level surface for the next layer of material. Sealing penetration in A, C, and D-Cells is being performed to prevent highly radioactive soil mixed with grout from migrating from these cells into the Airlock, B-Cell, or service galleries through gaps around the various cell penetrations. Penetrations from A, C, and D-Cells will be sealed and radiological shielding added over the penetrations to avoid increasing the radiological hazards in the Airlock and service galleries. Additionally, HVAC dams and snorkels need to be installed on the exhaust filter frames in A, C, and D-Cells to prevent grout from entering the zone I exhaust duct (refer to Section 3.10). A snorkel or other device may be added to the B-Cell filter to reduce the direct intake of fugitive dust generated during grout removal, floor removal, and remote soil excavation. Approved WCDs will be prepared to facilitate field work execution for sealing penetration and added radiological shielding by construction personnel in accordance with the PFWR.

2.4 Core Drilling

New access holes will be drilled through cell walls for installing remote excavator arms, water delivery system, and transfer mechanism (electrical) in B-Cell. Existing penetrations into A and B-Cells will be used to install cameras and lighting. One existing penetration and one new penetration will be installed in each of C-Cell, D-Cell, and the Airlock to install cameras and lighting. New penetrations will be provided into A, C, and D-Cells for grout addition for filling between layers of waste bins. An existing penetration into B-Cell can be used to add grout to backfill the excavation under each of the cell walls. Approved WCDs will be prepared to facilitate field work execution for core drilling new penetrations into the cells and Airlock by construction personnel in accordance with the PFWR.
2.5 Removal of Loose Debris from the Airlock and Cells

The REC cells and Airlock contain loose debris. Some of the loose debris will be removed to allow for installation of the remotely operated soil removal equipment within B-Cell and to provide space for storing the higher radioactively contaminated soil when excavating from beneath B-Cell. Loose debris removal from the Airlock and REC cells will be conducted by construction personnel. The loose debris within the Airlock and REC cells that is planned to be removed, packaged, and shipped to ERDF for disposal is identified in report A-300-296-00131, Debris Tracking within the REC, and summarized in Table 1.

**Table 1. Debris in Airlock and REC Cells Planned for Packaging and Disposal at ERDF**

<table>
<thead>
<tr>
<th>Location</th>
<th>Description of Item</th>
<th>Approximate Weight (lb)</th>
<th>Dimensions (L x W x H in.)</th>
<th>Approximate Volume (ft³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-Cell</td>
<td>Duct Sprayer (Spool) (2 each)</td>
<td>600⁹</td>
<td>72 x 72 x 72ᵃ</td>
<td>216.00</td>
</tr>
<tr>
<td>B-Cell</td>
<td>4 Sections of Airlock Tracks</td>
<td>1800</td>
<td>48 x 48 x 12</td>
<td>16.00</td>
</tr>
<tr>
<td></td>
<td>Duct Sprayer (Spool)</td>
<td>600ᵃ</td>
<td>72 x 72 x 72ᵃ</td>
<td>216.00</td>
</tr>
<tr>
<td></td>
<td>Turntable</td>
<td>1000</td>
<td>48 x 60 x 96</td>
<td>160.00</td>
</tr>
<tr>
<td>B-Cell</td>
<td>3 ton Crane Winch Motor Stand</td>
<td>500</td>
<td>36 x 48 x 48</td>
<td>48.00</td>
</tr>
<tr>
<td></td>
<td>3 Way Spreader Bar for Grout Container</td>
<td>290</td>
<td>36 x 30 x 0.125 thickᵃ</td>
<td>0.08</td>
</tr>
<tr>
<td></td>
<td>Cybenetix Robot/Stand</td>
<td>500ᵃ</td>
<td>48 x 84 x 72</td>
<td>168.00</td>
</tr>
<tr>
<td></td>
<td>Step Ladder</td>
<td>4.2 appré</td>
<td>18 x 36 x 36</td>
<td>13.50</td>
</tr>
<tr>
<td></td>
<td>Camera Counter Balance Bar</td>
<td>100</td>
<td>72 x 36 x 4</td>
<td>6.00</td>
</tr>
<tr>
<td></td>
<td>HEPA Vacuum</td>
<td>100</td>
<td>12 Dia. x 24 Hᵇ</td>
<td>2.00</td>
</tr>
<tr>
<td>C-Cell</td>
<td>Dust Stop Filters in Frame (2 each)</td>
<td>75</td>
<td>30 x 30 x 24ᵃ</td>
<td>12.50</td>
</tr>
<tr>
<td></td>
<td>Aluminum 10 ft Ladder</td>
<td>20</td>
<td>120 x 18 x 4⁴</td>
<td>5.00</td>
</tr>
<tr>
<td></td>
<td>Platform Ladder</td>
<td>70</td>
<td>84 x 24 x 121</td>
<td>141.17</td>
</tr>
<tr>
<td></td>
<td>Aluminum 4 ft Ladder</td>
<td>10</td>
<td>48 x 18 x 4⁴</td>
<td>2.00</td>
</tr>
<tr>
<td></td>
<td>Aluminum 6 ft Step Ladder</td>
<td>15</td>
<td>72 x 18 x 4ᵃ</td>
<td>3.00</td>
</tr>
<tr>
<td></td>
<td>Engineered Container</td>
<td>120</td>
<td>10 in. Sch. 40 SST Pipe ~ 36ᵇ</td>
<td>2.08</td>
</tr>
<tr>
<td></td>
<td>Duct Sprayer (Spool)</td>
<td>600ᵃ</td>
<td>72 x 72 x 72ᵃ</td>
<td>216.00</td>
</tr>
<tr>
<td></td>
<td>Grout Container 3-Way Spreader Bar</td>
<td>290</td>
<td>36 x 36 x 6ᵃ</td>
<td>4.50</td>
</tr>
<tr>
<td></td>
<td>50 ft Cybernetics Power Cable</td>
<td>400</td>
<td>36 x 36 x 6ᵃ</td>
<td>4.50</td>
</tr>
<tr>
<td></td>
<td>50 ft Cybernetics Hydraulic Cable</td>
<td>400</td>
<td>36 x 36 x 6ᵃ</td>
<td>4.50</td>
</tr>
<tr>
<td></td>
<td>5 ft Grab Tool, Aluminum</td>
<td>5</td>
<td>1 x 1 x 60ᵃ</td>
<td>0.03</td>
</tr>
<tr>
<td></td>
<td>KSI Arm</td>
<td>700</td>
<td>36 x 24 x 12ᵃ (contains lead)</td>
<td>6.00</td>
</tr>
<tr>
<td></td>
<td>Cover Block Lifting Fixtures</td>
<td>140</td>
<td>12 x 12 x 6ᵃ</td>
<td>0.50</td>
</tr>
<tr>
<td></td>
<td>Camera Unit on Frame</td>
<td>50</td>
<td>36 x 12 x 10</td>
<td>2.50</td>
</tr>
<tr>
<td></td>
<td>Winch Motor</td>
<td>50</td>
<td>10 Dia. x 12 H¹²</td>
<td>0.69</td>
</tr>
<tr>
<td></td>
<td>Rock Stop Filters (2 each)</td>
<td>240</td>
<td>24 x 48 x 6</td>
<td>4.00</td>
</tr>
<tr>
<td>Location</td>
<td>Description of Item</td>
<td>Approximate Weight (lb)</td>
<td>Dimensions (L x W x H in.)</td>
<td>Approximate Volume (ft³)</td>
</tr>
<tr>
<td>------------</td>
<td>------------------------------------------</td>
<td>-------------------------</td>
<td>-----------------------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>C-Cell</td>
<td>A-Cell Counter Balance Spreader Bar</td>
<td>500&lt;sup&gt;a&lt;/sup&gt;</td>
<td>96 x 3 x 6&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>SST Spent Fuel Cask Alignment Basket</td>
<td>200</td>
<td>30 dia. x 24 H&lt;sup&gt;2&lt;/sup&gt;</td>
<td>12.50</td>
</tr>
<tr>
<td></td>
<td>Manipulator Boot</td>
<td>4</td>
<td>2 x 2 x 2&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.01</td>
</tr>
<tr>
<td></td>
<td>10 ft Aluminum Extension Ladder</td>
<td>4</td>
<td>120 x 18 x 4&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.00</td>
</tr>
<tr>
<td>D-Cell</td>
<td>Duct Sprayer (Spool) (2 each)</td>
<td>600&lt;sup&gt;a&lt;/sup&gt;</td>
<td>72 x 72 x 72&lt;sup&gt;a&lt;/sup&gt;</td>
<td>216.00</td>
</tr>
<tr>
<td></td>
<td>Steel Box</td>
<td>400</td>
<td>24 x 30 x 24</td>
<td>10.00</td>
</tr>
<tr>
<td></td>
<td>Steel/Lead Lid</td>
<td>143&lt;sup&gt;a&lt;/sup&gt;</td>
<td>30 x 12 x 1</td>
<td>0.21</td>
</tr>
<tr>
<td></td>
<td>Dust Stop Filter and Frame</td>
<td>75&lt;sup&gt;a&lt;/sup&gt;</td>
<td>30 x 30 x 24&lt;sup&gt;a&lt;/sup&gt;</td>
<td>12.50</td>
</tr>
<tr>
<td>Airlock</td>
<td>Duct Sprayer</td>
<td>600&lt;sup&gt;a&lt;/sup&gt;</td>
<td>72 x 72 x 72&lt;sup&gt;a&lt;/sup&gt;</td>
<td>216.00</td>
</tr>
<tr>
<td></td>
<td>Counter Balance</td>
<td>2000&lt;sup&gt;a&lt;/sup&gt;</td>
<td>30 x 30 x 30&lt;sup&gt;a&lt;/sup&gt;</td>
<td>15.63</td>
</tr>
<tr>
<td></td>
<td>Televator</td>
<td>5000</td>
<td>48 x 96 x 120</td>
<td>320.00</td>
</tr>
<tr>
<td></td>
<td>Dust Stop Filters and Frames (4 each)</td>
<td>75&lt;sup&gt;a&lt;/sup&gt;</td>
<td>30 x 30 x 24&lt;sup&gt;a&lt;/sup&gt;</td>
<td>12.50</td>
</tr>
<tr>
<td></td>
<td>Misc. Rigging on Walls and Floor</td>
<td>100</td>
<td>16 x 16 x 15</td>
<td>2.22</td>
</tr>
<tr>
<td></td>
<td>Working Camera (crane rail camera)</td>
<td>50</td>
<td>24 x 24 x 15</td>
<td>5.00</td>
</tr>
<tr>
<td></td>
<td>Pan/Tilt Camera</td>
<td>50</td>
<td>24 x 24 x 15</td>
<td>5.00</td>
</tr>
<tr>
<td></td>
<td>Pan/Tilt Camera (not working)</td>
<td>50</td>
<td>24 x 24 x 15</td>
<td>5.00</td>
</tr>
<tr>
<td></td>
<td>Remote Camera/Medium Pressure Decon. Sprayer</td>
<td>100</td>
<td>24 x 24 x 12</td>
<td>4.00</td>
</tr>
<tr>
<td></td>
<td>4 ft Ladder</td>
<td>5</td>
<td>48 x 18 x 4&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.00</td>
</tr>
<tr>
<td></td>
<td>Small Clamshell</td>
<td>15</td>
<td>12 x 18 x 12</td>
<td>1.50</td>
</tr>
<tr>
<td></td>
<td>Port-A-Band Saw</td>
<td>10</td>
<td>20 x 15 x 10&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.74</td>
</tr>
<tr>
<td></td>
<td>Plastic on Floor</td>
<td>50</td>
<td>36 x 36 x 36&lt;sup&gt;a&lt;/sup&gt;</td>
<td>27.00</td>
</tr>
<tr>
<td></td>
<td>Misc. Tools, Hooks, Paint Cans on Work Tray</td>
<td>100</td>
<td>16 x 16 x 23</td>
<td>3.41</td>
</tr>
<tr>
<td></td>
<td>100 ft of Air Hose</td>
<td>30</td>
<td>36 x 36 x 6&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.50</td>
</tr>
<tr>
<td></td>
<td>Long-Reach Tools (several)</td>
<td>5</td>
<td>2 x 2 x 72</td>
<td>0.17</td>
</tr>
<tr>
<td></td>
<td>55 gal Drum</td>
<td>50</td>
<td>23.5 dia. x 34.75 H&lt;sup&gt;a,b&lt;/sup&gt;</td>
<td>11.11</td>
</tr>
<tr>
<td></td>
<td>25 ft Garden Hose</td>
<td>10</td>
<td>24 x 24 x 6&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Misc. Pipes, Conduit, Power Cords, Buckets</td>
<td>50</td>
<td>48 x 48 x 48&lt;sup&gt;a&lt;/sup&gt;</td>
<td>64.00</td>
</tr>
<tr>
<td></td>
<td>Aluminum Saw Horse (2 each)</td>
<td>100</td>
<td>18.5 x 38 x 25&lt;sup&gt;a&lt;/sup&gt;</td>
<td>10.17</td>
</tr>
<tr>
<td></td>
<td>Lead Blanket</td>
<td>70</td>
<td>18 x 60 x 0.25</td>
<td>0.16</td>
</tr>
</tbody>
</table>

