Hanford Building 324 REC Hot Cell Decommissioning Approach – 15484

Matt Cole, Kurion

Bryan Flannagan*, Steve Marske**
* Areva Federal Services
** Washington Closure Hanford

ABSTRACT

The 324 Building is a facility located at the Hanford Site and is undergoing decontamination and demolition (D&D) activities by Washington Closure Hanford (WCH). In October 1986, an in-cell leak of approximately 1.3 million curies occurred with a substantial fraction being lost into the subsurface soil beneath the floor of a large hot cell complex. Sampling under the hot cell floor revealed hot spots in the soil and cobble reading in excess of 10,000 R.

In January of 2014, WCH contracted an AREVA lead team with Kurion as primary design agent to remove the B-Cell floor and highly contaminated underlying soils. The objective of this project is to remove the contaminated debris and soil and repackage them into the existing adjacent hot cells for final disposition as monoliths. The approach to this project uses an innovate combination of existing cell equipment, commercial equipment, and special tools to perform a series of completely remote operations. Also, a novel waste handling approach allows all the highly radioactive waste to remain within the existing cells.

The remote handling approach to this project is to use customized off-the-shelf excavators which are mounted and operated remotely inside the cell. These can be moved and replaced remotely with a “Plug-and-Play” connection method. All the cables and utilities for the excavator and tools are managed through this cell connection with connections in a worker-accessible gallery space. The remote excavators are wall-mounted, which frees up the floor for the excavator work. The design also includes a transfer barrier which allows the B-Cell door to remain open during waste transfers while preventing spread of contamination between cells. The project balances the use of existing cell equipment such as cranes and shield doors, with the use of new remote equipment.

Existing equipment will be removed from the floor of the hot cell to adjacent cells. The concrete floor and stainless steel liner will then be remotely cut and removed, revealing the contaminated soil beneath the cell. The contaminated soil will be mixed with grout in the cell using the excavators and then placed in rigid bins. These bins will then be placed in the adjacent cells using existing overhead cranes. The waste containers allow optimal utilization of the limited adjacent hot cell space and improve the characteristics of the final waste monolith package. The system will use each bin once which significantly decreases the risk of contamination spread.

The project includes a full-scale mockup facility in which all installation and operational activities will be tested and proven prior to hot cell construction activities. The mockup facility will also be used for operator training before actual hot work starts. This facility will remain available for use during operations with a full set of spares for redundancy and to support operations modeling during construction and remediation activities.

INTRODUCTION

The 324 Building is a non-reactor, Hazard Category 2 nuclear facility located in the 300 Area of the U.S. Department of Energy (DOE) Hanford Site, located near Richland, Washington. The building is undergoing deactivation, decommissioning, decontamination, and demolition by Washington Closure Hanford (WCH) under the River Corridor Closure Contract. During the Cold War Era, the facility was used for chemical and radionuclide processing associated with nuclear weapons production.

Historical records indicate that in October 1986, approximately 516 L of a concentrated liquid waste stream containing cesium-137 and strontium-90 was spilled onto the floor of B-Cell. B-Cell is located in the Radiochemical Engineering Complex (REC) of the 324 Building. This spill contained approximately 1.3 million curies of radioactivity. A fraction of the spill was recovered; however, an unknown quantity was released into the soil beneath the 324 Building through an undetected breach in the B-Cell floor sump. Unknown quantities of water were used after the spill to wash items contained in B-Cell. A portion of this water, including entrained contaminants, was likely released through the undetected breach in the floor sump. When B-Cell was taken out of service, wastes being removed from B-Cell were placed in Grout Containers (GCs) and stabilized using a particulate grout. In the course of grouting activities, grout was spilled on the floor of B-Cell, eventually filling the sump. Figure 1 provides a schematic reference of the overall 324 Building.

