Removal Action Report for Decommissioning of the TRA-632 Hot Cells

October 2012
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U.S. Department of Energy
DOE Idaho Operations Office
ABSTRACT

This Removal Action Report describes the non-time-critical removal action taken to bring the TRA-632 Hot Cells at the Idaho National Laboratory Site to the end state selected in the Action Memorandum for Decommissioning of the TRA-632 Hot Cells, as evaluated in the Engineering Evaluation/Cost Analysis for Decommissioning of the TRA-632 Hot Cells.

Actions taken that contributed to the TRA-632 Hot Cells end state consisted of removing and disposing of asbestos, lead, mercury, polychlorinated biphenyls, and mixed and low-level radioactive wastes. The hot cell building was demolished to the top of the slab, and the three hot cells were removed. The majority of the waste was disposed of at the Idaho Comprehensive Environmental Response, Compensation, and Liability Act Disposal Facility at the Idaho National Laboratory Site.

The selected remedy addressed only the removal of the building and hot cells. Additional Voluntary Consent Order actions were conducted in coordination with this removal action to address Hazardous Waste Management Act/Resource Conservation and Recovery-regulated lines below the building slab. Upon completion of removal of these lines and the hot cells, radiologically contaminated soil remained at the bottom of the excavations. Both the Action Memorandum and the Voluntary Consent Order Plan state that contaminated soil is outside the scope, but that it must be managed by the Idaho Cleanup Project Comprehensive Environmental Response, Compensation, and Liability Act (CRECLA) Program. However, as a matter of convenience and while the excavations were open, samples of these soils were collected. Evaluation of the analytical results for these samples is the responsibility of the Idaho Cleanup Project CERCLA Program and will be included in the New Site Identification Form to be submitted to the CERCLA Agencies as part of their scope of work.

The building footprint then was covered with clean fill, rolled, and graded to provide a temporary cover while the CERCLA Program evaluates the need for institutional controls or remedial action. In the interim, the temporary cover provides sufficient protection to be protective of human health and the environment.
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ACRONYMS

ARAR applicable or relevant and appropriate requirement
ATR Advanced Test Reactor
CERCLA Comprehensive Environmental Response, Compensation, and Liability Act
COC contaminant of concern
D&D deactivation and decommissioning
DEQ Idaho Department of Environmental Quality
DOE U.S. Department of Energy
EE/CA engineering evaluation/cost analysis
EPA U.S. Environmental Protection Agency
HWMA Hazardous Waste Management Act
ICDF Idaho CERCLA Disposal Facility
ICDWL Idaho CERCLA Demolition Waste Landfill
INL Idaho National Laboratory
NTCRA non-time-critical removal action
OU operable unit
RAR removal action report
RCRA Resource Conservation and Recovery Act
ROD record of decision
SRPA Snake River Plain Aquifer
TRA Test Reactor Area
TSCA Toxic Substances Control Act
VCO Voluntary Consent Order
WAC waste acceptance criteria
Removal Action Report for Decommissioning of the TRA-632 Hot Cells

1. INTRODUCTION

This Removal Action Report (RAR) describes actions taken to bring the Test Reactor Area (TRA) Hot Cells (TRA-632) located within the Advanced Test Reactor (ATR) Complex at the Idaho National Laboratory (INL) Site to a final end state. Deactivation and decommissioning (D&D) work began in September 2009, and final demolition of the TRA-632 facility was completed in January 2012.

This RAR addresses the TRA-632 Hot Cell Building and the three hot cells contained within it. The TRA-632 Building was removed down to the slab, and the three hot cells contained in the building were removed and disposed of at the Idaho Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Disposal Facility (ICDF). No hazardous substances remain above the slab at the former location of the TRA-632 Hot Cell Building.

1.1 Purpose and Objective

This RAR describes actions taken under the non-time-critical removal action (NTCRA) recommended in the Action Memorandum for Decommissioning of the TRA-632 Hot Cells (DOE-ID 2009a). This RAR also confirms that actions taken under the removal action were consistent with Alternative 3 (selected alternative), as evaluated in the Engineering Evaluation/Cost Analysis (EE/CA) for Decommissioning of the TRA-632 Hot Cells (DOE-ID 2009b). The selected alternative includes demolishing the TRA-632 Building to the top of the slab and removing and disposing of hot cells at the Idaho CERCLA Disposal Facility.

This RAR demonstrates that actions taken met—and were consistent with—the removal action objectives in the TRA-632 Action Memorandum that were derived from the remedial action objectives in the Final Record of Decision (ROD) for TRA Operable Unit (OU) 2-13 (DOE-ID 1997) and support the overall remediation goals established through the Federal Facility Agreement and Consent Order (DOE-ID 1991). Radiological soil contamination discovered underneath the TRA-632 Building slab and the three hot cells will be addressed using the CERCLA new site identification process.

This RAR also discusses actions taken under other regulatory programs that contributed to the final end state of the TRA-632 Building and the three hot cells.

1.2 Removal Action Objectives

The OU 2-13 remedial action objectives were developed in accordance with the National Contingency Plan and the CERCLA (42 USC § 9601 et seq.) remedial investigation/feasibility study guidance. The OU 2-13 remedial action objectives were defined through discussions among the U.S. Department of Energy (DOE), the U.S. Environmental Protection Agency (EPA), and the Idaho Department of Environmental Quality (DEQ) (i.e., the Agencies). The OU 2-13 remedial action objectives are based on results of the human health risk assessment and are specific to the contaminants of concern (COCs) and exposure pathways developed for OU 2-13. The TRA-632 removal action objectives were derived from the OU 2-13 remedial action objectives.
1.2.1 Protection of Human Health and the Environment

The TRA-632 removal action objectives were developed for the protection of human health and the environment and are:

- Inhibit direct exposure to radionuclide COCs that would result in a total excess cancer risk greater than 1 in 10,000 to 1 in 1,000,000 for current and future workers and future residents
- Inhibit ingestion of radionuclide and nonradiological COCs by all affected exposure routes (including groundwater, soil, and homegrown produce ingestion) that would result in a total excess cancer risk greater than 1 in 10,000 to 1 in 1,000,000 or a hazard index of 1 or greater for current and future workers and future residents
- Prevent unacceptable internal exposure of biota that would result in the lack of maintenance or recovery of healthy local populations/communities of ecological receptors that are or should be present at or near the site.

1.2.2 Contaminants of Concern

The TRA-632 Action Memorandum identified radiological constituents as the COCs for the actions specified in this NTCRA, i.e., the removal of the TRA-632 Building and hot cells. The primary radiological COCs were Co-60, Cs-137, Eu-152, Eu-154, Eu-155, Fe-55, Ni-63, and uranium isotopes. The TRA-632 Action Memorandum determined that nonradiological constituents posed no unacceptable risk to the future residential receptor, groundwater, or an ecological receptor.

1.2.3 U.S. Department of Energy Remediation Goals

In addition to the TRA-632 removal action objectives described in Section 1.2.1, the selected alternative incorporated the DOE goal of reducing the risk footprint by consolidating wastes, as practicable, in ICDF and reducing surveillance and maintenance costs on legacy buildings and structures.

1.3 Chronology of Events

D&D of TRA-632 began in September 2009. Work was completed in January 2012 when the hot cells’ footprints were backfilled, and a cover of clean soil and gravel was applied over the slab of the TRA-632 Building. Table 1-1 lists the chronology of major events that led to the TRA-632 final end state.