<sup>a</sup> Values are estimates to be confirmed during work planning activities.

<sup>b</sup> Cylinders are modeled as rectangles for stacking purposes.

HEPA high-efficiency particulate air

SST stainless steel
2.6 D-Cell Floor Plug Removal

There is a floor plug in D-Cell that after removal will allow waste bins to be lowered into C-Cell using the D-Cell crane. A remotely operated tool, the Remote Operated Impact Device shown in Figure 5, has been designed and tested for deployment in D-Cell via the A/D crane and will be operated from a viewing window with an MSM. The Remote Operated Impact Device will be used by construction personnel, in conjunction with the Seal Breaker/Lifting Device shown in Figure 6, to facilitate removal of the D-Cell floor plug, shown in Figure 7. The D-Cell floor plug will be removed and placed elsewhere within D-Cell while waste bins containing soil excavated from B-Cell are transferred to C-Cell. After C-Cell has been filled, the D-Cell floor plug can be reinstalled and D-Cell can then be filled with waste bins.

![Figure 5. Remote Operated Impact Device](image)

![Figure 6. Seal Breaker/Lifting Device](image)
2.7 Removal of Geoprobes

As discussed in Section 1.1, 16 geoprobes were inserted into the contaminated soil beneath B-Cell. Fifteen of these geoprobes cross under the plane of the expansion joint in the B-Cell floor. These geoprobes will obstruct the excavation process. The geoprobes present a risk to the lower REA mechanical and hydraulic components. Mechanical restrictions of the REA movement prevent the hydraulic shear from cutting the probes any closer than 1 ft from the B-Cell floor expansion joint. These geoprobes will protrude into the excavation trench with a sharp, shear edge exposed. Once cut, the geoprobes will prevent the movement of the REA to reach the required excavation depth and perimeter (2 to 3 ft external to expansion joint). Hydraulic hoses are routed along the sides of the REA and use service loops at pivot points. The hoses may become caught on the exposed geoprobes and may be cut due to the sharp edges left from shearing, or fail at the hose connections. It is further likely that the geoprobes may become hooked between the linkages and actuators of the REA and cause damage to the mechanism and/or the hydraulic cylinders (TR-0094-00-005, Alternatives Analysis for Geoprobe Pipe Removal).

The area north of the 324 Building where the geoprobes were installed will be excavated. The geoprobes will be withdrawn from beneath B-Cell to the extent necessary to remove the geoprobes from interfering with remote soil excavation.