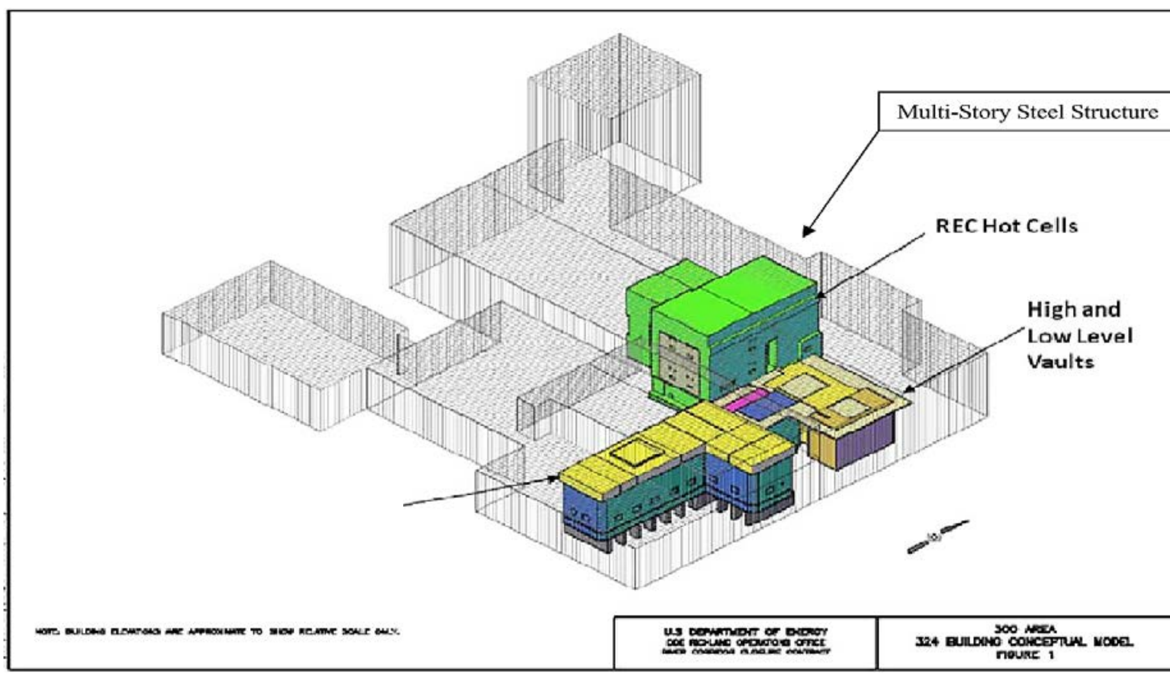

Figure 1. Overview of radiochemical engineering complex hot cells inside 324 Building

DISCUSSION

The primary scope of this project is to design, test, and implement a process capable of removing and isolating contaminated soil below B-Cell. This remediation effort has been divided into two removal zones identified as the primary and secondary removal zones. Based on current assumptions and estimates, the primary phase of this cleanup effort will remove roughly 5,525 ft^3 of highly-contaminated materials. B-Cell debris, particulate grout, and the floor slab and liner comprise about 750 ft^3 of the total. The remaining 4,775 ft^3 will be contaminated soil.

In the event contamination levels are discovered above the expected levels at completion of primary excavation, a secondary removal zone has been identified. The secondary zone comprises 1,700 ft^3 of sand and cobble soil. Figure 2 provides a rough depiction of the distribution of contaminated materials.

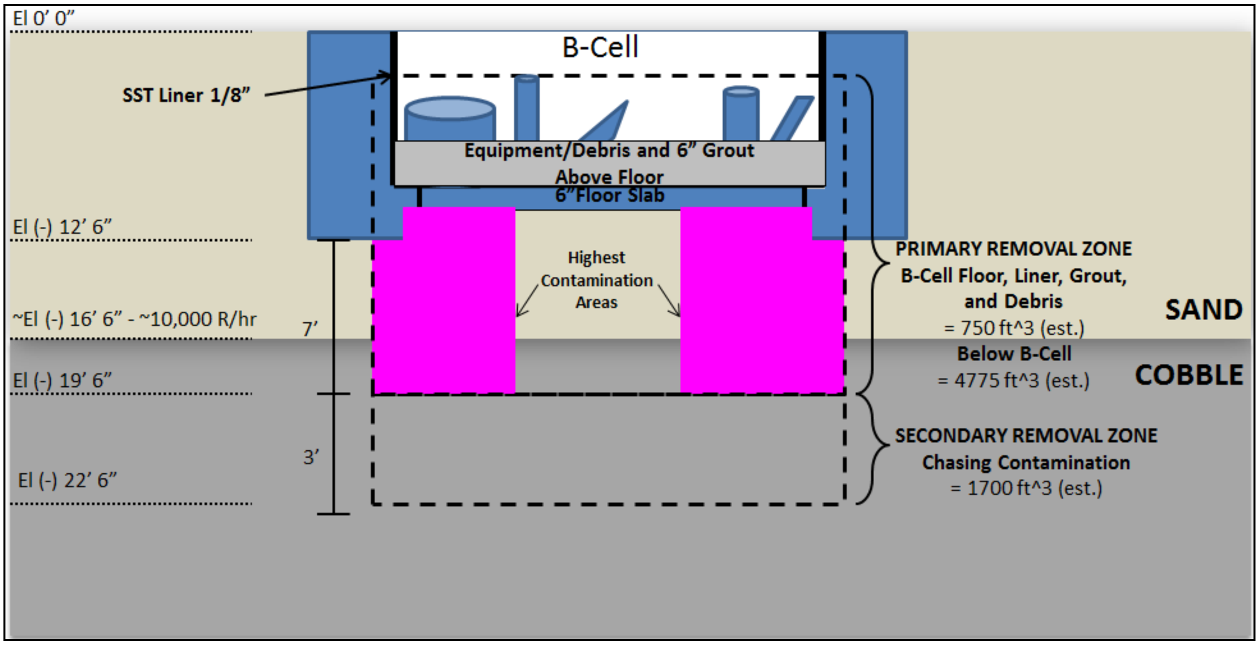

Figure 2. Sketch of anticipated contamination area

Prior to performing the remediation process, various activities must be performed to prepare the REC facility for remediation. Those activities include:

- Loose debris removal or relocation
- Cell sealing
- C-Cell floor modifications
- A-Cell retrofit for the upper monolith floor
- Building stabilization
- Soil stabilization
- Equipment installation

Structural Stabilization

In order to execute soil remediation, excavation is required under the existing B-Cell floor. The REC requires structural stabilization prior to initiating the soil removal activities, due to undermining of the foundation during remediation. This safeguard is accomplished by installing a structural stabilization system along the west wall of B-Cell. Figure 3 shows the major components of the stabilization system including spreader beam, footing, and tension rod assembly.