<table>
<thead>
<tr>
<th>Date</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>September 2009</td>
<td>Finalized TRA-632 Hot Cells EE/CA (DOE-ID 2009b)</td>
</tr>
<tr>
<td>December 2009</td>
<td>Approval of TRA-632 Action Memorandum (DOE-ID 2009a)</td>
</tr>
<tr>
<td>January 2010</td>
<td>Began asbestos abatement of the TRA-632 Hot Cell Building</td>
</tr>
<tr>
<td>March 2010</td>
<td>Removed accessible hazardous materials from inside Hot Cell 1 and Hot Cell 2</td>
</tr>
<tr>
<td>January 2011</td>
<td>Hot Cell 1 was grouted to below the large observation windows</td>
</tr>
<tr>
<td>February 2011</td>
<td>Removed 22,700 R/hr canister from Hot Cell 3</td>
</tr>
<tr>
<td>August 2011</td>
<td>Began TRA-632 building demolition</td>
</tr>
<tr>
<td>September 2011</td>
<td>Hot Cell 1 monolith removed and transported to ICDF</td>
</tr>
<tr>
<td>Date</td>
<td>Activity</td>
</tr>
<tr>
<td>----------------</td>
<td>---------------------------------------------------------------</td>
</tr>
<tr>
<td>December 2011</td>
<td>Completed removal of underlying soils from hot cell footprints</td>
</tr>
<tr>
<td>January 2012</td>
<td>Area graded and covered with clean soil</td>
</tr>
</tbody>
</table>

EE/CA  Engineering evaluation/cost analysis
ICDF  Idaho CERCLA Disposal Facility
2. BACKGROUND OF THE TRA-632 HOT CELLS

2.1 Location

The TRA-632 Hot Cells were located at the ATR Complex in the west-central portion of the INL Site (see Figure 2-1). The hot cells were located in the TRA-632 Building (see Figures 2-2 and 2-3). Historically, the ATR Complex was called the Reactor Technology Complex and before that was originally known as the Test Reactor Area.

Figure 2-1. Map of the Idaho National Laboratory Site showing the location of the Advanced Test Reactor Complex and other major INL Site facilities.
Figure 2-2. Location of TRA-632 Hot Cell Building at the Advanced Test Reactor Complex.

Figure 2-3. TRA-632 Building.
2.2 History

The TRA-632 Hot Cell Facility was constructed in 1952–1953 and was the first hot cell facility built at the INL Site. The facility was designed and built for the U.S. Atomic Energy Commission by the H. K. Ferguson Company of San Francisco, California. Hot Cell 1 was used primarily for the remote examination of fuel, reactor hardware, and irradiation experiments from the Materials Test Reactor. Hot Cell 1 was equipped with a hoist, manipulators, periscopes, metallographic machines, tools for cutting and etching, a mounting press, ultra-sonic cleaners, and polishing wheels.

In 1958–1960, the construction of the Engineering Test Reactor and the increase in irradiation experiments necessitated the expansion of the TRA-632 Hot Cell Facility to include two additional hot cells. This hot cell extension was constructed by the H. K. Ferguson Company. These additional hot cells (Hot Cell 2 and Hot Cell 3) were designed to provide different radiological shielding. Hot Cell 2, known as the “light cell,” was designed primarily for metallographic examination of irradiated materials, which included gamma scanning, photography, and optical metallographic. Hot Cell 3, known as the “heavy cell,” was designed to function much like Hot Cell 1 and could support examination of fuel and reactor hardware.

As the mission at the ATR Complex changed with the shutdown of both the Materials Test Reactor and Engineering Test Reactor, the hot cells’ usage was expanded to also include processing radioisotopes from fuel elements and target materials generated within the Advanced Test Reactor, including cobalt-60 and iridium-192, for use in radiography and other medical procedures, such as cancer treatment.

Final D&D of TRA-632 began in 2009 and was completed in 2012 under the Idaho Cleanup Project, performed by CH2M-WG Idaho, LLC. The cleanup contract was overseen by the U.S. Department of Energy Idaho Operations Office.

2.3 Descriptions

TRA-632 was a slab-on-grade structure with exterior walls that were generally constructed of 12-in. pumice blocks tied in with structural steel framing. The roof was built-up with tar and gravel over insulation and precast concrete slabs supported on bar joists and steel beams. The facility consisted of a main floor and an upper mezzanine level as illustrated in Figure 2-4. The height of the building in the hot cell region was nominally 15 ft 10 in. Enclosures for the external charging ports into Hot Cell 1 and Hot Cell 3 were added after the original construction. The exterior walls of the enclosures were constructed of 8-in pumice block. A steel-sided truck bay was attached to the east side of TRA-632, with truck access to the building via a vertical sliding door (see Figure 2-3).

TRA-632 Hot Cell Building contained three separate shielded hot cells with an associated truck bay, operating gallery, service area, office space, dark room, and change room. Each hot cell was equipped with separate exhaust systems designed to maintain the hot cell at negative pressure to minimize the spread of airborne radioactivity from inside the cell. The exhaust systems were located above the ceiling of the respective cells on the mezzanine level.
2.3.1 Hot Cell 1

As shown in Figure 2-4, Hot Cell 1 was located on the east side of the TRA-632 Building. The east wall of Hot Cell 1 formed part of the exterior wall of the original building. The inside dimensions of Hot Cell 1 were 14 ft × 6 ft 6 in., with a ceiling height of 13 ft 4 in. The floor was constructed of high-density concrete measuring 3 ft 2 in. thick. The hot cell ceiling was constructed of high-density concrete measuring 2 ft 6 in. thick. The walls were constructed of high-density concrete measuring 4 ft thick. The entire cell interior (i.e., floor, walls, and ceiling) was lined with a 1/4-in. carbon-steel plate. Hot Cell 1 was equipped with one floor drain. Incandescent and mercury-vapor light bulbs provided in-cell lighting.

Hot Cell 1 had three large shielded windows on the north wall and one small shielded window on the west wall. All shielded windows, except for the one at the western-most north wall position, consisted of a zinc bromide and water solution layered between leaded shield glass. The western-most north wall window had been replaced with a mineral oil-filled leaded shield glass unit. Personnel access to the hot cell was through two sliding shield doors in the south wall. Multiple penetrations on the north and west walls supported installation and use of master-slave manipulators, periscopes, and other cell access needs. A hand-operated transfer drawer was on the west end of the cell. Also, a charging port was on the east side of the cell. An enclosure covered the area around the charging port. Figure 2-5 is a historic photograph of Hot Cell 1.
2.3.2 Hot Cell 2

As shown in Figure 2-4, Hot Cell 2 was located in the center of the TRA-632 Building between Hot Cell 1 and Hot Cell 3. The inside dimensions of Hot Cell 2 were 18 ft 6 in. long × 8 ft wide, with a ceiling height of 13 ft. The walls were constructed of ordinary concrete and were nominally 2 ft 9 in. thick. The roof and floor were constructed of ordinary concrete measuring 2 ft 4 in. thick. The hot cell floor and interior walls were lined with 1/4-in. carbon-steel plate from the floor to a minimum height of 6 ft above the floor. This cell could be divided into two equal-sized subcells by means of a 6-in.-thick, motor-driven, steel door, which moved horizontally on a floor track.

Hot Cell 2 was equipped with two floor drains (one in each subcell). A metallographic cave was located on the east wall of the hot cell that allowed visual examination of specimens under magnification to approximately 2,000 power. A scanning electron microscope cave was located on the west wall of the hot cell that provided for examining specimens at a resolution of approximately 1 micron. Both caves were lead lined to provide radiological shielding from the specimens moved inside for examination. Incandescent and sodium-vapor light bulbs provided in-cell lighting for Hot Cell 2.

Hot Cell 2 had four shielded windows on the north wall and one on the west wall. All shielded windows were leaded glass and filled with mineral oil. Personnel access to the hot cell was through two pairs of 9-in., carbon-steel, single-swing doors on the south wall. Various penetrations were located in the north, east, and west walls of the hot cell that supported installation and use of master-slave manipulators and other cell access needs. Figure 2-6 is a historic photograph of Hot Cell 2.
2.3.3 Hot Cell 3

As shown in Figure 2-4, Hot Cell 3 was located in the west end of the building. The west wall of the hot cell formed part of the exterior wall of the original building. The inside dimensions of Hot Cell 3 were 20 ft 6 in. long × 10 ft wide, and had a ceiling height of 12 ft 10 in. The south and west walls of the hot cell were constructed of ordinary concrete, measuring 5 ft 6 in. thick. The north and east walls were constructed of high-density concrete measuring 4 ft thick. The hot cell roof and floor were constructed of ordinary concrete, with the ceiling measuring 3 ft 6 in. thick and the cell floor measuring 2 ft thick. The hot cell interior, including the floor and the walls, was lined with 1/4-in., carbon-steel plate from the floor to a minimum height of 6 ft above the floor. This cell could be divided into two equal subcells using a 6-in.-thick, motor-driven, steel door.