The RSEP is also pursuing an alternative to insert equipment within the geoprobes to segment each pipe internally into manageable pieces. The geoprobe pieces would be removed using the lower REA during remote soil excavation activities.
3.0 Equipment Installation

The following sections provide a preliminary description of installing the remotely operated soil removal equipment within the REC cells and in particular B-Cell. Excluded from this description is the installation of the grout addition system, control trailer, control systems, and electrical modifications to support the soil removal equipment. Design drawings will be prepared and provided to construction personnel for installing these systems. Final remote installation procedures will be fully developed at the Mockup prior to installing equipment in REC cells, as described in PRC-SRP-00135, 300-296 Remote Soil Excavation Project Mockup Operations Plan.

As described in Section 1.2, a PFWR has determined the Davis-Bacon Act is applicable to the scope of work described in the PFWR. Therefore, construction personnel will accomplish the modifications to the 324 Building, and installing and operating the soil removal equipment.

3.1 Cameras and Lighting

Cameras and lighting will be installed in the REC cells and Airlock to improve visibility, support installation, and operation of the soil removal equipment. As described in Section 2.4, existing penetrations into A and B-Cells are planned to be used to install cameras and lighting but additional penetrations may be required as the project plan is finalized. One existing penetration and one new penetration are planned to be installed in each of C-Cell, D-Cell, and the Airlock to install cameras and lighting.

The cameras are model SC985-HR cameras manufactured by Mirion Technologies. The model SC985-HR cameras can tolerate an accumulated radiation dose of 5E+06 rad. These cameras will be mounted to split plug and slide mechanisms for inserting through the cell walls or to a bail and carriage for use with one of the REC cranes. The general configuration and installation of the cameras is shown in Figure 8 and Figure 9.

![Figure 8. Mirion Model SC985-HR Camera](image)
The light bars planned for installation in REC cells is comprised of 27 light emitting diodes (LEDs). The light bars will also be mounted to a 4.5-in. diameter step plug and articulated joint as shown in Figure 10. Cobalt-60 gamma radiation exposure testing of LED light bars was conducted in 2014 at the Pacific Northwest National Laboratory’s High Energy Facility located in Building 318 of the Hanford Site (Memorandum AMRP: RFG/16-AMRP-0072, 300-296 KURION REPORT: LED GAMMA RADIATION TESTING, KUR- 1782-RPT-008). The tested unit was a commercially available, 15 LED light bar (LEDP3W-15-F-BLK) of a common design to the 27 LED light bars intended for use in the 324 Building. The LED light bar had an acceptable 83% Lux output and remained functional throughout its test exposure. The predicted equivalent service life in B-Cell for the LED light bar is between approximately 88 and 220 days, depending on location in B-Cell (Section 7.2.13 in PRC-SRP-00009, 300-296 Soil Remediation Project Radiation Material Evaluation). There are no anticipated changes to the LED light bars or penetrations sizes/locations as a result of the predicted service life.
Core drilling, penetration sealing and interference removal activities should be completed prior to installing cameras and lighting. The slide-mounted cameras and light bars will be inserted from the galleries through penetrations in the REC cell or Airlock walls. The camera split plug/light bar step plug provides radiation shielding to personnel in the galleries. The cameras and lights will be attached to local power outlets in the galleries. Camera signal cables will be attached and routed to the control trailer. Additionally, mobile, local camera and lighting control panels will be provided for use in the 324 Building, primarily for use with operation of the REC cell cranes.

### 3.2 Brokk® Installation

A remote-controlled, commercial Brokk® excavator (Model 160) will be a backup to support loose debris removal, size reduction, and waste packaging operations in the Airlock on an as-needed basis (see Section 2.5). The secondary function of the Brokk is to serve as a backup to the primary soil removal equipment in B-Cell. Initial loose debris removal will be attempted by 324 Building personnel through the use of existing REC cranes, MSMs, and manual methods, where radiological conditions permit. The Brokk is intended to be installed only if required.

The Brokk Model 160 excavator is equipped with caterpillar tracks for moving the machine, outriggers to give the machine stability, an upper swivel Section for rotation of the arm, and an arm system for attaching tools using a quick coupler such as an excavator bucket or hydraulic hammer (see Figure 11).

The excavator weighs approximately 4,200 lb. (with counter balance weight) and is approximately 95 in. long, 57.4 in. tall, and 42.5 in. wide when the arm, tracks, and outriggers are fully retracted. The Brokk arm can extend approximately 7 ft below the base of the machine and approximately 14 ft horizontally from the center of the machine. Further information on the Brokk Model 160 excavator can be found in project document A-300-296-00468, C036502A00, 300-296 Soil Remediation Project – Submittal No. 5-59, 90% IFC/IFF Design – Miscellaneous.

The Airlock shield door opening is 6 ft 6 in. wide and 18 ft tall, with a 6 in. door sill. The Brokk can be driven over the sill into the Airlock. The 5.75 ton B-Cell crane can be used to move the Brokk from the Airlock and position the Brokk inside B-Cell to excavate soil remotely.

© Brokk is a registered trademark of BROKK Aktiebolag, Skellefteå, SWEDEN
3.3 REA Through-Wall Support Installation

There will be four REA mounting locations within B-Cell with three penetrations each. These are located just above the 0 ft elevation on the north and south walls of B-Cell. There will be four core bores, each with an approximate 10 in. diameter, for the REA hydraulic hose bundle. There will be eight core bores, each with an approximate 13-in. diameter, for the REA through supports. The core borings will penetrate the 5 ft 4 in. reinforced concrete and the 11-gauge stainless steel liner of the B-Cell walls. Each core boring location has wall interferences that must be removed sufficiently to allow mounting of the outer anchor plate and coring tool.

An REA through support assembly, shown in Figure 12, will be inserted from the gallery into the core-hole penetrations using a lifting frame attached to a pallet jack. The plate on the through support assembly is secured to the exterior wall of B-Cell. A dummy post will be held in position with the B-Cell crane and attached to the through supports by tightening the center bolt on each through support. The void space around each through support will be grouted to secure the through support in the B-Cell wall. An inflatable seal located at each end of the REA through support assembly will be inflated with air to prevent grout from flowing into the gallery or B-Cell. The grout is introduced around each through support through a connection in the gallery. After the grout has cured, the dummy post can be removed.
3.4 Upper REA Installation

Once the through supports are installed, the upper REA on the associated cart will be moved into the Airlock and the Airlock shield door closed. The rail cart system will be used to move the REA and cart in the Airlock. The B-Cell shield door will be opened and the B-Cell crane used to pick up the REA, leaving the cart in the Airlock. The REA cart will be removed from the Airlock and stored for use if an REA requires replacement.

The B-Cell crane will be used to position the REA in front of the through support. The REA can then be secured to the through supports from outside of the cell using the REA bolts. A long-reach handle tool will be used from the gallery area to grasp the hydraulic hose bundle on the REA and pull the hose bundle through the cell wall into the gallery area. The hydraulic hoses will then be connected to the hydraulic power units in the gallery area (room 131). One hydraulic power unit will be positioned in the gallery near each of the four REA mounting locations. The hydraulic power units are a modified Brokk Model 160 with the hydraulic arm removed as shown in Figure 13. The hydraulic power units will be remotely operated from the control trailer.

The lower REA will be installed in a similar manner as the upper REA after the debris has been removed, the B-Cell floor cut into segments using the floor saw, and floor saw removed from B-Cell (see Section 5.3). The lower REA would interfere with the floor saw operation if installed before the floor is cut. Also, there is a combustible inventory limit of 380-kgs of plastic equivalent allowable in B-Cell (CHPRC-02984, Fire Hazards Analysis for 324 Building). In order to comply with the combustible inventory limits, the lower REA cannot be installed in B-Cell with the floor saw, transfer mechanism, upper REA, REA tools and holders, lighting and cameras (KUR-1782F-CALC-M020, Equipment Combustible Loading). The combustible...
inventory for equipment will need to be verified after manufacturing and equipment limits in B-Cell revised as necessary.