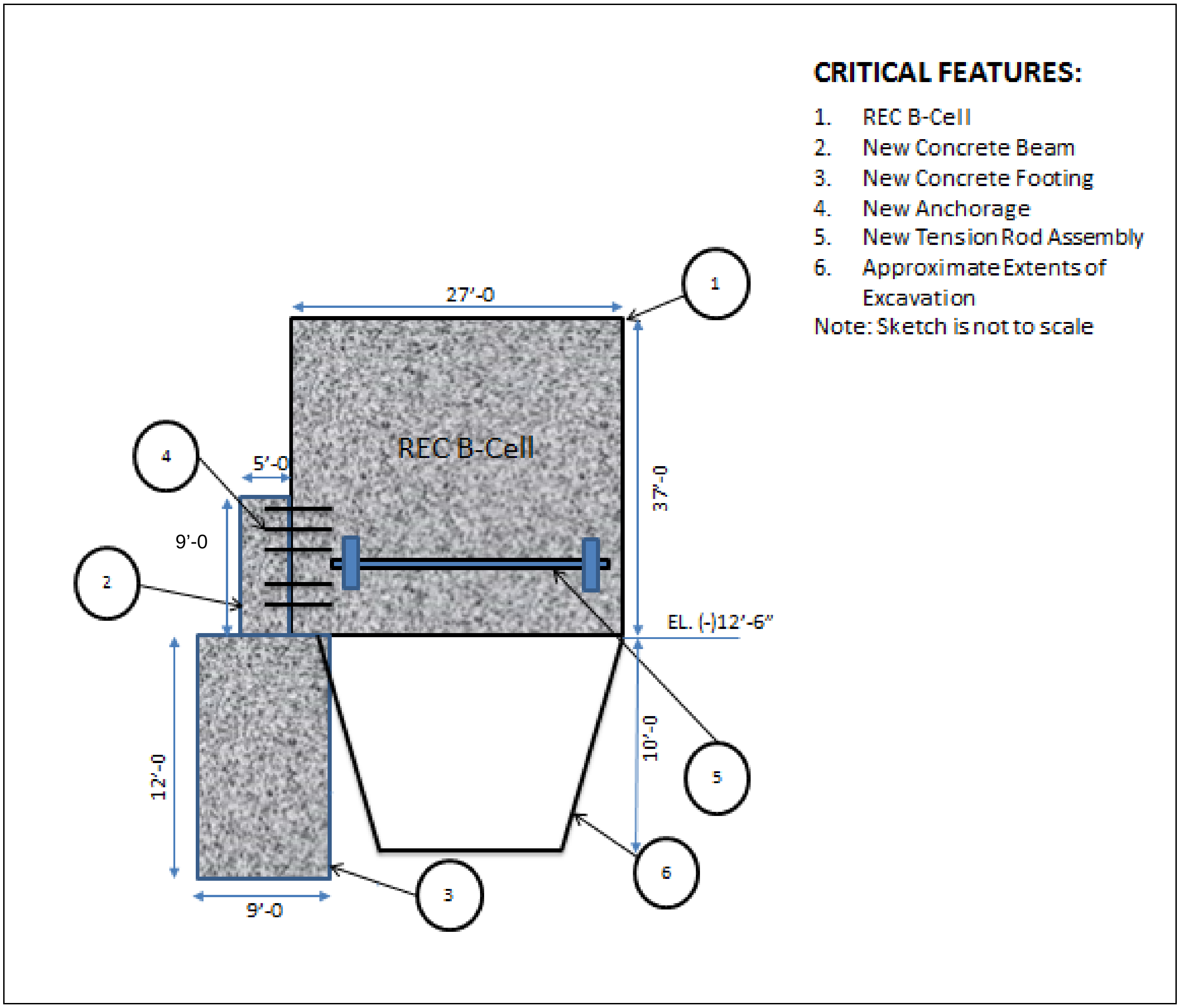

Figure 3. Diagrammatic view of structural stabilization components

A small commercial excavator (Brokk Model 160) will primarily be used to support debris removal, size reduction, and waste packaging operations in the Airlock (Figure 4). In addition, the Brokk can be used to support size reduction activities in A, C, and D-Cells. The Brokk's secondary function will be to serve as a backup to the primary equipment operating in B-Cell and assist with demobilization of equipment at the end of the project.

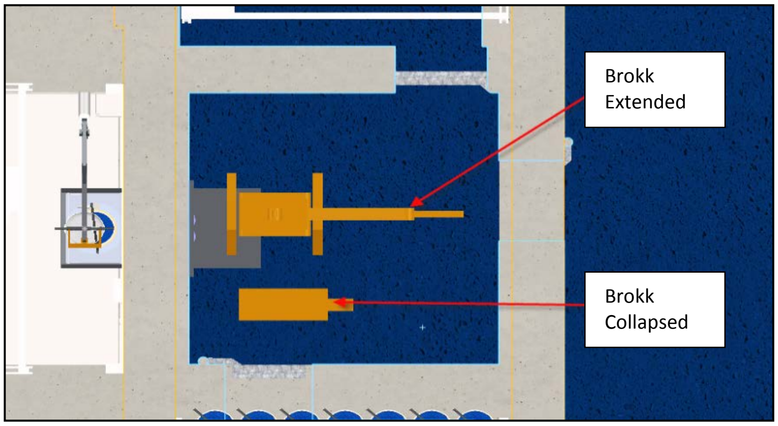

Figure 4. Brokk® footprint in the airlock

Equipment Installation

There will be four Remote Excavator Arm (REA) mounting locations within B-Cell with three penetrations each, as shown in Figure 5 for the South wall. These penetrations are located just above the 0-ft elevation on the north and south walls of B-Cell. There will be a total of twelve bores, each with an approximate 12-in. diameter. The two bottom penetrations will be used for structural support while the upper one will be used for routing hose to the REA.

