DOE/ID-11453
Revision 0

Final Removal Action Report for CPP-601, CPP-602, CPP-627, CPP-630, and CPP-640

February 2012

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Prepared for the
U.S. Department of Energy
DOE Idaho Operations Office

ABSTRACT

This removal action report describes the deactivation and decommissioning activities that were taken at CPP-601, CPP-602, CPP-627, CPP-630, and CPP-640 as non-time-critical removal actions described in the *Action Memorandum for General Decommissioning Activities under the Idaho Cleanup Project,* Revision 1, and in the *Action Memorandum for Decommissioning CPP-601/640 Fuel Reprocessing Facilities.* These actions were evaluated in the *Engineering Evaluation/Cost Analysis for General Decommissioning Activities under the Idaho Cleanup Project* and in the *Engineering Evaluation/Cost Analysis for Decommissioning of the CPP-601/640 Fuel Reprocessing Facilities*. These non-time critical removal actions also implemented the remedy selected in the Operable Unit (OU) 3-13 Record of Decision (ROD) for the O U 3-13 Group 2 sites beneath CPP-601 and CPP-602, as modified by the OU 3-14 ROD. These sites include CPP-80, CPP-117, CPP-118, CPP-119, CPP-120, CPP-121, CPP-122, and CPP-123. CPP-86 was identified in the RODs as a Group 2 site, but was encompassed by CPP-117 during the new site identification process in 2005.

These removal actions met the remedial action objectives and remediation goals of the *Final Record of Decision Idaho Nuclear Technology and Engineering Center Operable Unit 3-13*, as modified by the *Record of Decision for Tank Farm Soil and Idaho Nuclear Technology and Engineering Center Groundwater, Operable Unit 3-14*.

A Hazardous Waste Management Act/Resource Conservation and Recovery Act-permitted tank system was located within these buildings. Closure plans were developed, implemented, and certified as complete in coordination with these removal actions. CPP-601 and CPP-640, along with the adjacent CPP-627, were closed as a Resource Conservation and Recovery Act landfill. That portion of the permitted tank system within CPP-602 was closed to performance-based closure standards.

The removal action for CPP-601 and CPP-640 primarily consisted of removing abovegrade structures that were not part of the process cells. The process cells were filled with grout to create a stable monolith. Then, an earthen cover, as specified in the Hazardous Waste Management Act/Resource Conservation and Recovery Act Closure Plan, was installed over the monolith (including the former location of CPP-627) to provide long-term protection of the monolith from impacts of weather. The removal action for CPP-630 removed the entire building. The removal action for CPP-602 removed the entire building, leaving only the basement floor and subgrade walls (more than 3 ft below grade) intact. The basement area then was backfilled with pit run material, compacted, and contoured to grade.

A risk assessment determined that there is no unacceptable risk to groundwater or human health and the environment. Therefore, no additional remedial actions are required at the former location of these buildings, nor for the CERCLA sites CPP-80, CPP-117 (which encompasses CPP-86), CPP-118, CPP-119, CPP-120, CPP-121, CPP-122, and CPP-123. Institutional controls will be maintained as part of the Operable Unit 3-14 industrial use area under the Site-Wide Institutional Control Plan.

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ACRONYMS

CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CPP	chemical processing plant
D&D	deactivation and decommissioning
DEQ	Idaho Department of Environmental Quality
DOE-ID	U.S. Department of Energy Idaho Operations Office
EDF	engineering design file
EE/CA	Engineering Evaluation/Cost Analysis
EPA	Environmental Protection Agency
HWMA	Hazardous Waste Management Act
INL	Idaho National Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center
OU	operable unit
RCRA	Resource Conservation and Recovery Act
ROD	Record of Decision
TBL	technical baseline

Final Removal Action Report for CPP-601, CPP-602, CPP-627, CPP-630, and CPP-640

1. INTRODUCTION

This removal action report describes the deactivation and decommissioning (D&D) activities that were conducted as non-time critical removal actions for the following facilities located at the Idaho Nuclear Technology Engineering Center (INTEC) at the Idaho National Laboratory (INL) Site (see Figures 1 and 2):

- Fuel Reprocessing Building (CPP-601)
- Laboratory/Offices Building (CPP-602)
- Remote Analytical Facility (CPP-627)
- Safety and Spectrometry Building (CPP-630)
- Headend Process Plant (CPP-640).

1.1 Purpose and Objective

This removal action report describes the D&D activities that were taken at CPP-601, CPP-602, CPP-627, CPP-630, and CPP-640 as non-time-critical removal actions described in the following documents:

- *Action Memorandum for General Decommissioning Activities under the Idaho Cleanup Project* (DOE-ID 2009a)
- *Action Memorandum for Decommissioning CPP-601/640 Fuel Reprocessing Facilities* (DOE-ID 2008a).

