Completion of the Removal, Packaging and Disposal of Hanford 327 Building Hot Cells at the Hanford Site, Washington, USA - 11566

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ABSTRACT

The Department of Energy (DOE) Hanford Site 327 Building, built in 1953, played a key role in reactor material and fuel research programs. The 327 Building, previously a Category 3 nuclear facility, is in the final stages of below grade demolition activities. Under the River Corridor Closure Contract (RCCC), Washington Closure Hanford (WCH) is performing deactivation, decommissioning, decontamination and demolition (D4) for the 327 building, which included the pre-demolition removal of eleven primary hot cells within the building. These include hot cells “A through I” located on the main floor of the 327 Building “canyon” and the two Special Environmental Radio Metallurgy (SERF) cells located in an annex room (Upper SERF) and the basement (Lower SERF).

INTRODUCTION

The 327 Building is located in the 300 Area of the Hanford Site and performed its designed mission from 1953 to 1996. The building was designed to provide shielded, ventilated, and specially equipped laboratories (hot cells) for physical and metallurgical examination and testing of irradiated fuels, concentrated fission products, and structural materials in support of operational efforts carried out at Hanford. The primary operating area on the main floor includes a canyon area and connecting bays where auxiliary operations were performed. The 327 Building is a single-story structure with a partial basement. Maximum dimensions are 65.6 m (215 ft) by 43 m (140 ft) and 9.8 m (32 ft) in height. The total work area of the building is approximately 2,340 m^2 (25,200 ft^2) with 930 m^2 (10,000 ft^2) of laboratory and work areas, 195 m^2 (2,100 ft^2) of offices, 223 m^2 (2,400 ft^2) of storage areas, and 975 m^2 (10,500 ft^2) of common areas containing ventilation and auxiliary equipment.

Hot cells “A through I” are constructed of up to a dozen or more interlocking cast iron components (Figure 1). Of the 10 cells located on the first floor, 5 are elevated above the floor slab on steel corner posts, 4 are located directly on the steel-reinforced concrete floor slab and 1 (Upper Special Environmental Radio Metallurgy (SERF)) is mounted on a concrete pedestal that rises 2 feet above first floor slab elevation and is constructed of steel plate. Cell weights range from approximately 36 metric tons (40 tons) to 159 metric tons (175 tons) and the final packaged cells ready for shipment will range from 68 metric tons (75 tons) to 209 metric tons (230 tons).

The SERF Cell is a sealed enclosure that provides radiological containment/confinement. Nitrogen was supplied to the SERF Cell and was recirculated and exhausted through the HEPA-filtered exhaust system. The pressure inside the SERF Cell is maintained negative relative to that of the canyon. The nitrogen system has been removed from the facility and the SERF Cell now has an air atmosphere.

The SERF Cell's lower storage area (lower SERF) is located in the basement, is constructed of steel-reinforced concrete with a steel liner and is connected by a transfer tube to the operating area (upper SERF). A manipulator was provided to permit positioning and retrieval of materials in the storage area. Three storage racks are located in the cell, on the wall opposite of and on the two walls adjacent to the operating face of the cell.

Figure 1. First Floor Layout Before/After Hot Cell Removal

WORK ACTIVITIES

After nearly a year and a half of field activities, ten of the eleven hot cells have been removed from the facility. Only the lower SERF remains in the basement and this hot cell will be removed in the spring of 2011 using a conventional track mounted crane. The field activities associated with the removal of the hot cells were broken down into four main activities:

1) Hot cell cutting and coring
2) Hot cell removal and packaging
3) Loading hot cells on transport vehicle
4) Transportation and unloading of hot cells at disposal facility

Hot cell cutting and coring activities:

Before the hot cells could be removed from the building they were first unattached from the primary facility structure. The first step in this process was to remove all exposed piping and miscellaneous equipment from the cells. For cells B, C, D, E and I this operation was much simpler due to the fact that these cells rest on four pedestal legs which allowed all of the support piping and ductwork to be removed from between the cell and the floor using traditional methods and tools. These cells were then simply unbolted from the floor rather than physically separated from the building.

The remainder of the cells rested directly on the floor so an alternative method was chosen to separate these cells from the building structure. The decision was made to use a diamond embedded wire (Figure 2) to cut the cells free. This method would pull the 3/8" wire through the cell at floor level separating the cell from the rest of the building. Wedges were installed as the cut progressed in order to prevent the cell from crushing the cutting wire as the cut progressed to completion. This method proved to be quite effective and was completed in a timely manner. As cutting progressed it was discovered that many of the cells rested on shim packs that are believed to have been used to help level the cell during installation. These shim packs would often cause the cutting wire to jam and on a few occasions actually break the wire. Other items such as process piping, ventilation ductwork and grout were easily cut through using the diamond wire.