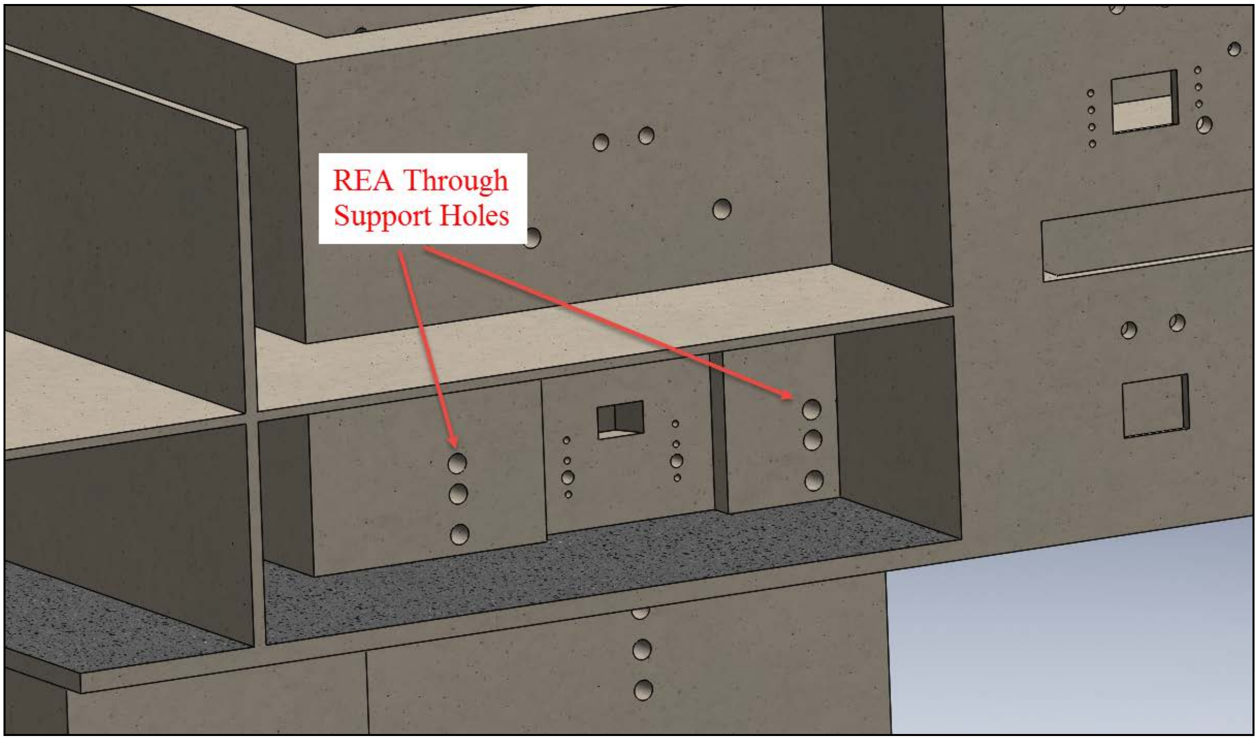

Figure 5. Remote excavator arm penetrations

The transfer barrier is placed into the airlock with the reverse boom hoist. The transfer barrier primary purpose is to shuttle waste packaged from the B-Cell to the airlock. It sits in the B-Cell door frame and has a cart and rail system that moves waste packages between the two cells. (Figure 6).