Figure 13. REA Hydraulic Power Units

3.5 REA Tools and Holders Installation

The REA tools with holders, with the exception of the long-reach bucket and holder\(^3\), will be placed into the Airlock using the existing REC reverse boom hoist or the rail cart system. The capacity of the reverse boom hoist is 5 tons with the boom extended and 10 tons with the boom retracted\(^4\). The Airlock shield door will be closed after placing the tools with holders into the Airlock. The B-Cell shield door will be opened and the B-Cell crane used to position each tool and holder onto a 4 in. tool hanger. Tools that can be used with either the lower REA or the upper REA include the hydraulic hammer (Figure 14), a PowerGrip\(^\circ\) bucket (Figure 15), a long-reach bucket (Figure 16), and the hydraulic shear (Figure 17). Each tool is equipped with an OilQuick\(^\circ\) coupling device for attachment to either REA. It should be noted that the tool holders can be mounted at any tool holder (4 in. penetration) location to provide flexibility and avoid interferences with other equipment.

\(^3\) The long-reach bucket and tool holder will interfere with operation of the floor saw and will be installed after the floor saw is removed from B-Cell (TR-0094-003, REA Operability Study)

\(^4\) Air Technical Industries Reverse Boom Crane model #RBC20000SPBW parts and service manual.

\(^\circ\) PowerGrip is a registered trademark of the Helac Corporation, Enumclaw, Washington.

\(^\circ\) OilQuick is a registered trademark of OilQuick AB, Hudiksvall Sweden.
To attach a tool to an REA, the B-Cell crane (either the 3 or 5.75 ton) lifts the tool holder and places it on the cell floor or on top of the soil. The crane hook will remain attached to the tool holder to prevent the tool holder from falling over. When the REA is extended, it engages the OilQuick coupling on the tool. The coupling is engaged and the REA is retracted to lift the tool from the tool holder. The B-Cell crane lifts and places the tool holder on a tool bar.

Figure 14. Hydraulic Hammer in Tool Holder
Figure 15. PowerGrip Bucket without Tool Holder

Figure 16. Long-Reach Bucket in Tool Holder
3.6 Transfer Mechanism Installation

The Transfer Mechanism will be used to transfer waste bins between B-Cell and the Airlock, and will consists of a rail system and a powered transfer cart as shown in Figure 18. The rail system is designed to allow the B-Cell door to open and close without removal of the Transfer Mechanism. A drawbridge-type design is used to raise and lower a portion of the rails to allow this operation. The Transfer Mechanism will be installed in the B-Cell door frame utilizing existing wall penetrations between the Airlock and B-Cell. Two shield plugs that penetrate from B-Cell in the Airlock pipe-trench (refer to drawings H-3-20272 and H-3-21087) will be removed to install the Transfer Mechanism.

The Transfer Mechanism interferes with the range of motion of the lower REA when operated to excavate soil along the east wall of B-Cell. Therefore, the excavation of soil along the B-Cell east wall will be performed first before the Transfer Mechanism is installed. The B-Cell crane with the special lifting bail (see Figure 20) would be used to transfer waste bins between the Airlock and B-Cell. Section 5.4 discusses soil excavation activities in further detail.

The Transfer Mechanism, fully assembled with the cart and locking through tubes installed, will be placed into the Airlock using the existing REC reverse boom hoist or the rail cart system. The Airlock shield door will be closed after placing the Transfer Mechanism into the Airlock. The B-Cell shield door will be opened and the B-Cell crane used to pick up and position the Transfer Mechanism near a shield-window. An electrical connection passing through a new 8 in. penetration (NCDH-14) in the north wall of B-Cell (refer to ECR-17-001871, 324 Building Radiochemical Engineering Complex Core Drill Modifications Update) will be connected to the bulkhead fittings on the transfer mechanism using an MSM.
After all connections have been made, the Transfer Mechanism will be moved to be centered in the B-Cell door frame. The locking through tubes will be inserted into the 12 in. penetrations below the B-Cell door and moved east until the vertical wall plate is in contact with the B-Cell wall. The Transfer Mechanism will then be lowered so the upper frame structures rest on the door threshold and the lock motors engaged on the locking through tubes. This will tighten the locking pawls against the back of the penetration. The transportation pin can be removed and the rail bridge lowered into the Airlock.

![Figure 18. Transfer Mechanism - Rail in Folded Position](image)

### 3.7 Floor Saw Installation

The floor saw, shown in Figure 29, will be placed into the Airlock using the rail cart system. The Airlock shield door will be closed. The B-Cell shield door will be opened and the B-Cell crane used to pick up and position the floor saw near a shield-window. An existing 4-inch penetration through the south wall of B-Cell (BS010-04) will be used for the electrical and water hose connections to the floor saw, as described in Section 5.2. The floor saw will be positioned on the B-Cell floor and used as described in Section 5.2 to section the stainless steel lined, reinforced concrete floor.
3.8 **A, C, and D-Cell Dams Installation**

Dams must be installed in the shield door openings for A, C, and D-Cells to form a seal to ensure waste does not migrate from the cells into the Airlock during grout addition to each cell. The designs for these dams are in progress. Additional installation information will be added to this document once the dam designs are completed.

3.9 **Lifting Devices Installation**

The following five lifting devices are planned to be used during remote excavation of soil beneath the B-Cell floor:

- Standard Lifting Bail
- Special Lifting Bail
- REA Bin Lifting Tool
- Offset Tool
- Transfer Cart Lifting Device

The Standard Lifting Bail is to be used in the Airlock, A, C, or D-Cells to lift a waste bin. Figure 19 shows the Standard Lifting Bail. The Standard Lifting Bail (weight 56 lbs.) will be placed into the Airlock using the existing REC reverse boom hoist or the rail cart system. The Airlock shield door will be closed. The Standard Lifting Bail will be picked up using the Airlock A/D crane to engage a waste bin, as needed. When not in use, the Standard Lifting Bail will be stored in the Airlock; there is not a 4 in. tool hanger assembly available in B-Cell to store this lifting bail. Additional standard lifting bails will also be procured and installed in C and A-Cell for use in moving waste bins with the crane in each of these cells (PRC-SRP-00089, *Evaluation of the Number of Standard Lifting Bails Required in the 324 Building during Soil Removal Operations*).

![Figure 19. Standard Lifting Bail Attached to Waste Bin](image)
The Special Lifting Bail shown in Figure 20 will be used with the B-Cell crane to lift waste bins. The B-Cell crane with the Special Lifting Bail can be used to hold a waste bin while the upper or lower REA places material into the waste bin. The upper REA equipped with the REA Bin Lifting Tool will be used to hold a waste bin once the lower REA is installed in the cell.

The Special Lifting Bail (approximate weight 199 lb.) will be placed into the Airlock using the existing REC reverse boom hoist or the rail cart system. The Airlock shield door will be closed. The Special Lifting Bail will be picked up using the B-Cell crane to engage a waste bin, as needed. When not in use, the Special Lifting Bail will be stored in the Airlock as there is not a 4 in. tool hanger assembly available in B-Cell to store this lifting bail.

Figure 20. Special Lifting Bail - Used with B-Cell Crane
The REA Bin Lifting Tool is to be used with the upper REA to handle waste bins in B-Cell during soil excavation as shown in Figure 21. The REA Bin Lifting Tool (approximate weight 269 lb.) in the tool holder will be placed into the Airlock using the rail cart system. The Airlock shield door will be closed. The REA Bin Lifting Tool in the holder will be picked up using the B-Cell crane and positioned on the cell floor. The REA will engage the REA Bin Lifting Tool and remove it from the tool holder. The B-Cell crane will place the tool holder onto a 4 in. tool hanger assembly. The REA with the REA Bin Lifting Tool attached will engage a waste bin. When not in use, the REA Bin Lifting Tool will be stored in the tool holder mounted to a 4 in. tool hanger assembly in B-Cell.