Hot Cell 3 was equipped with two floor drains (one in each subcell). Hot Cell 3 had four shielded windows on the north wall and one on the east wall. All shielded windows were leaded glass filled with mineral oil. Personnel access to the hot cell was through two pairs of 18-in., carbon-steel, single-swing doors located on the south wall. Various penetrations were located in the north and east walls of the hot cell and supported installation and use of master-slave manipulators and other cell access needs. A hand-operated transfer draw was located on the east end and provided access into the “cold” side of the cell. Incandescent and sodium-vapor light bulbs provided in-cell lighting. Figure 2-7 is a historic photograph of Hot Cell 3.
Figure 2-7. Hot Cell 3.
3. DECOMMISSIONING ACTIVITIES FOR THE TRA-632 HOT CELL FACILITY

This section describes the TRA-632 building demolition as well as removal and disposition activities associated with Hot Cell 1, Hot Cell 2, and Hot Cell 3.

3.1 TRA-632 Building Demolition

Prior to demolition of the TRA-632 Hot Cell Building, hazardous materials were removed from the building. The hazardous materials removed and disposed of at an offsite disposal facility consisted of electronics, light fixtures (i.e., light bulbs, balusters), zinc bromide solution removed from three of the 14 shielded windows, mineral oil removed from the remaining 11 shielded windows, silver zeolite filter media, lead shielding, asbestos, etc. (see Figures 3-1 and 3-2). Upon completion of the building strip out, a polymeric coating was applied to the interior surfaces of the TRA-632 Building to minimize the spread of any radiological contamination.

A portion of the south wall of the TRA-632 Building was supported with steel posts so that this wall would remain standing after the roof was removed (see Figure 3-3). This portion of the south wall provided a radiological and construction barrier for the TRA-632 demolition activities from the Battelle Energy Alliance, LLC-occupied TRA-653 Building that houses a fabrication shop and offices and is located just south of the TRA-632 Hot Cell Building (see Figure 2-2). The Hot Cell Building was removed, with the exception of a portion of the south wall, around each of the three hot cells to allow heavy equipment greater access to the hot cells (see Figures 3-4 and 3-5). Upon removal of Hot Cell 1, Hot Cell 2, and Hot Cell 3, as discussed in the subsequent sections, the south building wall was removed (see Figure 3-6). Demolition debris from the TRA-632 Building was disposed of on the INL Site at ICDF or the Idaho CERCLA Demolition Waste Landfill (ICDWL).

Figure 3-1. Workers removing a manipulator from a hot cell.
Figure 3-2. Workers preparing the TRA-632 Hot Cell Building for demolition.

Figure 3-3. Workers installing the support posts for the south wall of the TRA-632 Building.
Figure 3-4. Heavy equipment demolishing the TRA-632 Hot Cell Building.

Figure 3-5. TRA-632 Building being demolished around the three hot cells.
3.2 Hot Cell 1 Demolition

In accordance with the Action Memorandum (DOE-ID 2009a), Hot Cell 1 was disposed of on the INL Site at ICDF. In order to place the hot cell into ICDF, it was necessary for the radiological and chemical constituents to be within acceptable levels, as defined by the ICDF Waste Acceptance Criteria (WAC) (DOE-ID 2010). Due to the physical configuration of Hot Cell 1 with only one set of doors into the cell and the radiological levels inside greater than 1,000 R/hr, manned entries inside the cell to remove hazardous materials were not feasible. Therefore, remote reach tools and the manipulators were utilized to remove hazardous materials to the extent accessible and practicable from Hot Cell 1; this waste was disposed of as Resource Conservation and Recovery Act (RCRA)-hazardous waste at a permitted disposal facility off the INL Site. The removed hazardous waste included mercury-vapor light bulbs and lead in the form of manipulators, shield glass, shot, putty, plugs, and bricks. Figure 3-7 shows Hot Cell 1 after strip out was complete.

To reduce the radiological levels inside the cell, Hot Cell 1 was grouted to the bottom of the large observation windows (see Figure 3-8). The radiological dose inside Hot Cell 1 was reduced from greater than 1,000 R/hr to less than 2 R/hr, with a radiological hot spot of 34 R/hr. Because of this radiological dose, open-air demolition of the upper portion of Hot Cell 1 was deemed unfeasible. Due to the radiological hazards that caused the demolition strategy for Hot Cell 1 to change, the remaining hazardous materials located inside the cell were deemed impracticable to remove. These hazardous items included a poured lead plug associated with the inside portion of the transfer drawer, seven 1,000-watt mercury-vapor light bulbs, two lead bricks, and a lead sheet, resulting in approximately 482 lb of lead and 3.86E-03 lb of mercury remaining inside Hot Cell 1.
Figure 3-7. Hot Cell 1 after waste materials were removed.

Figure 3-8. Grout pour to the bottom of the large observation windows inside Hot Cell 1.
After the initial partial grouting of the hot cell and prior to lifting the hot cell, the interior surfaces of the cell were sprayed with a polymeric coating for radiological contamination control. All penetrations into the cell were sealed in preparation of the transport to ICDF. Finally, Hot Cell 1 was separated from the concrete building slab with a 40-in. circular concrete saw (see Figure 3-9). The floor slab and underlying soils immediately adjacent to the hot cell were removed to allow access to the exterior wall of the hot cell for installation of the lifting fixtures. These removed materials were CERCLA low-level waste, along with the other debris generated from the D&D of TRA-632, and disposed of in the ICDF landfill. As the sliding shield doors and concrete were being removed, a significant radiation field of 7 to 200 R/hr was exposed in the concrete seam located under the door and floor slab. For worker protection, a steel frame was installed so that approximately 127.5 lead bricks and seven lead blankets could be mounted in front of the door seam. This lead shielding reduced the radiation field to manageable levels (less than 500 mR/hr) while not interfering with the lifting fixtures.

In order to lift and transport the 1.2-M-lb hot cell as a single monolith to ICDF, a massive set of lifting fixtures was designed and fabricated. The lifting fixtures and hardware alone weighed approximately 40,000 lb. The lifting fixtures were attached to the hot cell by 2 to 2½-in.-diameter bolts epoxied into 160 holes drilled approximately 17 to 24 in. deep into the top and bottom of the cell. The lifting fixtures were linked by steel connecting rods from the top plate to the bottom to disperse the weight of the massive load (see Figure 3-10). Workers worked around the clock to ensure that the lifting fixtures were installed by the time Southwest Industrial Rigging (subcontractor hired to lift and transport Hot Cell 1 to ICDF) arrived on site.

Hot Cell 1 was lifted utilizing a portable 850-ton-capacity, four-legged mobile gantry crane system set on tracks to horizontally move the suspended load to the transport trailer. The gantry system was selected due to the stability of the suspended load (even in windy conditions, which often occur at the INL Site) and the relatively short time needed to assemble, lift the load, disassemble, move, and reassemble the gantry system at ICDF.

![Figure 3-9. Concrete saw used to separate Hot Cell 1 from the building slab.](image)
Figure 3-10. Installation of the lifting fixtures on Hot Cell 1.
Figure 3-11 shows a series of photographs that documents the lifting of Hot Cell 1. Contamination control during the hot cell lift was of utmost importance. The hot cell was lifted very carefully with plastic drapes, a remote camera, and high-efficiency particulate air ventilation to ensure the highly contaminated Duriron drain line located underneath the cell separated, as anticipated, when the hot cell was lifted (see second frame shown in Figure 3-11). The drain line was part of the Voluntary Consent Order (VCO) and is discussed in Section 4.2. Once the hot cell was lifted and it was confirmed that the drain line was successfully separated from the hot cell monolith, the cell was moved to a catch pan that was filled with sand. The purpose of the sand was to support the uneven surfaces of the cell bottom. The pan was covered in a large plastic tarp that was wrapped around the bottom and sides of the hot cell to contain any radiological contamination that may have been present on the bottom of the cell. Then the pan was attached to the hot cell utilizing heavy ¾-in. chains, which attached to mounting brackets that had been attached to the hot cell. This allowed the hot cell and pan/sand assembly to be lifted and placed onto a specialized Goldhofer transport trailer assembly that was approximately 22 ft wide and 70 ft long. The trailer consisted of 14 lines of axles, with a total of 224 tires.