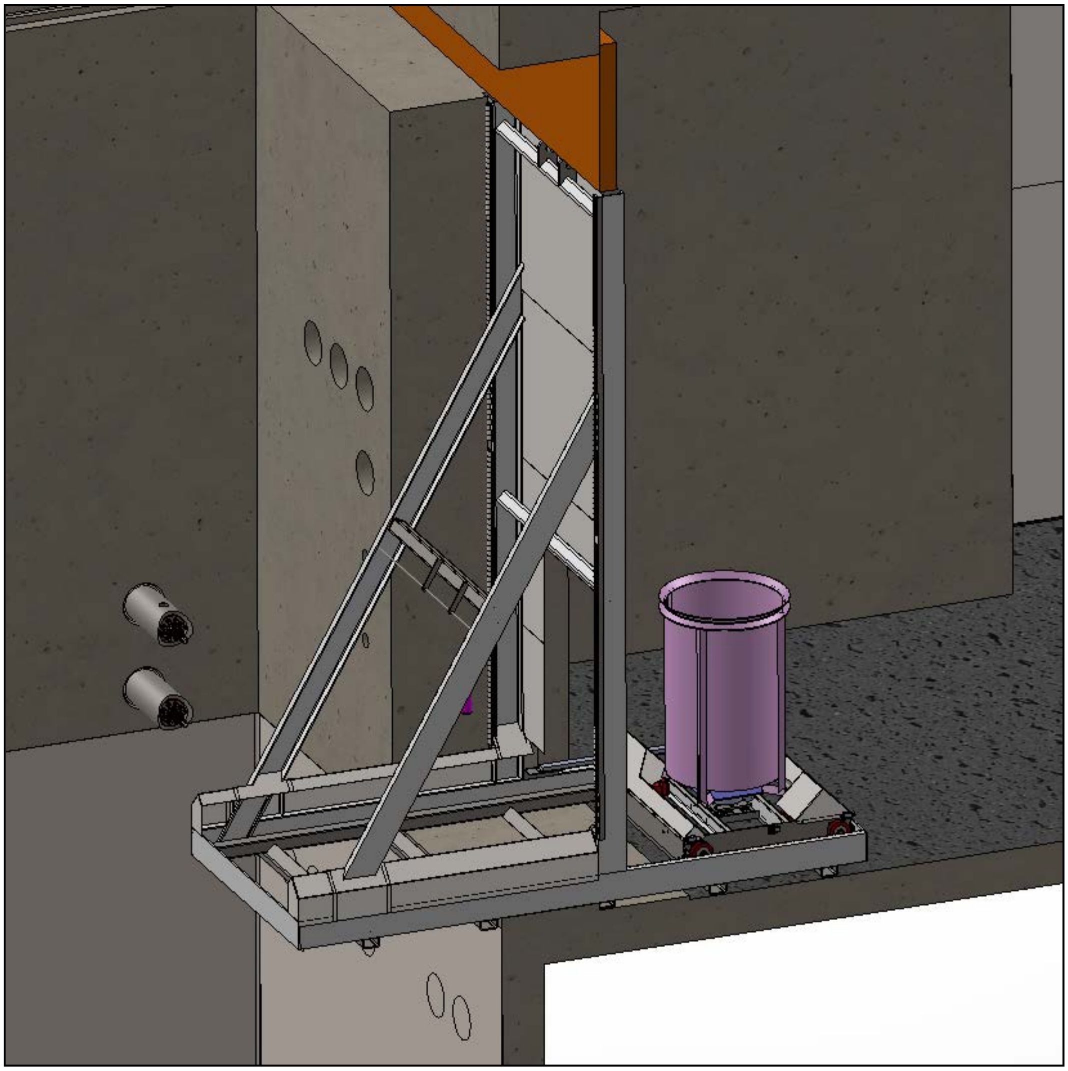

Figure 6. Transfer barrier installed in the B-Cell doorway

Floor Debris Removal

Prior to discovering the B-Cell sump breach, various debris items were stabilized in place in B-Cell with a layer of particulate grout (Figure 7). In order to remediate the soil under B-Cell, the debris and layer of particulate grout must be removed. This will be done by the Upper REA using a hammer or bucket tool. The grout will be chipped loose and stockpiled in areas away from the corners of B-Cell to allow for future installation of the Lower REA. The hammer or bucket will be capable of quickly separating the cold joint interface between the relatively thin grout layer and stainless steel liner.

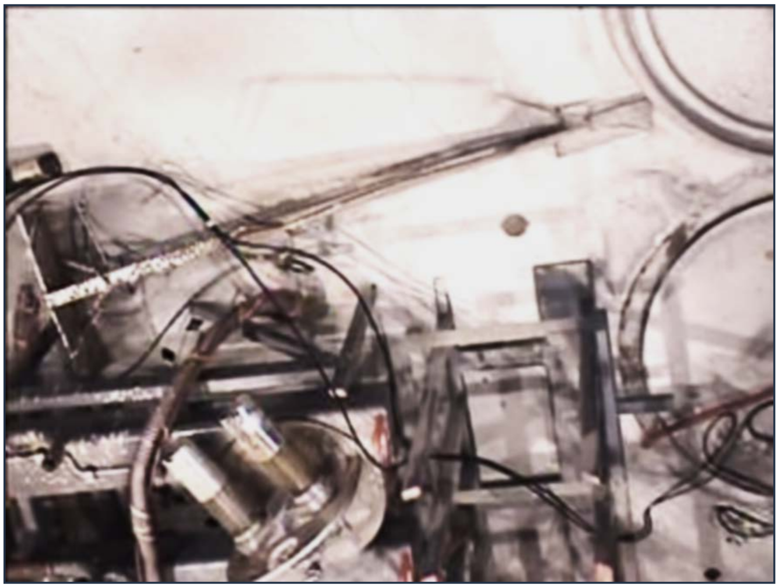

Figure 7. Fixed debris in B-Cell

After the debris is removed, the remaining equipment can be installed, which includes upper and lower REAs, tools, and floor saw.