![Figure 21. Upper REA with REA Bin Lifting Tool and Waste Bin](image)

An Offset Tool, shown in Figure 22, will not be initially installed but will be used in the event the 3 ton crane in B-Cell fails. The Offset Tool enables the 5.75 ton B-Cell crane to reach the western through support locations for accessing the REAs if the 3 ton B-Cell crane is inoperable. The Offset Tool (approximate weight 2925 lb.) will be placed into the Airlock using the existing REC reverse boom hoist or the rail cart system. The Airlock shield door will be closed. The Offset Tool will be picked up using the 5.75 ton B-Cell crane and positioned in B-Cell to access an REA.

The Transfer Cart Lifting Device, shown in Figure 23, will not be initially installed but will be used in event of cart failure. This lifting device allows for recovery of the Transfer Cart in the event the cart needs to be replaced (e.g., motor failure). The Transfer Cart Lifting Device (approximate weight 258 lb.) will be placed into the Airlock using the existing REC reverse boom hoist or the rail cart system. The Airlock shield door will be closed. The Transfer Cart
Lifting Device will be picked up using the Airlock A/D crane. Hooks on the lifting device will engage with the four trunnions on the cart frame to allow the cart to be lifted away and disposed. A replacement cart will then be placed into the Airlock using the existing REC reverse boom hoist or the rail cart system. The Airlock shield door will be closed. The Airlock A/D crane with the Transfer Cart Lifting Device attached will be used to position the replacement cart on the rails of the Transfer Mechanism. Note: The design of the Transfer Mechanism is being revised and the Transfer Cart Lifting Device may not be needed.
3.10 HVAC Exhaust Dams and Snorkels Installation

There are two zone I exhaust duct openings on the west and east walls in each of A, C, and D-Cells as shown on drawing H-3-20620. There is a single zone I exhaust duct openings on the north wall in B-Cell as shown on drawing H-3-20620. The west exhaust duct opening in A-Cell has a pipe sleeve that was installed into the HEPA filter to create an opening through the filter to enable installation of a duct sprayer device. This pipe sleeve assembly has been removed.

The exhaust ventilation from the REC Cells needs to remain operational to maintain a negative differential pressure between the cells and the galleries and the cells and the Airlock, to reduce the likelihood of contamination migration. A, C, and D-Cells will be filled with waste bins and grout as explained in Section 5.4. If left as-is grout could flow into the exhaust duct openings in each of these cells and potentially flow to the downstream “A” frame filters.

The exhaust duct openings in A, C, and D-Cells need to be sealed and extended above the maximum elevation of waste bins and grout in each cell to maintain a negative differential pressure in each cell and preclude grout from entering the exhaust ducts. Snorkels will be added to each of the exhaust duct openings to extend the exhaust duct above the planned elevation of waste bins and grout in each cell. The bottom Section of each snorkel will be sealed to the exhaust duct opening. A replaceable HEPA filter assembly will be attached to the top Section of each snorkel to maintain exhaust ventilation in each cell. These HEPA filter housings will be replaced periodically as a result of particulate loading caused from activities performed within each cell. A snorkel or other device may be added to the B-Cell filter to reduce the direct intake of fugitive dust generated during grout removal, floor removal, and remote soil excavation.

The design for the HVAC exhaust dams and snorkels is in progress. Additional installation information will be added to this Operations Plan once the HVAC exhaust dams and snorkels designs are completed.

A new HEPA filter assembly (refer to drawing H-3-70479) will be installed on the exhaust duct opening in B-Cell using the in-cell crane after grout and debris has been removed from in front of
the duct opening. The B-Cell exhaust filter assembly will be periodically replaced as a result of particulate loading caused from activities performed within B-Cell (e.g., removal of the grout, debris, cell floor, and soil).

3.11 Water Delivery Hose Assembly Installation

The two water delivery hose assemblies shown conceptually in Figure 24 will be installed in B-Cell, one unit on the south wall and one unit on the north wall, with both positioned above the MSMs on these walls. Each water delivery hose assembly will be placed into the Airlock using the existing REC reverse boom hoist or the rail cart system. The Airlock shield door will be closed after placing the water delivery hose assembly into the Airlock. The B-Cell shield door will be opened and the B-Cell crane used to pick up and position the water delivery hose assembly near a shield window.

![Figure 24. Water Delivery Hose Assembly Concept](image)
The B-Cell crane will be used to insert the long end of the water delivery assembly into a new 6 in. core drill penetration (NCDH-13 and NCDH-15) through the B-Cell north or south wall (refer to ECR-17-001871). A reach rod will be inserted from the gallery through the 6 in. penetration to pull the hose connection from inside the B-Cell wall into the gallery. The hose connection for the water delivery assembly will be connected to a new flow totalizer and to the existing water distribution system within the 324 Building. A branch line and valves after the flow totalizer will also supply water to the floor saw blade.

The flow totalizer will be used to measure the volume of water potentially added to the soil beneath B-Cell. The maximum water application volume is 22,000 gal for a 400-day period. This is the maximum quantity of water that can be added to the B-Cell floor with no likely negative impact to the shallow groundwater following migration of $^{137}$Cs and $^{90}$Sr. A considerable margin of safety is built-in in the calculations due to the highly conservative set of assumptions (ECF-300FF5-17-0019, *Calculations Supporting 324 Building B-Cell Water Application Impact Analysis*). Additionally, it is necessary to avoid (via administrative controls) repeated applications for an extended time interval at the same location. Such recurrent applications include application of 1,280 gal at the same location for a 32-day period or 16,000 gal at the same location for a 400-day period. These are not the expected application scenarios but were analyzed to illustrate the worst-case conditions for moisture movement (ECF-300FF5-17-0019).

The water delivery hose assembly can deliver approximately 5 gpm of water at 80 psig in a fan-pattern spray that can be used to rinse off the exterior of a waste bin, the self-dumping bin, other equipment, or supply water for dust suppression during activities performed in B-Cell.

### 4.0 Mockup Testing and Training

The Mockup is located at 2325 Horn Rapids Road in Richland, Washington and mimics the Airlock and B-Cell areas in the 324 Building, as shown in Figure 25. The Mockup will be used for:

1. Testing to validate/prove the remediation equipment and process design
2. Process and procedure development
3. Training to support personnel in safely and proficiently completing the work
4. Practicing equipment installation/relocation within B-Cell
5. Demonstrating operator proficiency to support readiness objectives
6. Troubleshooting to aid in developing solutions to issues that may develop during operations (PRC-SRP-00107, *300-296 Project Testing and Training Program Plan* and PRC-SRP-00135).
The features of the Mockup include the following:

- A full-scale simulation of B-Cell and the Airlock, with B-Cell concrete walls from −10 ft to a height of 5 ft above the floor, and steel stud walls with sheetrock for the remaining walls to the 14.5 ft elevation.
- The B-Cell mockup includes a stainless steel lined concrete floor similar to the B-Cell floor in the 324 Building
- A single overhead 10-ton crane to simulate the B-Cell crane.
- The Mockup is enclosed in a fabric building with a footprint of approximately 80 by 100 ft
- A gravel parking lot is adjacent to the fabric building
- Temporary trailers will be utilized for the operations control center and operations support

Electrical power and lighting has been provided to the Mockup. Frames have been installed on the north, west, and south walls of B-Cell at the Mockup for mounting MSMs. A pit, similar to the 324 Building pipe trench, has been constructed with two sleeved penetrations for installing the Transfer Mechanism.