The Hot Cell 1 and pan assembly were placed on the Goldhofer trailer in a precalculated location to ensure that the trailer load and weight distribution met manufacturing specification and engineering calculations. Once the load was secured, the transport embarked on the 2.5-mile journey to ICDF, reaching a maximum speed of 5 miles per hour (see Figure 3-12). Once at ICDF, the load was staged until the gantry system was reassembled inside ICDF. Using a Caterpillar D9T bulldozer, Hot Cell 1 was moved into ICDF, where the cell and attached pan assembly were lifted off the trailer (see Figure 3-13) and placed onto the final resting place within ICDF. Prior to transport, Hot Cell 1 had been grouted to just below the large observation windows. After placement in the ICDF landfill, the remaining internal void was filled with grout, meeting the Land Disposal Restrictions alternative treatment standards for hazardous debris (mercury-vapor light bulbs) in 40 CFR 268.45, the treatment standard for radioactive lead solids in 40 CFR 268.40, and the void space requirements of the ICDF WAC (DOE-ID 2010).
Figure 3-11. Lifting TRA-632 Hot Cell 1.
Figure 3-12. TRA-632 Hot Cell 1 in route to the Idaho CERCLA Disposal Facility.

Figure 3-13. Offloading TRA-632 Hot Cell 1 at the Idaho CERCLA Disposal Facility.
3.3 Hot Cell 2 Demolition

In accordance with the Action Memorandum (DOE-ID 2009a), Hot Cell 2 was disposed of on the INL Site at ICDF. In order to place the hot cell into ICDF, it was necessary for the radiological and chemical constituents to be within acceptable levels, as defined by the ICDF WAC (DOE-ID 2010). The physical configuration of Hot Cell 2 with a cold side and a hot side, as shown in Figure 2-4, allowed manned entries into the cell to remove all the equipment, tables (see Figure 3-14), and hazardous materials, which included sodium-vapor light bulbs and lead in the form of manipulators, shield glass, plugs, and shield caves (scanning electron microscope and metallographic) (see Figure 3-15). These RCRA-hazardous materials were disposed of at a permitted disposal facility off the INL Site.

Figure 3-14. View through shield window as workers cut up a table to support removal activities from Hot Cell 2.
Figure 3-15. Separating the metallographic cave from Hot Cell 2.

Once all items had been removed from Hot Cell 2, the interior surfaces of the cell were sprayed with a polymeric coating for radiological contamination control. The resulting radiological dose remaining inside Hot Cell 2 supported open air demolition. Heavy equipment was used to demolish the hot cell, and the debris was loaded into heavy duty dump trucks or containers for disposal at ICDF (see Figure 3-16). The entire cell was removed, including 1–2 ft of soil underneath Hot Cell 2. These removed materials were classified as CERCLA low-level waste, along with the other debris generated from the D&D of TRA-632, and disposed of in the ICDF landfill.
Figure 3-16. Demolition of Hot Cell 2.
3.4 Hot Cell 3 Demolition

In accordance with the Action Memorandum (DOE-ID 2009a), Hot Cell 3 was disposed of at ICDF on the INL Site. In order to place the hot cell into ICDF, it was necessary for the radiological and chemical constituents to be within acceptable levels, as defined by the ICDF WAC (DOE-ID 2010).

3.4.1 Removal of Material from Hot Cell 3

The physical configuration of Hot Cell 3 with a cold side and a hot side, as shown in Figure 2-4, allowed manned entries into the cold side of the cell. Low-level waste items located on top of the table (see Figure 3-17) were remotely moved from the hot side to the cold side of the cell. The 6-in.-thick shield door, which separated the hot and cold sides, provided sufficient shielding from any remaining high radiological dose items located in the hot side of the cell when closed. This shielding allowed workers to open the doors into the cold side of the cell and remove the waste items. Special shielded boxes made of concrete and steel plate were designed and constructed to provide the necessary shielding for the waste items remotely placed inside (see Figure 3-18). These concrete/steel boxes were rigged onto a cart, which could be manually pushed into and pulled out of the cell, minimizing the time that the workers were exposed to the radiological doses present in the cell (see Figure 3-19).

Figure 3-17. Waste items located on the table top inside the hot side of Hot Cell 3.
Figure 3-18. Workers using manipulators and remote camera to load waste items into concrete/steel box.

Figure 3-19. Looking through Hot Cell 3 shield window as workers push a concrete/steel box into the cell.

A remote camera was placed in Hot Cell 3 that allowed the workers better views. An AMP-100 was also placed in the cell to obtain radiological readings of all the waste items being removed to ensure the ICDF WAC limits were achieved. A metal grid was placed over the lighter waste items in the concrete/steel box to prevent them from floating during the subsequent grouting process (see Figure 3-20). The waste boxes were grouted in-cell (cold side) prior to being removed (see Figure 3-21). Once removed from the cell, the grouted concrete/steel waste boxes could be placed into Department of Transportation-compliant containers and grouted, if necessary, to further reduce the radiological dose to acceptable transportation levels (see Figure 3-22). The waste items then were transported to ICDF for disposal.
Figure 3-20. Workers placing a metal grid in concrete/steel box to prevent waste items from floating during the grouting process.

Figure 3-21. Grout being pumped into a loaded concrete/steel box.
A satellite accumulation area containing RCRA-hazardous and Toxic Substances Control Act (TSCA)-regulated waste also was located inside Hot Cell 3. The RCRA/TSCA-regulated waste items were removed and treated in a similar manner as the low-level waste items described previously. However, the RCRA/TSCA-regulated waste was disposed of at a permitted disposal facility off the INL Site. The treatment and removal of these RCRA/TSCA-regulated waste items were specifically excluded from the Action Memorandum (DOE-ID 2009a) and are not addressed further in this RAR.

Once all the waste items had been removed from the top of the table located in the hot side of Hot Cell 3, an aluminum plate was moved that covered a U-shaped notch in the table that allowed items to be moved from the charging port into or out of Hot Cell 3 (see Figure 3-23). A canister reading 22,700 R/hr was discovered in this U-shaped notch. Documentation was obtained confirming that this canister was holding unprocessable cobalt (Co-60) targets. The canister was removed from Hot Cell 3 and loaded into the white elephant transport cask (see Figure 3-24), overpacked into a Department of Transportation-compliant CO-225 waste box, and transported to ICDF for disposal.

Once all the waste items had been removed from the table top, all the waste that had accumulated underneath the table since the cell became operational in the early 1960s had to be removed (see Figure 3-25). The ANDROS, a remote robot, was utilized to remove the waste from under the tables (see Figure 3-26). A vacuum system was used to remove the loose waste items (see Figure 3-27). All the waste removed from under the table was containerized and transported to ICDF for disposal.
Figure 3-23. Top of table showing U-shaped notch and charging port access.

Figure 3-24. White elephant transport cask containing the 22,700-R/hr canister.
Figure 3-25. Garbage that had accumulated underneath the table in Hot Cell 3.