The engineering evaluation/cost analysis (EE/CA) conducted for each of these action memorandums evaluating the proposed actions is presented in the following documents:

- *Engineering Evaluation/Cost Analysis for General Decommissioning Activities under the Idaho Cleanup Project* (DOE-ID 2006a)
- *Engineering Evaluation/Cost Analysis for Decommissioning of the CPP-601/640 Fuel Reprocessing Facilities* (DOE-ID 2008b).

CPP-627 was subject to a previous non-time-critical removal action documented in *Final Report for the Decontamination and Decommissioning of the CPP-627 Remote Analytical Facility* (ICP 2006a). CPP-627 is included in this report because the residual source for that facility is included in the source term evaluated to demonstrate compliance with remedial action objectives for the Fuel Reprocessing Complex at INTEC.

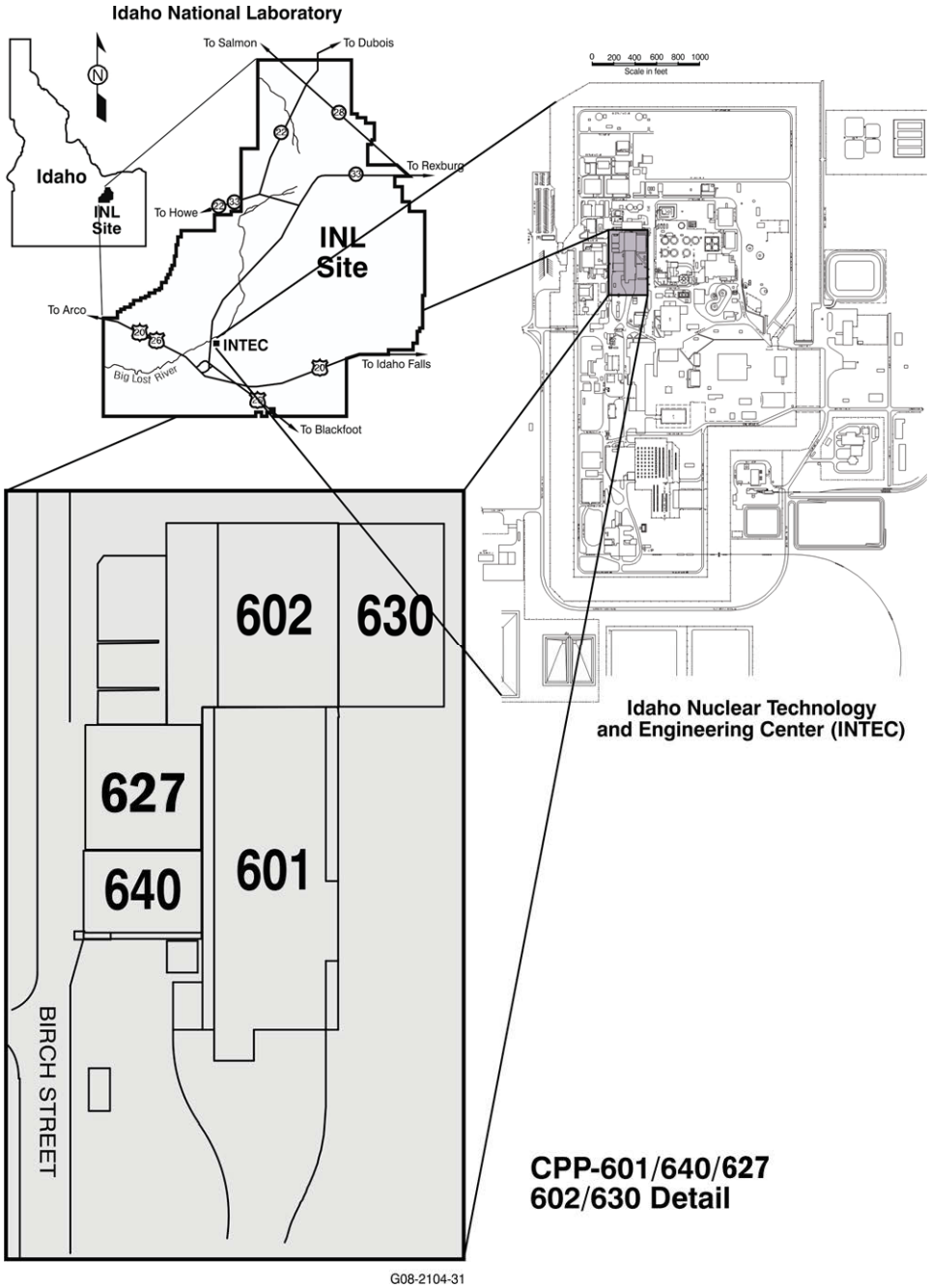


Figure 1. Location of CPP-601, CPP-602, CPP-627, CPP-630, and CPP-640.