The Mockup will provide an essential function to the success of the 300-296 waste site remediation activities. The Mockup will be used to demonstrate the remotely operated equipment and processes that will be employed during soil removal from beneath B-Cell. This will be accomplished by duplicating the intended equipment installation processes, and remote operations process steps as closely as possible from the start of installation through to project completion. All process conditions, steps and operations conducted at the Mockup are to be as close as is possible to the expected operational facility conditions; thereby allowing the intended operators and equipment to interact and allow any necessary additional learning while in a safe and controlled environment. The equipment used in the Mockup will also be available during the project as critical spares to those pieces of equipment located within the 324 Building.
5.0 Operations

Project Operations (formerly Project Technical Services), 324 Facility Operations, Engineering, and Nuclear Safety organizations have been involved from the inception of the project in order to integrate the nuclear safety, construction, and operations point of views into the planning, engineering, and procurement activities of the project. During the design phase, Nuclear Safety and Operations staff provided input to the design to ensure that the construction and operations approach for the project is integrated with the design effort and optimizes the project safety, quality, cost, and construction schedule. This input is verified during the review of drawings and specifications prior to their issuance for construction. Upon completion of site and facility preparation, remediation operations will commence. The following sections provide a summary of planned operations.
5.1 Grout and Fixed Debris Removal

Prior to discovering the B-Cell sump breach, various debris items were stabilized in place in B-Cell with an approximate 6 in. layer of grout (Work Package 324-09-11-06-005). Figure 26 and Figure 27 show the debris in B-Cell prior to and after grout addition. In order to remediate the soil under B-Cell, the debris and the approximate 6 in. layer of grout must first be removed. This will be done by the upper REA using the hydraulic hammer tool and the PowerGrip bucket tool. The grout will be chipped loose and the debris lifted out. Water can be added using the water addition system (see Section 3.11) to suppress dust generation and reduce loading on the in-cell filter assembly. Water addition limitations discussed in Section 3.11 will need to be followed. The hydraulic hammer or PowerGrip bucket is expected to be capable of quickly separating the cold joint interface between the relatively thin grout layer and stainless-steel liner.

Figure 26. B-Cell Before Addition of Grout (30 March 2010)
The upper REA cannot access the entire B-Cell floor area from a single through support mounting location (H-3-318000 sheet 18). In order to remove the existing grout, it will be necessary to relocate the upper REA. This will be done by attaching the crane to the REA lifting eye, disconnecting the hydraulic hoses and through wall supports from outside the cell, and then moving the upper REA to a new location. The through wall supports and hydraulic hoses will be reconnected to the upper REA after repositioning.

Once the grout has been turned to rubble, a self-dumping bin, similar to the unit shown in Figure 28, will be positioned into the cell. The upper REA with the PowerGrip bucket or long-reach bucket attachment will be operated to load grout and debris into the self-dumping bin. Waste bins may also be used to load grout and debris and would be handled in a similar manor as described for the self-dumping tool. A hydraulic shear may also be attached to the upper REA to segment debris into smaller pieces for removal from B-Cell.
Figure 28. Self-Dumping Bin

Once filled, the self-dumping bin will be lifted using the B-Cell crane and the exterior surfaces rinsed off using the water delivery hose assembly (see Section 3.11). Water addition limitations discussed in Section 3.11 will need to be followed. The B-Cell crane will be used to transfer the self-dumping bin to the Airlock, where it will be set down on plastic sheeting on the Airlock floor. The plastic sheeting will be periodically disposed based on radiological surveys to reduce contamination in the Airlock.

The self-dumping bin will be picked up by the A-Cell crane, taken into A-Cell, and set down on the debris pile. The A-Cell crane will lower the bail on the self-dumping tool to unlock the catch, then the A-Cell crane will lift the bail on the self-dumping bin to deposit the grout and debris into A-Cell. The use of the self-dumping bin will allow efficient utilization of the available space within A-Cell.

This process will be repeated until the debris and grout are removed from B-Cell. If the debris is too large to fit within the self-dumping tool, the larger debris can be lifted using the B-Cell crane and placed on plastic sheeting in the Airlock. The Airlock A/D crane will then place the larger debris in A-Cell. The A-Cell crane will be used to position the debris within A-Cell to use the available space efficiently. After the debris and grout are removed from B-Cell, the self-dumping tool will be loaded into a waste box along with other debris, grout added, and the waste box exported from the Airlock for transportation and disposal at ERDF.

5.2 Floor and Liner Removal

A remotely operated concrete cutting saw, equipped with a 30 in. diamond encrusted blade, will be used to segment and size reduce the stainless-steel clad concrete floor. The track-mounted saw, shown conceptually in Figure 29, will be placed into the Airlock using the rail cart system. The Airlock shield door will be closed after placing the saw assembly into the Airlock. The B-Cell shield door will be opened and the B-Cell crane used to pick up and position the floor saw on the cell floor.
The B-Cell crane will be used to pick up the utility umbilical attachment (aka bazooka) and present the bazooka to an existing 4 in. penetration in the south wall of B-Cell (BS010-04). The tee-handled tool is inserted through the 4 in. penetration from the gallery, attached to the utility umbilical, and withdrawn into the gallery. Electrical and water connections are made to the utility umbilical within the gallery. A recirculating chilled water system is connected to the motors and variable frequency drives for the floor saw. Water is also connected to sprays directed to cool the saw blade. Water used to cool the saw blade is discharged into B-Cell (see Section 3.11 for additional discussion on water usage and limitations in B-Cell).

The floor saw is positioned using the B-Cell crane, with the upper REA used to adjust its alignment. The floor saw will be positioned such that one end of the frame will bear against the wall. When a cut is completed, the saw is picked up by the crane and placed in the next position. The process is repeated until a series of intersecting cuts are made extending from all four walls.

Once the floor and liner cutting has been completed, the saw frame will be size reduced using the upper REA and shear tool. The floor saw frame has engineered cut points to facilitate segmenting the frame. The floor saw pieces will be exported to the Airlock where they will be packaged for disposal, if contamination levels permit, or moved to A-Cell.

To contain the soil underneath the floor, operation of the saw is currently planned to cut to a depth of approximately 5 in. into the liner and concrete floor. Since the concrete floor is 6 in. thick tapering to 9 in. thick at approximately 3 ft from the cell wall (see Concrete General Notes on drawing H-3-20198), the planned depth of the saw cuts will not be deep enough to go all the
way through the concrete. However, the depth of the cuts should be sufficient to cut the 6 by 6 in. 1/1 gauge (0.283 in. diameter\(^5\)) welded wire fabric installed in the concrete floor.

The upper REA equipped with the hydraulic hammer will be operated to break free a few of the floor segments. The upper REA equipped with the PowerGrip bucket will be used to lift the floor segments and stage these in B-Cell for loading into the self-dumping bin. Operations may need to alternate between using the upper REA equipped with the hydraulic hammer and the upper REA equipped with the PowerGrip bucket to break free the floor segments. A hydraulic shear may also be attached to the upper REA to cut weld wire fabric or the stainless steel liner. The upper REA will have to be relocated multiple times to facilitate removal of the floor debris.

Once the floor segments have been separated and staged in B-Cell, the upper REA equipped with the PowerGrip bucket will be used to load floor segments into the self-dumping bin. Soil may also be incidentally loaded along with the floor segments into the self-dumping bin. Once filled, the self-dumping bin will be lifted using the B-Cell crane and the exterior surfaces rinsed off using the water delivery hose assembly (see Section 3.11). The B-Cell crane will be used to transfer the self-dumping bin to the Airlock, where it will be set down on plastic sheeting on the Airlock floor. The plastic sheeting will be periodically disposed based on radiological surveys to reduce contamination in the Airlock.

The self-dumping bin will be picked up by the A-Cell crane, taken into A-Cell, and set down on the debris pile. The A-Cell crane will lower the bail on the self-dumping tool to unlock the catch, then the A-Cell crane will lift the bail on the self-dumping bin to deposit the floor segments into A-Cell. The use of the self-dumping bin will allow efficient utilization of the available space within A-Cell. This process will be repeated until the floor segments are removed from B-Cell.

Once the B-Cell debris and floor segments have been moved into A-Cell, a layer of grout will be added in A-Cell to cover the material and provide a level surface for adding waste bins containing soil. It is estimated the grout will extend to the 10 ft elevation inside A-Cell (A-300-296-00131, page 33).