Figure 3-26. ANDROS remote robot and worker remotely operating ANDROS to remove waste from cell floor.
3.4.2 Demolition of Hot Cell 3

RCRA-hazardous materials, which included sodium-vapor light bulbs and lead in the form of manipulators, shield glass, plugs, counter weights, and shielding, were removed from Hot Cell 3 and disposed of at a permitted disposal facility off the INL Site. The interior surfaces of the cell were sprayed with a polymeric coating for radiological contamination control. The resulting radiological dose remaining inside Hot Cell 3 supported open air demolition. Heavy equipment was used to demolish Hot Cell 3, and the debris was loaded into heavy duty dump trucks or containers for disposal at ICDF (see Figure 3-28). The entire cell was removed, including 1–2 ft of soil underneath Hot Cell 3. These removed materials were classified as CERCLA low-level waste, along with the other debris generated from the D&D of TRA-632, and disposed of in the ICDF landfill.
Figure 3-28. Photographs of the demolition of Hot Cell 3.
3.5 Building Slab End State

Portions of the building slab were cut using a 40-in. circular concrete saw to remove the concrete and underlying soils to access the TRA-632 drain pipes, which were removed as part of the VCO (see Section 4.2). Removed sections of building slab and soils were disposed of at ICDF on the INL Site. Once the drain lines had been removed and soil samples collected, clean fill was brought in to fill the trenches that were cut into the building slab (see Figure 3-29). In areas where heavy equipment was utilized, the trenches also were filled with grout to ensure a smooth working surface. Then the TRA-632 Building was demolished to the top of the slab.

The three hot cells, which extended below the building slab, were removed in their entirety. In order to ensure that residual radiological contamination associated with the demolition debris had been removed (see Figure 3-30), approximately 1 to 2 ft of soil below the bottom of the three hot cells was also removed. The removed materials were classified as CERCLA low-level waste, along with the other debris generated from the D&D of TRA-632, and disposed of in the ICDF landfill.

Contamination was identified at the bottom of the excavations. Although the NTCRA scope did not include addressing soil contamination, while the excavation was open, the remaining soils were sampled as a matter of convenience to provide initial information to the Idaho Cleanup Project CERCLA Program for the preparation of the New Site Identification Form for the area.

The hot cell excavations then were backfilled with clean fill from the Monroe pit (an INL approved borrow source for clean fill material) (see Figure 3-31). Approximately 1 to 2 ft of clean fill was brought in to cover the TRA-632 Building slab. The area was graded and rolled to stabilize the surface area over the TRA-632 Building slab (see Figures 3-32 and 3-33).

Figure 3-29. Portions of the TRA-632 Building slab removed to access TRA-632 drain piping and resulting trench filled with clean gravel.
Figure 3-30. Removing Voluntary Consent Order drain pipes and soils from under the TRA-632 Hot Cells.

Figure 3-31. Backfilling the Hot Cell 1 area with clean fill.
Figure 3-32. View looking south over the gravel pad remaining at the previous location of TRA-632.

Figure 3-33. View looking northwest over the gravel pad remaining at the previous location of TRA-632.
4. OTHER ACTIVITIES CONTRIBUTING TO THE END STATE OF THE TRA-632 HOT CELL FACILITY

Many D&D activities at the ATR Complex were completed prior to the approval of the 2009 NTCRA Action Memorandum associated with the TRA-632 Hot Cell Facility (DOE-ID 2009a). This section describes D&D activities that contributed to the final TRA-632 Hot Cell Facility end state.

4.1 Comprehensive Environmental Response, Compensation, and Liability Act Activities

The CERCLA Final ROD for OU 2-13 (DOE-ID 1997) and the Explanation of Significant Differences to the ROD for OU 2-13 (DOE-ID 2000) selected a remedy for the cleanup of contaminated soil identified at the ATR Complex. Remedial actions specified by the OU 2-13 ROD have been completed at Waste Area Group 2 and as required under CERCLA. Whenever contamination was left in place, institutional controls were implemented for residual contaminants at concentrations that would not allow for unrestricted use or access. The Explanation of Significant Differences discusses implementation, maintenance, and monitoring of institutional controls at the ATR Complex.

No radiological contamination was previously known to exist under the TRA-632 Building slab. However, soil samples collected under the TRA-632 Building slab and the three hot cell footprints confirmed that radiologically contaminated soils remain in this area. The CERCLA new site identification process will be followed to address the newly discovered radiological contaminated soils. The soil samples collected as part of the VCO RCRA closure activities (see Section 4.2) will be used to obtain radiological characterization information to support a risk assessment, which will determine if further CERCLA removal actions are necessary for this area.

Groundwater monitoring under CERCLA has been ongoing at the ATR Complex, in accordance with the requirements of the OU 2-12 and 2-13 RODs (DOE-ID 1992, 1997). On October 7, 1991, EPA designated the Snake River Plain Aquifer (SRPA) as a sole-source aquifer under the Safe Drinking Water Act (42 USC § 300f et seq.). Although the SRPA and perched water beneath the ATR Complex are listed as No Further Action sites, they are monitored extensively because changes in these sites could be indicative of the effectiveness of the remedies in place at the OU 2-13 sites or could indicate the occurrence of a new release.

4.2 Voluntary Consent Order Activities

The VCO program was responsible for closing the Hazardous Waste Management Act (HWMA) (Idaho Code § 39-4401 et seq.,) /RCRA-regulated TRA-632 drain lines. The following two HWMA/RCRA closure plans address the TRA-632 drain lines:

- HWMA/RCRA Closure Plan for the TRA-630 Catch Tank System Courtyard Components – Voluntary Consent Order Action Plan VCO-5.8.d, DOE/ID-11379, Revision 2, November 2009 (DOE-ID 2009c)—This closure plan addresses the removal actions associated with the drain lines that were located underneath the TRA-632 Building slab, but exterior to the three hot cells.

- HWMA/RCRA Closure Plan for the TRA-632 Hot Cell Drain Piping – Voluntary Consent Order Action Plan VCO-5.8.d, DOE/ID-11434, Revision 2, September 2011 (DOE-ID 2011)—This closure plan addresses the removal actions associated with the drain lines located underneath the footprint of the three hot cells.
The HWMA/RCRA-regulated drain piping was removed, and soil samples were collected from under the drain lines. These soil samples were analyzed for HWMA/RCRA COCs. The sample results were used to complete site-specific risk assessments, which confirmed the HWMA/RCRA COCs were sufficiently removed to levels that do not pose unacceptable risk to human health or the environment.

DEQ has acknowledged completion of the HWMA/RCRA closure activities associated with the TRA-632 drain lines that were located underneath the TRA-632 Building slab, but exterior to the three hot cells (Bullock 2012a). DEQ also has acknowledged completion of the HWMA/RCRA closure activities associated with the TRA-632 hot cell drain lines that were located underneath the footprint of the three hot cells (Bullock 2012b).
5. ACHIEVING REMOVAL ACTION OBJECTIVES

Implementing this removal action was consistent with remedial action objectives established in the OU 2-13 ROD (DOE-ID 1997) and supports the overall remediation goals established through the Federal Facility Agreement and Consent Order (DOE-ID 1991). As such, this removal action was consistent with and will contribute to the future final end state of the ATR Complex under CERCLA. The TRA-632 removal action objectives identified in Section 1.2 were calculated to reduce the risk from external radiation exposure from above the TRA-632 Building slab and the three hot cells to a total excess cancer risk of less than 1 in 10,000 for future residents and for current and future workers. In addition, at the INL Site, the standard for protecting the SRPA is to prevent any release that could result in an exceedance of the maximum contaminant level and ensure that the site is available for unrestricted use in the future. The TRA-632 removal action objectives were achieved, as described in the following subsections.

The selected alternative (i.e., Alternative 3), as documented in the TRA-632 Hot Cells Action Memorandum (DOE-ID 2009a), was fully implemented and included removal and disposal of the TRA-632 Building and three hot cells at a disposal facility on the INL Site (i.e., ICDF or ICDWL). The estimated total activity of radionuclides present in TRA-632, prior to the commencement of D&D activities, was approximately 1,800 Ci. All of this radiological source was removed upon completion of this NTCRA, thereby removing the COCs (i.e., the radiological contamination) as identified in the TRA-632 Action Memorandum.

5.1 Future Actions at TRA-632

All contaminants associated with the above-slab TRA-632 Building and three hot cells were removed to meet the TRA-632 removal action objectives specified in the Action Memorandum (DOE-ID 2009a). However, previously unknown radiological contamination was discovered under the TRA-632 Building slab and will be addressed as part of the CERCLA new site identification process as specified in the Action Memorandum. However, as a matter of convenience and while the excavations were open, samples of these soils were collected. Evaluation of the analytical results for these samples is the responsibility of the Idaho Cleanup Project CERCLA Program and will be included in the New Site Identification Form to be submitted to the CERCLA Agencies as part of their scope of work. Details regarding institutional control post-removal-action requirements for this area will be reviewed by DEQ and EPA for continued protectiveness during the INL Site-wide CERCLA 5-year review process prescribed under the Federal Facility Agreement and Consent Order (DOE-ID 1991).