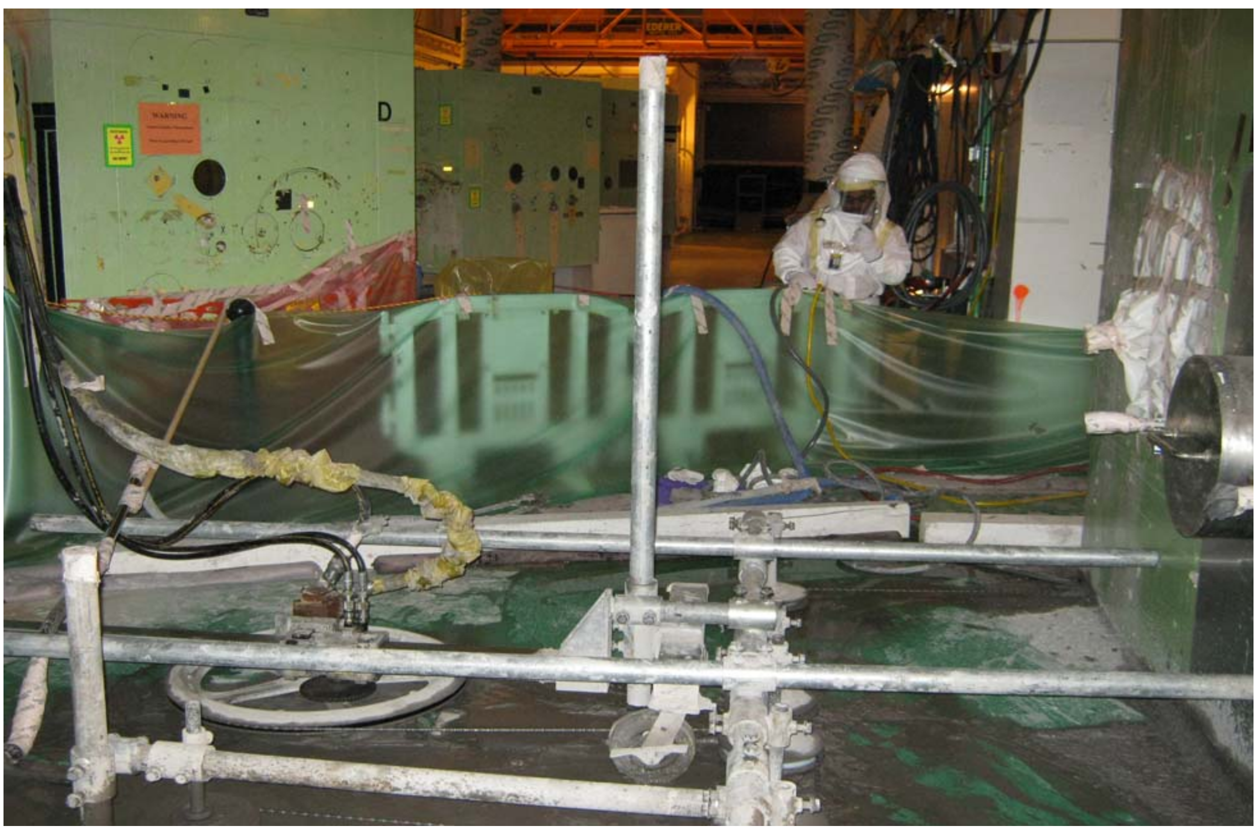

Figure 2. Wiresaw Cutting of Upper SERF

In support of wire cutting and future rigging points, several concrete cores were drilled through the Upper and Lower SERF Cells. These cores ranged from 15 cm (6 inch) to 1.8 m (6 ft) in total length and from 5.1 cm (2 inch) to 10.2 cm (4 inch) in diameter. Prior to several of these cores being drilled the project injected grout into hollow 20.3 cm (8 inch) stainless steel pipes that would be drilled through in order to prevent these pipes being filled with cooling water and presenting a contamination control problem later on when the cells were moved for packaging and disposal. A total of 15 cores were drilled using diamond embedded drill bits.

The water used to cool the diamond wire and bits was collected through a vacuum system and recycled in order to reduce the overall waste water that would need to be disposed. The water vacuumed into 208 liter (55 gallon) drums and then transferred into two 1136 liter (300 gallon) settling tanks. Once the sediment in the water had settled to the bottom of the tanks, this water was transferred into an 1893 liter (500 gallon) feed tank. The water from the feed tank was pumped to the drill and wire saw equipment as cooling water and once again collected and recycled.

Hot cell removal and packaging activities:

In order to install the first floor canyon temporary gantry system that was used to lift the hot cells from the floor, several facility modifications had to be completed. These modifications included removal of several hundred feet of highly contaminated piping and ventilation ductwork from the basement to allow for the installation of twenty 108,862 kg (240,000 pound) capacity shoring stands. These stands were strategically located in the basement under the gantry joint locations to add additional support to the canyon concrete floor. The shoring stands were placed on 3 m (10 ft) x 2.4 m (8 ft) x 0.3 m (1 ft) shoring mats and used to lift 226.8 kg (500 pound) header beams snug to the underside of the canyon floor.