### 5.3 Lower REA Installation

After the floor segments have been removed, the lower REA will be installed in the cell. The lower REA installation will follow the same procedure as described above for the upper REA (see Section 3.4). The preferred installation location for the upper REA would be in either of the eastern locations, whereas the lower REA initially will be installed in the one of the western locations. This will allow the lower REA to perform soil excavation, while the upper REA handles and manipulates waste bins at the Transfer Mechanism. Figure 30 shows the initial orientation of the upper REA and lower REA within B-Cell.

---

As discussed in Section 3.5, all REA tools and holders are initially installed in B-Cell except for the long-reach bucket and holder, due to placement in the cell interferes with operation of the floor saw. After the floor saw is removed from B-Cell, the long-reach bucket and holder will be placed into the Airlock using the rail cart system. The Airlock shield door will be closed after placing the tool and holder into the Airlock. The B-Cell shield door will be opened and the B-Cell crane used to place the tool and holder onto a 4 in. tool hanger. It should be noted that the tool holders can be mounted at any 4 in. penetration location to provide flexibility and avoid interferences with other equipment.

![Figure 30. Initial Configuration of Upper and Lower REAs in B-Cell](image)

### 5.4 Soil Removal

Soil underneath each of the B-Cell walls is remotely excavated. Soil is excavated underneath the east wall first, followed by installation of the Transfer Mechanism and then excavation from the north, west, and south walls. The Transfer Mechanism interferes with access by the lower REA to excavate along the east wall within B-Cell and therefore will not be installed until soil removal from beneath the east wall is completed. The B-Cell crane with the special lifting bail attached will be used to transfer waste bins between B-Cell and the Airlock until the Transfer Mechanism is installed. The waste bin will be handled in a similar manner as described in Section 5.4.1. Both REAs will need to be relocated several times to excavate the contaminated soil remotely.
Radiation measurements of the soil obtained through the geoprobe indicates the highest radiological contamination is located approximately 2 to 3 ft horizontally on either side of the B-Cell floor expansion joint (see Section 1.1). Therefore, the excavation beneath each of the B-Cell walls is started at the expansion joint and the highly radioactive soil is removed horizontally approximately 2 to 3 ft on each side of the expansion joint and vertically to the point where the remaining contaminated soil can be removed by conventional open-air methods or to a maximum depth of approximately 12 ft, which is the limit of the remote excavation equipment design capability (PRC-SRP-00141). Modeling of the radionuclide contamination beneath B-Cell indicates that remote soil excavation may be completed when the $^{137}\text{Cs}$ concentration is approximately $4 \mu\text{Ci/g}$ in the soil and the corresponding modelled transuranic concentration is approximately 7 nCi/g, which is predicted to occur after remotely excavating to a depth of approximately 6 ft (PRC-SRP-CN-O-00108, 300-296 Soil Removal Project, Total Alpha-Emitting Radionuclide Concentration vs. Elevation). Once the transuranic concentration decreases to less than 7 nCi/g (corresponding $^{137}\text{Cs}$ concentration is less than approximately $4 \mu\text{Ci/g}$), conventional open-air excavation may be performed of the remaining contamination in the 300-296 waste site.

Waste bins containing soil excavated from beneath B-Cell will be placed in a radiation assay unit to quantify the $^{137}\text{Cs}$ concentration in soil and determine when the $^{137}\text{Cs}$ concentration in the soil is approximately $4 \mu\text{Ci/g}$. Samples of soil will be obtained from each of the excavation trenches and analyzed to verify the remote soil excavation end-state has been achieved (PRC-SRP-00130). The soil samples will be analyzed to determine the concentration of the radionuclides listed in Table 2. As the soil excavation proceeds beneath each wall, a shielded, radiation detector shown conceptually in Figure 31 will be attached to the B-Cell crane, lowered into the excavation area, and used to verify the highly radioactive soil has been removed.

### Table 2. Isotopic Analyzes for Soil Samples

<table>
<thead>
<tr>
<th>Radionuclide</th>
<th>Radionuclide</th>
</tr>
</thead>
<tbody>
<tr>
<td>$^3\text{H}$</td>
<td>$^{155}\text{Eu}$</td>
</tr>
<tr>
<td>$^{60}\text{Co}$</td>
<td>$^{233/234}\text{U}$</td>
</tr>
<tr>
<td>$^{90}\text{Sr}$</td>
<td>$^{235}\text{U}$</td>
</tr>
<tr>
<td>$^{99m}\text{Tc}$</td>
<td>$^{238}\text{U}$</td>
</tr>
<tr>
<td>$^{129}\text{I}$</td>
<td>$^{238}\text{Pu}$</td>
</tr>
<tr>
<td>$^{137}\text{Cs}$</td>
<td>$^{240}\text{Pu}$</td>
</tr>
<tr>
<td>$^{152}\text{Eu}$</td>
<td>$^{241}\text{Pu}$</td>
</tr>
<tr>
<td>$^{154}\text{Eu}$</td>
<td>$^{241}\text{Am}$</td>
</tr>
</tbody>
</table>
After soil is excavated from beneath B-Cell, grout is added to fill the excavation to the original floor elevation. The excavation is filled with grout to enable future demolition of the 324 Building and remediation of the remaining contamination in the 300-296 waste site. The grout that will be used is being developed (PRC-SRP-00132, Performance Specification 300-296 Remote Soil Excavation Project Cementitious Grout).

Note: The location of the grout delivery system and routing of grout delivery lines remains to be established.

As discussed in Section 1.1, the highest levels of radiological contamination (i.e., greater than 10 R/hr.) beneath B-Cell is generally confined to an area approximately 2 ft on either side of the expansion joint in the B-Cell floor (i.e., a “picture frame” pattern). Table 3 shows the estimated number of waste bins filled by excavating soil in the “picture frame,” assuming no soil sloughing, different excavation depths and widths, filling waste bins to 90% or 100% capacity, and the soil expands by 25% upon excavation. Table 4 shows the estimated number of waste bins filled by excavating the entire area beneath B-Cell, assuming no soil sloughing, different excavation depths and widths, filling waste bins to 90% or 100% capacity, and the soil expands by 25% upon excavation. The volume of soil removed is dependent on the degree of soil sloughing that occurs and distribution of the radionuclides in the soil, both of which will not be known until the time of actual soil excavation.

Following removal of the soil underneath the B-Cell walls in the “picture frame,” the remaining highly radioactive soil is remotely excavated as necessary to enable future open-air remediation of the remaining waste site, which will be performed by a separate project. A shielded, radiation detector will be attached to the B-Cell crane and used to identify the locations of the highly radioactive soil that needs to be removed.
Table 3. Estimated Number of Waste Bins Filled with Highest Radiological Contaminated Soil, Assuming Picture Frame Excavation

<table>
<thead>
<tr>
<th>Excavation</th>
<th>Number of Waste Bins</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Depth (ft)</td>
<td></td>
</tr>
<tr>
<td>Width (feet on each side of expansion joint)</td>
<td>Soil Volume (ft³)</td>
</tr>
<tr>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3</td>
</tr>
<tr>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3</td>
</tr>
<tr>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3</td>
</tr>
<tr>
<td>12</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>

Table 4. Estimated Number of Waste Bins Filled Assuming Entire Area Beneath B-Cell is Excavated

<table>
<thead>
<tr>
<th>Excavation</th>
<th>Number of Waste Bins</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Depth (ft)</td>
<td></td>
</tr>
<tr>
<td>Width (feet beyond expansion joint)</td>
<td>Soil Volume (ft³)</td>
</tr>
<tr>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3</td>
</tr>
<tr>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3</td>
</tr>
<tr>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3</td>
</tr>
<tr>
<td>12</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>

5.4.1 Soil Excavation Sequence

Excavation of the soil beneath B-Cell is conducted in the following sequence. An empty waste bin is loaded onto the Transfer Mechanism using the Airlock A/D crane equipped with a standard lifting bail. The Transfer Mechanism then moves the waste bin into B-Cell where the upper REA, with the bin lifting tool attached, can lift the waste bin and lower it down into B-Cell near the floor. The soil will be loaded into the empty bin using the lower REA with the long-reach bucket attachment. Care will be taken to load the waste bin as cleanly as possible to minimize the spread of contamination. If needed, the exterior of the waste bin can be rinsed to remove loose contamination using the water delivery hose assembly installed in B-Cell.
A portion of soil will become suspended in the air when transferred from the lower REA into the waste bin. Air is exhausted from B-Cell through four in-cell filters attached to a frame on the north wall. Soil particles suspended in the air will be trapped on the in-cell filters. To prolong the life of the in-cell filters and reduce replacement frequency, the waste bin should be positioned as far as practical away from the exhaust filters when being loaded with soil.