The selected remedy only addressed the removal of the building and hot cells. Additional VCO actions were conducted in coordination with this removal action to address HWMA/RCRA-regulated lines below the building slab. Upon completion of removal of these lines and the hot cells, radiologically contaminated soil remained at the bottom of the excavations. Both the Action Memorandum and the Voluntary Consent Order Plan state that contaminated soil is outside the scope, but it must be managed by the Idaho Cleanup Project CERCLA Program.

Upon completion of the compacting and grading of the backfill, the 1 to 2 ft of compacted soil above the remaining building slab was radiologically surveyed. Those surveys confirmed that the remaining radiological contamination did not present an unacceptable radiological risk. The compacted fill is sufficient to provide adequate protection until the New Site Identification Form can be reviewed and approved by the CERCLA Agencies and institutional controls, as necessary, can be applied.
5.2 Compliance with Environmental Regulations and Applicable or Relevant and Appropriate Requirements

Section 121 of CERCLA (42 USC § 9621) requires the responsible CERCLA implementing agency to ensure that the substantive standards of HWMA/RCRA and other applicable laws be incorporated into the federal agency’s design and operation of its long-term remedial actions and into its more immediate removal actions. The U.S. Department of Energy Idaho Operations Office is the implementing agency for this NTCRA. Both DEQ and EPA concurred that a NTCRA was warranted to protect human health and the environment. Through the NTCRA process, the risks presented in this document were mitigated in a timely manner.

Table 5-1 lists the applicable or relevant and appropriate requirements (ARARs) that were identified for this removal action. These ARARs are a compilation and expansion of the ARARs identified in the OU 2-13 ROD (DOE-ID 1997). At completion of the TRA-632 Hot Cells end state, all identified ARARs had been satisfied.

The ARARs list was based on several key assumptions identified in the Action Memorandum (DOE-ID 2009a). Those key assumptions and whether there were any deviations from the assumptions are identified following the table. Waste volumes and disposal locations are identified in Section 7.
Table 5-1. Summary of applicable or relevant and appropriate requirements for the TRA-632 Hot Cell Facility non-time-critical removal action.

<table>
<thead>
<tr>
<th>Requirement (Citation)</th>
<th>ARAR Type</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Clean Air Act and Idaho Air Regulations</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>“Toxic Substances,” IDAPA 58.01.01.161</td>
<td>A</td>
<td>Applies to any toxic substances emitting during implementation of the removal action.</td>
</tr>
<tr>
<td>“Toxic Air Pollutants, Noncarcinogenic Increments,” IDAPA 58.01.01.585</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>“Toxic Air Pollutants, Carcinogenic Increments,” IDAPA 58.01.01.586</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>“Environmental Remediation Source,” IDAPA 58.01.01.210.16(a)</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>&lt;10 mrem/yr, “Standard,” 40 CFR 61.92</td>
<td>A</td>
<td>Applies to the waste handling activities.</td>
</tr>
<tr>
<td>“Emission Monitoring and Test Procedures,” 40 CFR 61.93</td>
<td>A</td>
<td>Applies to the waste handling activities.</td>
</tr>
<tr>
<td>“Compliance and Reporting,” 40 CFR 61.94(a)</td>
<td>A</td>
<td>Applies to the waste handling activities.</td>
</tr>
<tr>
<td>“Rules for Control of Fugitive Dust” and “General Rules,” IDAPA 58.01.01.650 and IDAPA 58.01.01.651</td>
<td>A</td>
<td>Applies to the waste handling activities.</td>
</tr>
<tr>
<td><strong>Idaho Solid Waste Facilities Act</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>“Applicable Requirements for Tier II Facilities,” IDAPA 58.01.06.012</td>
<td>A</td>
<td>Applies to disposal of solid wastes.</td>
</tr>
<tr>
<td><strong>RCRA and Idaho Hazardous Waste Management Act</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Generator Standards:</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>“Standards Applicable to Generators of Hazardous Waste,” IDAPA 58.01.05.006, and the following, as cited:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>“Hazardous Waste Determination,” 40 CFR 262.11</td>
<td>A</td>
<td>Applies to waste that would be generated during the removal action.</td>
</tr>
<tr>
<td><em>General Facility Standards:</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>“Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities,” IDAPA 58.01.05.008, and the following, as cited in it:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>“Temporary Units (TU),” 40 CFR 264.553</td>
<td>A</td>
<td>Waste may be treated or temporarily stored in a temporary unit prior to disposal.</td>
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</table>
Table 5-1. (continued).

<table>
<thead>
<tr>
<th>Requirement (Citation)</th>
<th>ARAR Type</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Staging Piles,” 40 CFR 264.554</td>
<td>A</td>
<td>Waste may be temporarily staged prior to disposal.</td>
</tr>
<tr>
<td>“General Inspections Requirements,” 40 CFR 264.15</td>
<td>A</td>
<td>Applies to a facility staging, storing, or treating hazardous waste prior to transfer to ICDF or an off-Site facility.</td>
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<tr>
<td>“Preparedness and Prevention,” 40 CFR 264, Subpart C</td>
<td>A</td>
<td>Applies to a facility staging, storing, or treating hazardous waste prior to transfer to ICDF or an off-Site facility.</td>
</tr>
<tr>
<td>“Contingency Plan and Emergency Procedures,” 40 CFR 264, Subpart D</td>
<td>A</td>
<td>Applies to a facility staging, storing, or treating hazardous waste prior to transfer to ICDF or an off-Site facility.</td>
</tr>
<tr>
<td>“Disposal or Decontamination of Equipment, Structures, and Soils,” 40 CFR 264.114</td>
<td>A</td>
<td>Applies to contaminated equipment used to remove, treat, or transport hazardous waste.</td>
</tr>
<tr>
<td>“Use and Management of Containers,” 40 CFR 264.171-178</td>
<td>A</td>
<td>Applies to containers used during the removal and treatment of hazardous waste.</td>
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**Land Disposal Restrictions:**

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<th>Requirement (Citation)</th>
<th>ARAR Type</th>
<th>Comments</th>
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<tr>
<td>“Applicability of Treatment Standards,” 40 CFR 268.40(a)(b)(e)</td>
<td>A</td>
<td>Applies to hazardous waste and secondary waste, if treatment is necessary to meet the disposal facility’s WAC or if treatment is required before placement.</td>
</tr>
<tr>
<td>“Treatment Standards for Hazardous Debris,” 40 CFR 268.45</td>
<td>A</td>
<td>Applies to hazardous debris, if treatment is necessary to meet the disposal facility’s WAC or if treatment is required before placement.</td>
</tr>
<tr>
<td>“Universal Treatment Standards,” 40 CFR 268.48(a)</td>
<td>A</td>
<td>Applies to nondebris hazardous waste and secondary waste, if treatment is necessary to meet the disposal facility’s WAC or if treatment is required before placement.</td>
</tr>
</tbody>
</table>

**Universal Waste Management:**

<table>
<thead>
<tr>
<th>Requirement (Citation)</th>
<th>ARAR Type</th>
<th>Comments</th>
</tr>
</thead>
</table>

**Idaho Groundwater Quality Rules**

<table>
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<tr>
<th>Requirement (Citation)</th>
<th>ARAR Type</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Ground Water Quality Rule,” IDAPA 58.01.11</td>
<td>A</td>
<td>The waste handling activities must prevent migration of contaminants from the TRA-632 Hot Cells that would cause the SRPA groundwater to exceed applicable State of Idaho groundwater quality standards in 2095 and beyond.</td>
</tr>
</tbody>
</table>
Table 5-1. (continued).