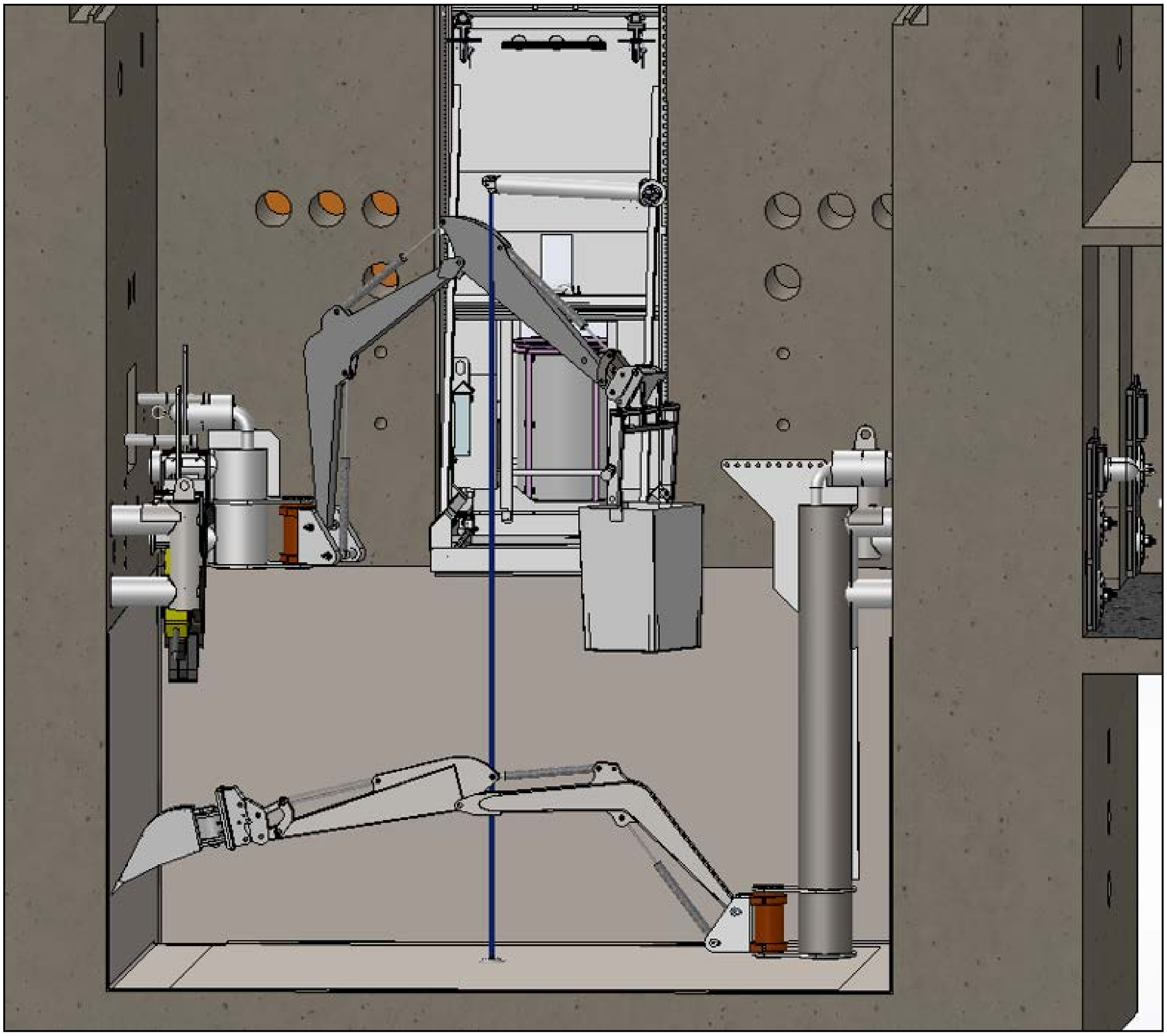

Figure 8. Initial equipment configuration

Floor 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 (Figure 9). The track-mounted saw will be attached to a lifting fixture to be positioned using the B-Cell crane. One of the REAs can be used to adjust the saw alignment. The fixture will be positioned, such that one end of the frame will bear against the wall. The saw will cut from the wall toward the center of the room. The frame is long enough to cut over half the span of the cell. When a cut is completed, the saw is picked up and placed in the next position. The process is repeated until a series of parallel cuts are made extending from all four walls. The resulting floor sections are approximately 2 ft^2. The resulting blocks will be loaded into waste bins by the REA for movement through the transfer barrier.