When the waste bin is full, it will be lifted back into the Transfer Mechanism using the upper REA equipped with the REA bin lifting tool and then moved into the Airlock. Soil loading into waste bins needs to be maximized to minimize the number of waste bins. Each waste bin will be picked up by the Airlock A/D crane equipped with a standard lifting bail and moved to the radiation assay unit to determine activity level. Once the radiation assay is complete and recorded, the waste bin will be lifted with the Airlock A/D crane, and then taken to A-Cell, if the activity of the soil is sufficiently low. Otherwise the waste bin will be taken to either D or C-Cell.

C and D-Cells will be used to receive waste bins containing higher activity soil. C and D-Cells each have a capacity to hold up to 72 waste bins (PRC-SRP-CN-C-00032, 300-296 Remote Soil Excavation Project 324 Building REC A, C, D Cell Floor Loading Calculation). Waste bins will be moved from the Airlock into D-Cell using the Airlock A/D crane equipped with a standard lifting bail. The Airlock A/D crane will move the waste bin to the open floor hatch between D and C-Cells and lower the waste bin into C-Cell. The C-Cell crane equipped with a standard lifting bail will position the waste bin into rows within C-Cell. A total of up to 24 waste bins will be placed into C-Cell in a single, 4 by 6 layer. C-Cell will be filled with grout up to approximately 3 in. above the waste bins. This will provide a level surface for the next layer of waste bins. The grout delivery system, the grout formulation, and cure time are being developed (PRC-SRP-00132). This process will be repeated for subsequent layers of waste bins. Once C-Cell reaches capacity, the floor hatch will be reinstalled within D-Cell and waste bins will be placed into D-Cell, similar to the process described for C-Cell.

The A-Cell crane equipped with a standard lifting bail will be used to position the waste bins within A-Cell to use the available space efficiently. If the activity of the soil is sufficiently low, the waste bin(s) staged in A-Cell will be placed in a waste package and grout added for shipment to ERDF, as discussed in Section 5.5.

Floor loading calculations indicate A-Cell can store a maximum of 105 waste bins containing soil (PRC-SRP-CN-C-00032) in addition to the existing debris, debris and grout removed from B-Cell, and B-Cell floor segments. A total of 21 waste bins will be placed into A-Cell in a single 7 by 3 layer. Grout will be added to cover over the top of the waste bins by approximately 3 in. to provide a level surface for the next layer of waste bins.
### 5.5 Waste Box Loading

There is limited space within A, C, and D-Cells for storing the higher activity soil and debris. In order to preserve this space for the higher activity soil and debris, as much as practical of the low activity soil and debris should be packaged for transportation and disposal at ERDF.

As discussed in Section 5.4, waste bins containing sufficiently low activity soil or debris will be staged in A-Cell. After a quantity of waste bins containing sufficiently low activity soil have been accumulated within A-Cell, these waste bins will be loaded into a waste package for transportation and disposal at ERDF.

An empty waste package will be brought into the CHA in the 324 Building through the truck dock. The waste package, prototype shown in Figure 32, will be pre-configured with internal cribbing to contain racks to hold wastes bins. The waste package can hold 2, 4, 6, 9, or 12 waste bins. Figure 33 shows the waste package with cribbing configured to hold six waste bins.

![Figure 32. Prototype IP-2 Waste Package](image)
The 30 ton capacity crane in the CHA will be used to move the empty waste package from the truck dock onto the Airlock rail cart in the CHA. The waste package lid will be removed and cribbing configuration verified for the intended loading of waste bins. The cribbing serves to hold waste bins in a fixed geometry within the waste package during grout addition to the waste package. The cribbing may be configured to hold 1, 2, 4, 5, 6, 9, or 12 waste bins inside a waste package (CHPRC-03088, *Procurement Specification for 300-296 Project DOT IP-2 Packaging*). The cribbing configuration will be selected based on the activity level of the waste bin(s) selected for loading (PRC-SRP-CN-O-00061, *300-296 Soil Remediation Project Estimated Soil Bin Dose Rates for Shipping Based on Prototype Waste Box*). The empty waste package will be wrapped in plastic to provide a removable barrier for contamination control on the exterior of the waste package.

The Transfer Mechanism rail will be folded into the B-Cell doorway and the B-Cell shield door closed. If a waste bin is in the radioactive assay unit in the Airlock, it will be lifted with the Airlock A/D crane equipped with a standard lifting bail, and moved to either A-Cell or D-Cell to reduce the radiation dose rate before the Airlock shield door is opened.

The Airlock shield door will be opened and the empty waste package will be moved into the Airlock using the rail cart system. The Airlock shield door will be closed after the rail cart with the waste package is inside the Airlock.

Waste bins will be moved from the staging area within A-Cell using the Airlock A/D crane equipped with a standard lifting bail. The Airlock A/D crane equipped with a standard lifting bail will be used to load waste bin(s) into the waste package. Some of the cribbing inside the waste package may need to be removed using the Airlock A/D crane to load the waste bins. The

---

**Figure 33. Cribbing in Waste Package for Six Bin Configuration**
number of waste bins and orientation in the waste package will be based on the activity of each waste bin and will be predetermined before placing the waste package into the Airlock.

After loading the waste bins and re-installing cribbing (if removed), grout will be added to fill the void space in the waste package. The grout that will be used is being developed (PRC-SRP-00132).

Note: The location of the grout delivery system and routing of grout delivery lines remains to be established.

The grout will be allowed to cure partially to minimize the potential for liquid spillage before the waste package is removed from the Airlock. The Airlock shield door will be opened. Personnel entries will be made into the Airlock to conduct a radiation survey and prepare to remove the plastic wrapping on the exterior of the waste package. The rail cart with the waste package will be withdrawn from inside the Airlock. As the waste package is moved through the threshold of the Airlock shield door, the plastic wrapping on the waste package exterior will be removed by personnel inside the Airlock, keeping the plastic inside the Airlock. Additional survey of the rail cart and waste package exterior surfaces will be performed in the CHA. The CHA crane will be used to install the lid on the waste package in the CHA. Personnel will use a platform to access the top of the waste package to secure the lid fasteners. The CHA crane will be used to move the waste package to a trailer in the truck port. The waste package will be secured to the trailer and then moved to a location nearby the 324 Building where the grout inside the waste package will be allowed to cure to achieve a minimum compressive strength of 3,000 psi (DOE/RL-2001-36, Hanford Sitewide Transportation Safety Document) before transporting to the ERDF.

5.6 Grout Addition to B-Cell

After completing soil excavation beneath B-Cell, a controlled density fill will be added to backfill the excavation to the floor level. The grout that will be used is being developed (PRC-SRP-00132). The location of the grout delivery system and routing of grout delivery lines remains to be established.
6.0 References


PNNL-21214, 2012, *Numerical Modeling of $^{90}\text{Sr}$ and $^{137}\text{Cs}$ Transport from a Spill in the B-Cell of the 324 Building, Hanford Site 300 Area*, Pacific Northwest National Laboratory, Richland Washington


PRC-SRP-CN-O-00061, 2017, 300-296 Soil Remediation Project Estimated Soil Bin Dose Rates for Shipping Based on Prototype Waste Box, Rev. 0, CH2MHILL Plateau Remediation Company, Richland Washington