<table>
<thead>
<tr>
<th>Requirement (Citation)</th>
<th>ARAR Type</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TSCA</strong></td>
<td>A</td>
<td>Applies to removal, decontamination, storage, and disposal of items (including equipment) with PCB contamination.</td>
</tr>
<tr>
<td>“Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions,” 40 CFR 761</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Migratory Bird Treaty Act of 1918</strong></td>
<td>A</td>
<td>Applies to disturbances of nesting migratory birds.</td>
</tr>
<tr>
<td>“Protection of Migratory Game and Insectivorous Birds,” 16 USC 7</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>To-Be-Considered Requirements</strong></td>
<td>TBC</td>
<td></td>
</tr>
<tr>
<td>“Radiation Protection of the Public and the Environment,” DOE O 5400.5 Chg 2, Chapter II(1)(a,b)</td>
<td>TBC</td>
<td>Applies to the TRA-632 Building and Hot Cells before, during, and after the removal action. Substantive design and construction requirements would be met to keep public exposures as low as reasonably achievable.</td>
</tr>
<tr>
<td>“Radioactive Waste Management,” DOE O 435.1 Chg 1</td>
<td>TBC</td>
<td>Applies to the TRA-632 Building and Hot Cells before, during, and after the removal action. Substantive design and construction requirements would be met to protect workers.</td>
</tr>
</tbody>
</table>

Region 10 Final Policy on the Use of Institutional Controls at Federal Facilities (EPA 2006)

- **A** applicable requirement
- **ARAR** applicable or relevant and appropriate requirement
- **CFR** Code of Federal Regulations
- **DOE** U.S. Department of Energy
- **EPA** U.S. Environmental Protection Agency
- **ICDF** Idaho CERCLA Disposal Facility
- **IDAPA** Idaho Administrative Procedures Act
- **PCB** polychlorinated biphenyl
- **RCRA** Resource Conservation and Recovery Act
- **SRPA** Snake River Plain Aquifer
- **TBC** to be considered
- **TRA** Test Reactor Area
- **TSCA** Toxic Substances Control Act
- **USC** United States Code
- **WAC** waste acceptance criteria
• **Assumption 1**—The drains and piping are ancillary to the TRA-630 Catch Tank System, have been identified as part of the VCO Action Plan (VCO-5.8.d), and are outside the scope of this EE/CA. Soil contamination, if found under the slab, will be addressed under a HWMA/RCRA Closure Plan and/or the CERCLA program.

Prior to backfilling the excavations, soil samples were collected to support further management of the contaminated soils. Based on soil samples collected under the drains and piping, the HWMA/RCRA COCs do not pose unacceptable risk to human health and the environment; therefore, no further actions with regards to the underlying soils are necessary as part of HWMA/RCRA closure. However, screening soil samples were also collected underneath the TRA-632 drain piping and analyzed for Cs-137 utilizing a lanthanum bromide detector. These sample results confirm that radiological soil contamination is present under the TRA-632 slab. The Idaho Cleanup Project CERCLA Program will include evaluation of the analytical data and address this radiological soil contamination in the CERCLA New Site Identification Form submitted to the CERCLA Agencies.

• **Assumption 2**—Lead shielding will be removed from TRA-632 Hot Cells prior to initiation or during this removal action through other regulatory activities intended to place the facility in an environmentally safe condition. Some incidental lead, such as small amounts of lead encapsulated in debris, may be managed under the scope of the NTCRA as CERCLA waste and be disposed of in ICDF, according to the WAC. Removed lead that cannot be recycled or reclaimed shall be declared a hazardous waste or mixed low-level waste, will be managed in accordance with the substantive requirements of the HWMA/RCRA, and will be disposed of at an off-Site disposal facility in accordance with the disposal facility WAC.

All accessible radiologically contaminated lead shielding was removed from TRA-632 (see Figures 5-1 and 5-2) and disposed of off the INL Site as RCRA hazardous waste. However, some lead was determined to be impracticable to remove due to the radiological hazards present inside Hot Cell 1, including a poured lead plug associated with the transfer drawer, two lead bricks, and a lead sheet. Therefore, 482 lb of lead remained in Hot Cell 1 and was transported to ICDF for disposal as part of the monolith. At ICDF, grout was placed inside the hot cell to cover the lead items. The placement of grout around the lead items ensured that the Land Disposal Restrictions treatment standard of macroencapsulation for radioactive lead solids in 40 CFR 268.40 was achieved.

Some lead that was found in noncontaminated areas was recycled for use as shielding at other INL Site facilities.

• **Assumption 3**—Management of CERCLA waste generated during the removal action would be subject to meeting the ICDF WAC (DOE-ID 2010).

Only CERCLA wastes meeting the ICDF WAC were disposed of at ICDF.

• **Assumption 4**—If decontamination liquids are generated, they will be disposed of at the ICDF evaporation ponds in accordance with the approved WAC. Small amounts of decontamination liquid may be solidified with absorbent and be disposed of in the disposal cells at ICDF.

No decontamination liquids were generated as a result of this NTCRA.
Figure 5-1. Workers removing a lead shield plug from one of the TRA-632 Hot Cells.

Figure 5-2. Leaded shield glass windows were remotely removed from Hot Cell 3 using the Brokk 260.
Assumption 5—Debris generated during removal of the TRA-632 Hot Cells might have paint that contains polychlorinated biphenyls (PCBs). If encountered, such waste may trigger substantive requirements of the Toxic Substances Control Act (15 USC § 2601 et seq.). Lead-contaminated paint also may be present on demolition debris, which would be subject to the substantive requirements of RCRA hazardous waste regulations. Nonhazardous low-level waste would be disposed of at ICDF. Waste that can be demonstrated to be nonhazardous and to contain no added radiological constituents is eligible for disposal as solid waste at an approved onsite solid waste disposal facility. Any PCB-containing electrical equipment, such as PCB-containing light ballasts or capacitors, will be removed and disposed of offsite at an approved disposal facility.

Waste generated during this NTCRA was characterized and appropriately disposed of. Industrial waste was disposed of at the ICDWL. Nonhazardous low-level waste was disposed of at ICDF. PCB-containing electrical equipment (see Figure 5-3) was removed and disposed of at an approved off-Site disposal facility. Hazardous materials (see Figure 5-4) were removed and disposed of at an off-Site permitted disposal facility. No RCRA- or TSCA-regulated substances remained above the TRA-632 slab at the completion of the NTCRA.

• Assumption 6—Asbestos-containing material, which is both friable and nonfriable, may be encountered incidental to performance of the NTCRA. Friable or regulated asbestos-containing material is subject to specific asbestos regulations and would be acceptable for disposal at ICDF and/or, if not radiologically contaminated, at an approved on-Site solid waste disposal facility. Regulated asbestos will be removed and disposed of as required by 40 CFR 61.150, “Standard for Waste Disposal for Manufacturing, Fabricating, Demolition, Renovation, and Spraying Operations.”

Noncontaminated asbestos-containing material was removed from TRA-632 and disposed of at the CFA Landfill. Contaminated asbestos was removed and disposed of at ICDF. No asbestos-containing materials remained above the TRA-632 slab at the completion of the NTCRA.

• Assumption 7—Mercury located in mercury fluorescent lamps is planned for removal prior to this removal action under other regulatory activities intended to place the facility in an environmentally safe condition, as are the mercury-containing electrical switches and lights. No mercury at concentrations of regulatory concern is expected to be present in the building substructure at the start of the removal action.

Mercury-containing items were removed and disposed of as RCRA hazardous waste at an off-Site permitted disposal facility, in accordance with the disposal facility’s WAC. The exception being the seven 1,000-watt, mercury-vapor light bulbs located inside Hot Cell 1, which were deemed impracticable to remove. Once Hot Cell 1 had been lifted, transported, and off-loaded at ICDF, grout was placed inside the cell to cover the mercury-vapor light bulbs. The placement of grout around the mercury-vapor light bulbs ensured that the Land Disposal Restrictions treatment standard of macroencapsulation for hazardous debris (i.e., mercury-vapor light bulbs) in 40 CFR 268.45 was satisfied. No hazardous materials remained above the TRA-632 slab at the completion of the NTCRA.
Figure 5-3. PCB-containing light ballasts and capacitors were removed and disposed of off the INL Site.