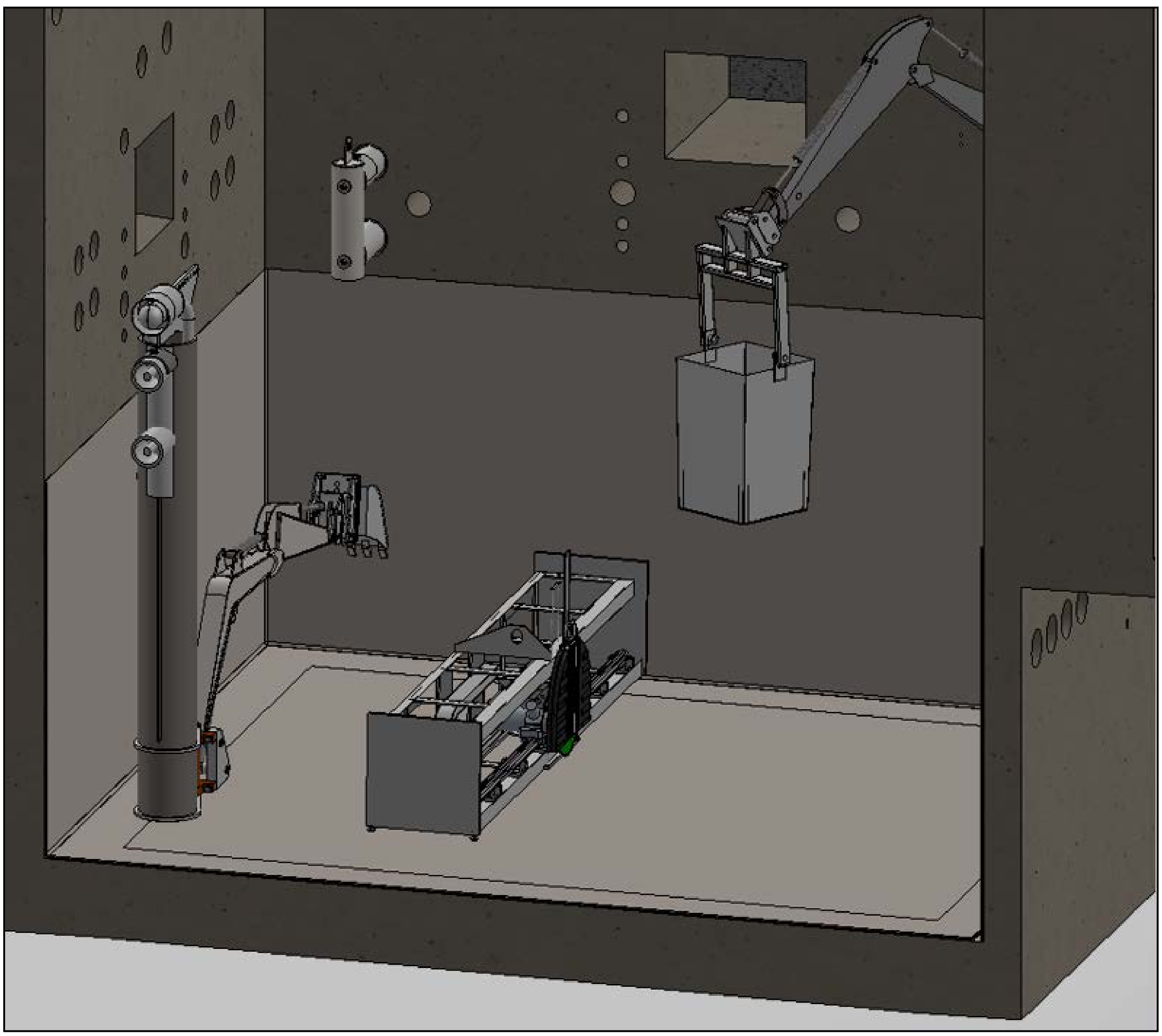

Figure 9. Saw cutting floor

Soil Removal

For the primary material removal, waste bins will be installed into the B-Cell which have dry grout. These bins will be placed into the transfer barrier using the cranes in the airlock. The transfer barrier moves the waste bin to B-Cell where the Upper REA can then lift the waste bin down near the B-Cell floor. This grout will be dumped into a mixing bin, and loose soil will be added. Water will be added when the right mixture has been obtained, and the REA will mix it into a grout. The wet mixture will then be placed into the waste bin (Figure 10).

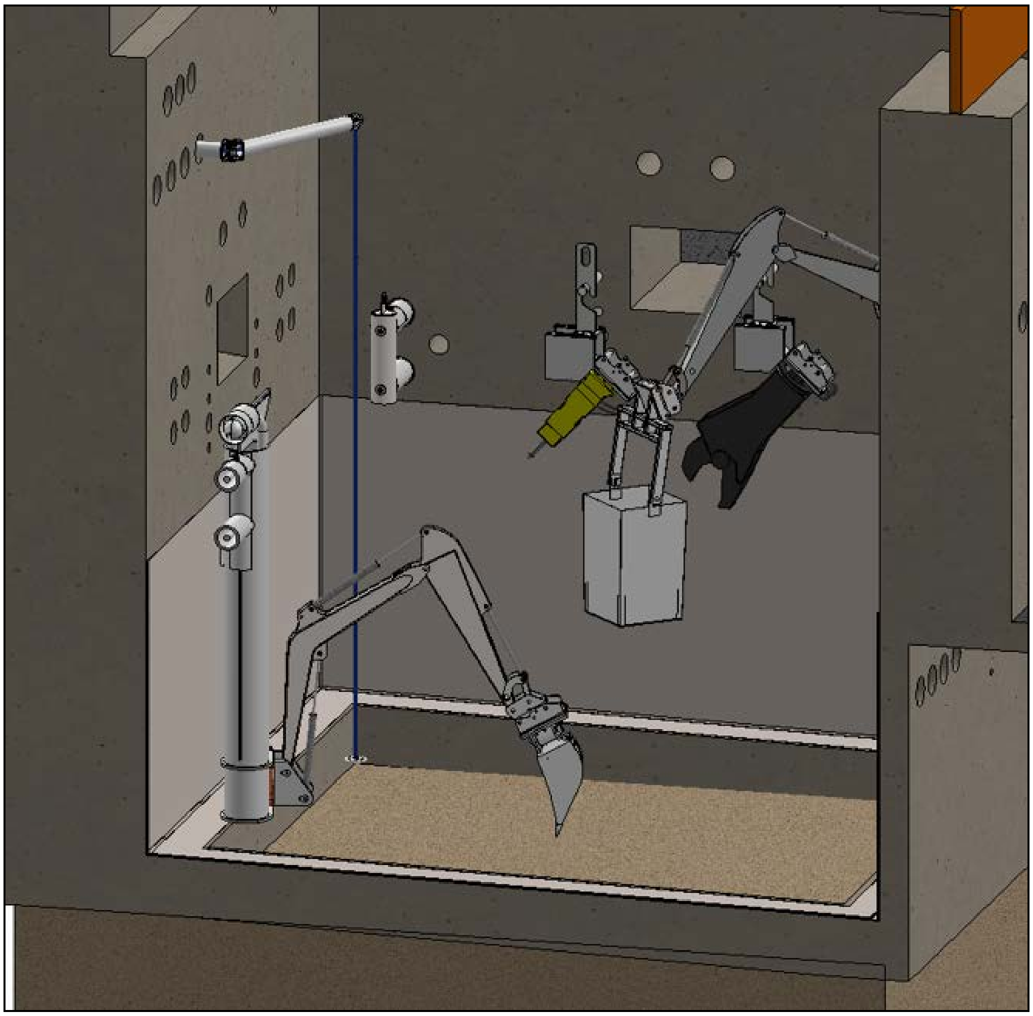

Figure 10. Grout applied to soil surface

The waste bin will then be moved to the airlock side of the transfer barrier, and lifted with the A/D crane. Immediately after the filled waste bin is removed, the A-Cell crane will be used to place a new empty waste bin into the transfer barrier.