Prior to the installation of the gantry system, the entire east wall of the canyon was removed to allow for the placement of up to 13,608 km (30,000 pound) gantry rail sections into the building. A temporary 9.1 m (30 ft) x 12.2 m (40ft) plastic curtain was installed to help prevent any contamination spread from inside the building to the environment. The roughly 91.4 m (300 ft) of gantry rails that was installed into the building were placed by use of both an external mobile crane and the facility overhead crane. The rail sections were placed as far into the facility as possible using the mobile crane and then in order to get the rail sections completely into the facility a dual pick was accomplished by using both the mobile and facility crane. Once enough rail sections were in place, additional sections were placed on Hilman rollers on top of the newly placed rail sections and pushed into the building and placed using only the facility crane.

In addition to the 91.4 m (300 ft) of rail installed inside the facility, another 121.9 m (400 ft) of gantry rail was installed outside of the building. Once the rail installation was complete four 363 metric tons (400 ton) capacity hydraulic gantry legs with two 7.6 m (25 ft) header beams were installed onto the rail system.

Once the gantry system was installed and tested, each cell had four lifting haunches installed. The lifting haunches were bolted to each cell using existing bolt holes from the original cell construction process. Jacking haunches were attached to the header beams on the gantry system and used to lift the cell for rotation and movement out of the facility onto a stainless steel plate built into the bottom skid section of the disposal package (Figure 3). Once the hot cell was placed onto the skid, the gantry system was disconnected from the jacking haunches and moved back into the facility. After a thorough contamination survey was completed, the four disposal package steel walls were erected and bolted to the skid with gasket material placed between all connecting surfaces. The package lid was then temporarily installed to prevent rain and dirt from entering the disposal package until all of the cells were removed and packaged outside of the building.

Figure 3. Removal of Hot Cell from Building

Once all of the hot cells were located outside of the facility and package construction was completed a grouting campaign was be initiated. Grouting of the interior cell void spaces and areas between the exterior cell surfaces and the interior disposal package walls was completed for hot cells F, G, H and I. The grout was poured in alternating cell interior and external lifts to prevent cell windows and access ports from being pushed out of the cell due to internal grout pressure. In addition, three levels of whalers were installed on the outside of the package to prevent the package from bulging due to grout pressures. These disposal packages were filled to within 2.5 cm (1 in) from the top and then the package lid was re-installed and bolted in place with gasket material between the sealing surfaces.

After grouting was completed for hot cells F, G, H and I it was discovered that condensate water from the concrete curing process was leaking past the gasket installed between the lower package skid unit and the package walls. This small quantity leak, which ranged from a drop every couple of minutes to a drop every couple of hours continued for several days. Attempts to seal the leaks included using RTV, roof patch material, elastic tape and even JB Weld were unsuccessful for the most part. The final path forward was to enclose these cells and all future cells to be shipped inside of a soft sided IP-1 certified waste package and to change from using a concrete grout mix to using a four part high strength epoxy mix to fill the void space between the exterior of the cell wall and the interior of the package wall. In addition, the package lids were modified to allow for grouting of the cell interiors at ERDF without the need to re-open the packages.

Loading hot cells on transport vehicle activities:

Once the hot cells were packaged outside of the building they were individually loaded onto a 12-axle transporter for disposal using the gantry system installed to the east of the 327 Building. The gantry system was attached to the disposal package lifting points and the package was lifted high enough to be moved over the transporter and lowered between a heavy duty longitudinal restraint system. Each hot cell was bolted to the transporter and the restraint system was moved into position and locked into place to ensure that the disposal package would not move during transportation of the cells to the Environmental Restoration Disposal Facility (ERDF).

Transportation and unloading of hot cells to disposal facility activities:

Each disposal package was individually transported the approximate 41.8 km (26 miles) to the ERDF. Due to on-site shipping restrictions the transport vehicle had a maximum speed limit of 16.0 km (10 miles) per hour and could only be on the road between the hours of 7:00 p.m. and 5:00 a.m.

Once the hot cells reached the disposal facility they were unloaded using a second gantry crane system that was assembled inside of the ERDF (Figure 4). This required the construction of an additional 61 m (200 ft) x 15.2 m (50 ft) compacted gravel pad and a large additional area for support equipment. Once all of the hot cells were off-loaded, both gantry systems were de-mobilized and the hot cells buried in place using standard heavy equipment.

Figure 4. Packaged Hot Cell on Transporter at ERDF

<u>Path Forward:</u>

As of the end of 2010, all wiresaw and coring activities associated with the 327 Hot Cells has been completed and all Hot Cells except Lower SERF have been removed from the building and disposed of at ERDF. With the completion of the above grade demolition of the 327 Facility work will begin on the removal of the below grade portions of the building. Demolition activities will occur around the Lower SERF and once it is exposed it will be removed from the excavation using a traditional track mounted crane and transported to ERDF for disposal.