Figure 5-4. Silver zeolite filter media were removed and disposed of at a RCRA-permitted disposal facility off the INL Site.
6. PROJECT COSTS

Detailed cost estimates are included in the EE/CA (DOE-ID 2009b). These estimates include a cost for the selected remedy, Alternative 3. That estimate identifies D&D costs at $6,300,000. Actual costs for completion of the removal action were $5,180,792. The actual cost is within the threshold of +50% to -30% of the estimated cost identified in the EE/CA.
7. WASTE GENERATION

Wastes removed from TRA-632 as part of the NTCRA were disposed of in compliance with applicable disposal requirements. Volumes of waste generated and the disposal locations are listed in Table 7-1. The radiological doses encountered inside each of the three hot cells were higher than anticipated. The total curies of the CERCLA low-level waste disposed of at ICDF from Hot Cell 1, Hot Cell 2, and Hot Cell 3 are summarized in Table 7-2.

Table 7-1. Waste generation and disposal location.

<table>
<thead>
<tr>
<th>Waste Type</th>
<th>Volume</th>
<th>Disposal Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mixed LLW</td>
<td>293.64 m³</td>
<td>Energy Solutions</td>
</tr>
<tr>
<td>CERCLA LLW</td>
<td>5,946.14 m³</td>
<td>207,750 ft³</td>
</tr>
<tr>
<td>PCBs</td>
<td>0.22 m³</td>
<td>7.8 ft³</td>
</tr>
<tr>
<td>Batteries</td>
<td>1.07 m³</td>
<td>37.8 ft³</td>
</tr>
<tr>
<td>Universal waste</td>
<td>0.43 m³</td>
<td>15.2 ft³</td>
</tr>
<tr>
<td>RCRA-hazardous</td>
<td>0.8 m³</td>
<td>28.3 ft³</td>
</tr>
<tr>
<td>Used oil</td>
<td>0.4 m³</td>
<td>13.4 ft³</td>
</tr>
<tr>
<td>Industrial waste</td>
<td>279 m³</td>
<td>55,812 ft³</td>
</tr>
<tr>
<td>Noncontaminated asbestos</td>
<td>1.46 m³</td>
<td>51.6 ft³</td>
</tr>
</tbody>
</table>

CERCLA Comprehensive Environmental Response, Compensation, and Liability Act
CFA Central Facilities Area
ICDF Idaho CERCLA Disposal Facility
ICDWL Idaho CERCLA Demolition Waste Landfill
LLW low-level waste
PCB polychlorinated biphenyl
RCRA Resource Conservation and Recovery Act
Table 7-2. Radiological source term from each hot cell disposed of at the Idaho CERCLA Disposal Facility.

<table>
<thead>
<tr>
<th>Radionuclide</th>
<th>Hot Cell 1 (Ci)</th>
<th>Hot Cell 2 (Ci)</th>
<th>Hot Cell 3 (Ci)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Am-241</td>
<td>3.16E-03</td>
<td>1.95E-02</td>
<td>9.35E-04</td>
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<td>Am-243</td>
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<td>—</td>
<td>3.82E-04</td>
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<td>Be-10</td>
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<td>—</td>
<td>4.99E-10</td>
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<td>C-14</td>
<td>1.62E-03</td>
<td>—</td>
<td>2.83E-03</td>
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<tr>
<td>Cl-36</td>
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<tr>
<td>Cm-242</td>
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<td>7.95E-05</td>
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<td>1.18E-03</td>
<td>4.88E-05</td>
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<tr>
<td>Co-60</td>
<td>2.21E+02</td>
<td>2.87E-01</td>
<td>1.34E+03</td>
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<tr>
<td>Cr-51</td>
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<td>—</td>
<td>8.53E-17</td>
</tr>
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<td>7.09E-01</td>
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<td>7.33E-02</td>
<td>1.57E+00</td>
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<td>Eu-154</td>
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<td>8.42E-03</td>
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<td>—</td>
<td>—</td>
<td>1.80E+02</td>
</tr>
<tr>
<td>Gd-153</td>
<td>—</td>
<td>—</td>
<td>9.46E-04</td>
</tr>
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<td>H-3</td>
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<td>1.66E-04</td>
</tr>
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<td>Hf-181</td>
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<td>—</td>
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<td>Np-237</td>
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<td>8.41E-05</td>
<td>1.87E-05</td>
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<tr>
<td>Pu-238</td>
<td>2.37E-03</td>
<td>3.19E-02</td>
<td>3.05E-03</td>
</tr>
<tr>
<td>Pu-239</td>
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<td>8.64E-03</td>
<td>2.58E-03</td>
</tr>
<tr>
<td>Pu-240</td>
<td>8.72E-04</td>
<td>1.13E-02</td>
<td>4.69E-04</td>
</tr>
<tr>
<td>Pu-241</td>
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<td>2.51E-01</td>
<td>1.09E-02</td>
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<tr>
<td>Sb-124</td>
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<td>Si-32</td>
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<td>1.14E-11</td>
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<td>Sr-90</td>
<td>2.17E-01</td>
<td>5.88E-01</td>
<td>2.00E-02</td>
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<tr>
<td>Tc-99</td>
<td>—</td>
<td>4.32E-05</td>
<td>—</td>
</tr>
<tr>
<td>U-234</td>
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<tr>
<td>U-235</td>
<td>6.36E-07</td>
<td>3.50E-05</td>
<td>1.71E-04</td>
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<tr>
<td>U-238</td>
<td>3.32E-06</td>
<td>9.78E-05</td>
<td>1.06E-02</td>
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<tr>
<td>Zn-65</td>
<td>—</td>
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<td>7.98E-03</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td><strong>230.93</strong></td>
<td><strong>2.37</strong></td>
<td><strong>1,986.98</strong></td>
</tr>
</tbody>
</table>
8. LESSONS LEARNED

During removal of the leaded shield windows from Hot Cell 3, an employee received a static shock through his arm and right side of his body when the sledge hammer used to break up the window impacted the leaded glass. Work was immediately stopped, and the employee was taken to the dispensary for a thorough evaluation and was returned to work with no restrictions. Electricians surveyed the work site for possible electrical conductors or other sources of electrical energy, and none were found.

Engineers performed a comprehensive review of the construction drawing and literature to gain an understanding of what happened to cause this electrical discharge. A literature review discovered that electrical energy could be stored in the leaded shield windows due to the windows being exposed to either or both gamma or other types of radiation. As was discussed in Section 3.4.1, multiple waste items with doses as high as 22,700 R/hr were removed from Hot Cell 3. Because the removal of these waste items (i.e., radiological source term) from Hot Cell 3 occurred just prior to the removal of the leaded shield windows, it is believed the stored energy in the windows did not have sufficient time to fully dissipate. As quoted from ASTM Standard C 1572:

“The discharge can occur spontaneously due to dielectric breakdown in the dielectric strength of the material or it can be initiated by pressure or impact.”

It is believed that when the sledge hammer contacted the leaded shield window, the impact initiated a dielectric breakdown in the glass material and/or had a piezoelectric effect on the glass block that resulted in subsequent electrical energy being released in the form of an electric arc to the next window block. This theory is further substantiated by the fact that no electric arc was experienced when the leaded shield windows were removed in this same manner from Hot Cell 1 and Hot Cell 2. It should be noted that the waste items had been removed from these cells long before the leaded glass windows were removed, and that the radiation fields in these cells were significantly lower than those present in Hot Cell 3, as shown in Table 7-2.

Corrective action was implemented to use remote equipment that was appropriately grounded to remove the remaining leaded shield windows from Hot Cell 3. Figure 8-1 shows the visible electric arc that resulted when the remote hammer impacted the leaded shield window.

Figure 8-1. Electric arc visible when leaded shield glass is impacted by remote hammer.
A “Lesson Learned” was prepared and disseminated throughout the DOE Complex to alert personnel working with hot cells that leaded glass radiation shield windows can accumulate an electric charge when exposed to radiation. This electric charge can be released either spontaneously or when the glass receives a mechanical impact.
9. REFERENCES