The filled waste bin will then be lifted into D-Cell and lowered down the open hatch into C-Cell. Once released by the A/D crane, the C-Cell crane will then be used to position the waste bin within C-Cell.

Mockup evaluation will finalize this waste loading approach; however, the current intent is to cover the C-Cell floor in a single tier of filled waste bins. The waste bins will initially be spread out on the floor in an upright position. After the initial tier of waste bins is in place, the void regions between the waste bins will be filled with a flowable structural (3,000 psi) particulate grout to encase the waste bins. Grout will have to reach 1,500 psi strength prior to placing the next lift of material. Figure 11 shows a partially filled cell with immobilizing grout to encase the filled waste bins. This cell loading process is repeated until the cell is filled with as many waste bins as can be achieved using the cell cranes.

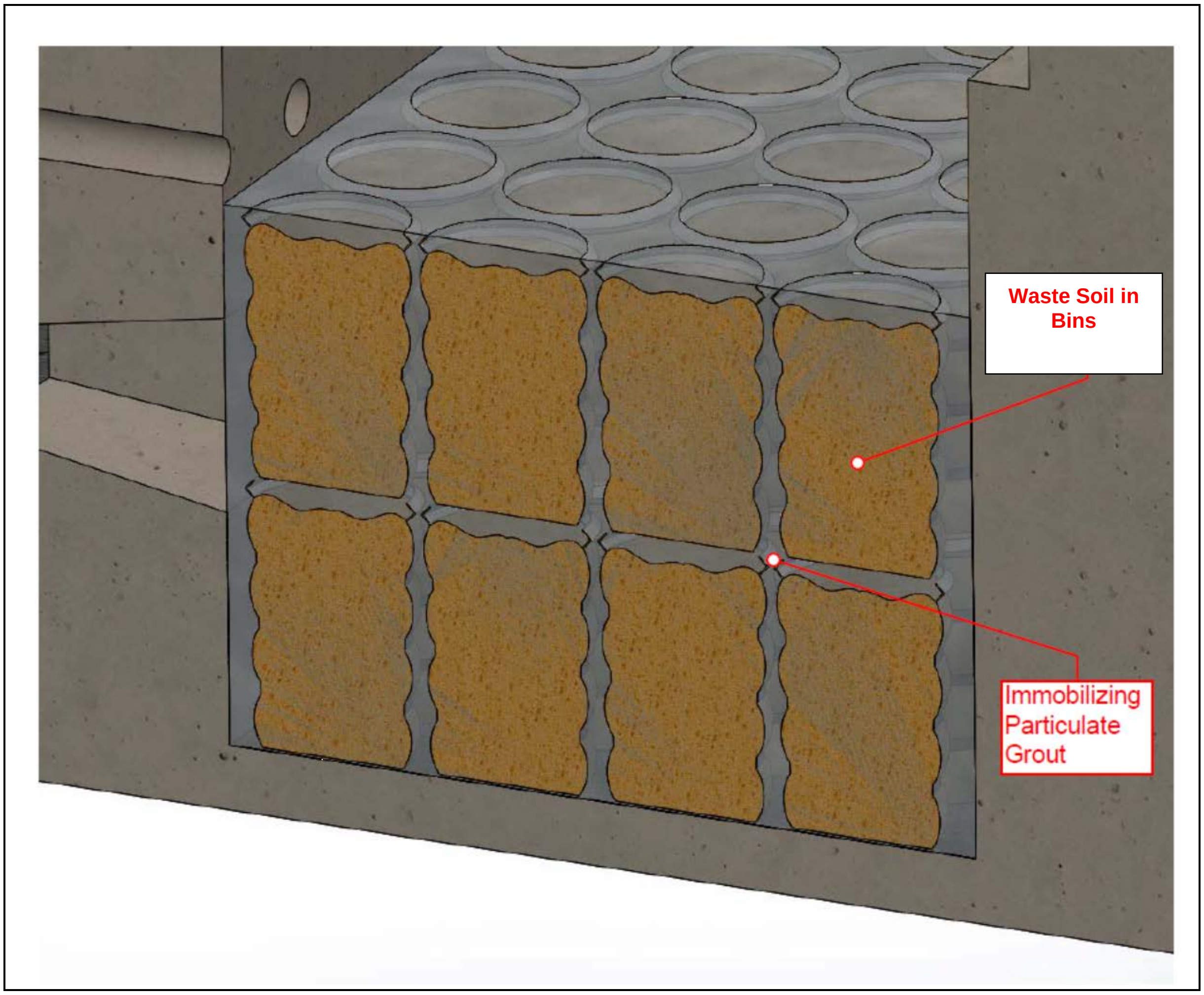

Figure 11. Partially filled cell

When all the soil has been removed, the B-Cell excavation space will be backfilled with controlled-density-fill (CDF).

The majority of existing cell debris will be packaged and shipped to the Environmental Restoration Disposal Facility (ERDF) to maximize the available space within the REC for contaminated soil. Contaminated soil will be stabilized with grout, transferred to C and D-Cells, and lastly A-Cell, and grouted in place. Additional soil which exceeds the available space in A, C, and D-Cells will be packaged separately and shipped to ERDF. Under a separate contract, a wire saw will be used to cut the cells into segments, or monoliths. The monoliths will be lifted using an overhead gantry crane or jacking equipment, and placed on multi-wheeled trailers that will be rolled to ERDF.

REFERENCES

ACKNOWLEDGEMENTS
AREVA Federal Services
Washington Closure Hanford, LLC
Department of Energy