Figure 2. Fuel Reprocessing Complex and associated buildings, including CPP-601, CPP-602, CPP-627 pad, CPP-630, and CPP-640.

This report demonstrates that actions taken met and were consistent with the following:

- Operable Unit (OU) 3-13 remedial action objectives, as modified by the OU 3-14 Record of Decision (ROD)
- OU 3-13 remediation goals, as modified by the OU 3-14 ROD
- Applicable or relevant and appropriate requirements for Group 2 soils from the *Final Record of Decision Idaho Nuclear Technology and Engineering Center Operable Unit 3-13* (DOE-ID 1999), as modified by the *Record of Decision for Tank Farm Soil and INTEC Groundwater Operable Unit 3-14* (DOE-ID 2007).

In addition, this report demonstrates that actions taken support the overall remediation of the INL, as established through the Federal Facility Agreement and Consent Order (DOE-ID 1991).

1.2 Scope

The scope of the removal actions for CPP-601, CPP-602, CPP-627, CPP-630, and CPP-640 was based upon achieving the end states defined in the following:

- *Action Memorandum for General Decommissioning Activities under the Idaho Cleanup Project* (DOE-ID 2009a) for CPP-602 and CPP-630
- *Action Memorandum for Decommissioning CPP-601/640 Fuel Reprocessing Facilities* (DOE-ID 2008a).

CPP-627 is included in this report only for the purposes of evaluating the residual source term for that facility in the risk assessment for the adjoining facilities. The demolition waste primarily was disposed of in the Idaho Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Disposal Facility.

These action memoranda and the associated EE/CA were prepared to assist the U.S. Department of Energy Idaho Operations Office (DOE-ID) to identify the most effective method for decommissioning structures with completed missions. This removal action approach satisfies environmental review requirements and provides for stakeholder involvement, while providing a framework for selecting the appropriate decommissioning alternative. An Administrative Record was established to record information used to support the selected alternative and document decisions and progress of the removal action.

2. REMEDIAL ACTION OBJECTIVES AND REMEDIATION GOALS

2.1 Operable Unit 3-13 Group 2 Sites

CPP-601, CPP-602, CPP-627, CPP-630, and CPP-640 were physically located within Waste Area Group 3, as established by the Federal Facility Agreement and Consent Order (DOE-ID 1991). During the operational phase of these buildings, soils beneath CPP-601 and CPP-602 were contaminated from system or piping failures beneath those buildings. The following sections contain brief descriptions of the designated CERCLA sites beneath these buildings. In 2006, the *Nature and Extent of Releases at the INTEC Fuel Reprocessing Complex* (ICP 2006b) was issued updating estimates of the volume and curies of contaminants released at these sites. The primary contaminants released were radionculides. The non-radionuclides were estimated based upon typical concentrations for the types of solutions released and were documented in *Non-Radiological Material Inventory for CPP-601 and CPP-640* (Engineering Design File (EDF)-8192) for CPP-80, CPP-118, CPP-119, CPP-120, CPP-121, CPP-122, and CPP-123 and in *Estimate of Nonradioactive Contaminants Released Beneath CPP-602* (EDF-9357) for CPP-117 (which emcompasses CPP-86). The estimated volume and total curies of the primary radionuclides for each release are shown in Table 1. The location of these CERCLA sites is shown in Figure 3. Both the radioactive and non-radioactive contaminants were included in the residual source term evaluated by the risk assessment discussed later in this document.

Table 1. Estimated volume and total curies released at each CERCLA site.[a]

Facility	Estimated Volume Released (gal)	Estimated Radionuclides Released[b] (Ci)
CPP-80	105,540	6.35E-1
CPP-117[c]	1,366	1.04E+0
CPP-118	200	1.52E-1
CPP-119	9,000	1.72E-5
CPP-120	36.9	7.86E+1
CPP-121	0.25	2.00E-7
CPP-122	3	7.72E+1
CPP-123	75	2.00E+2
Total	**116,154**	**3.58E+2**

a. Source: ICP (2006b).

b. The curies released in this table represent the primary radionuclides only. Additional radionuclides are added to the residual source term in later tables based upon process knowledge.

c. CPP-117 encompasses CPP-86.

CERCLA Comprehensive Environmental Response, Compensation, and Liability Act

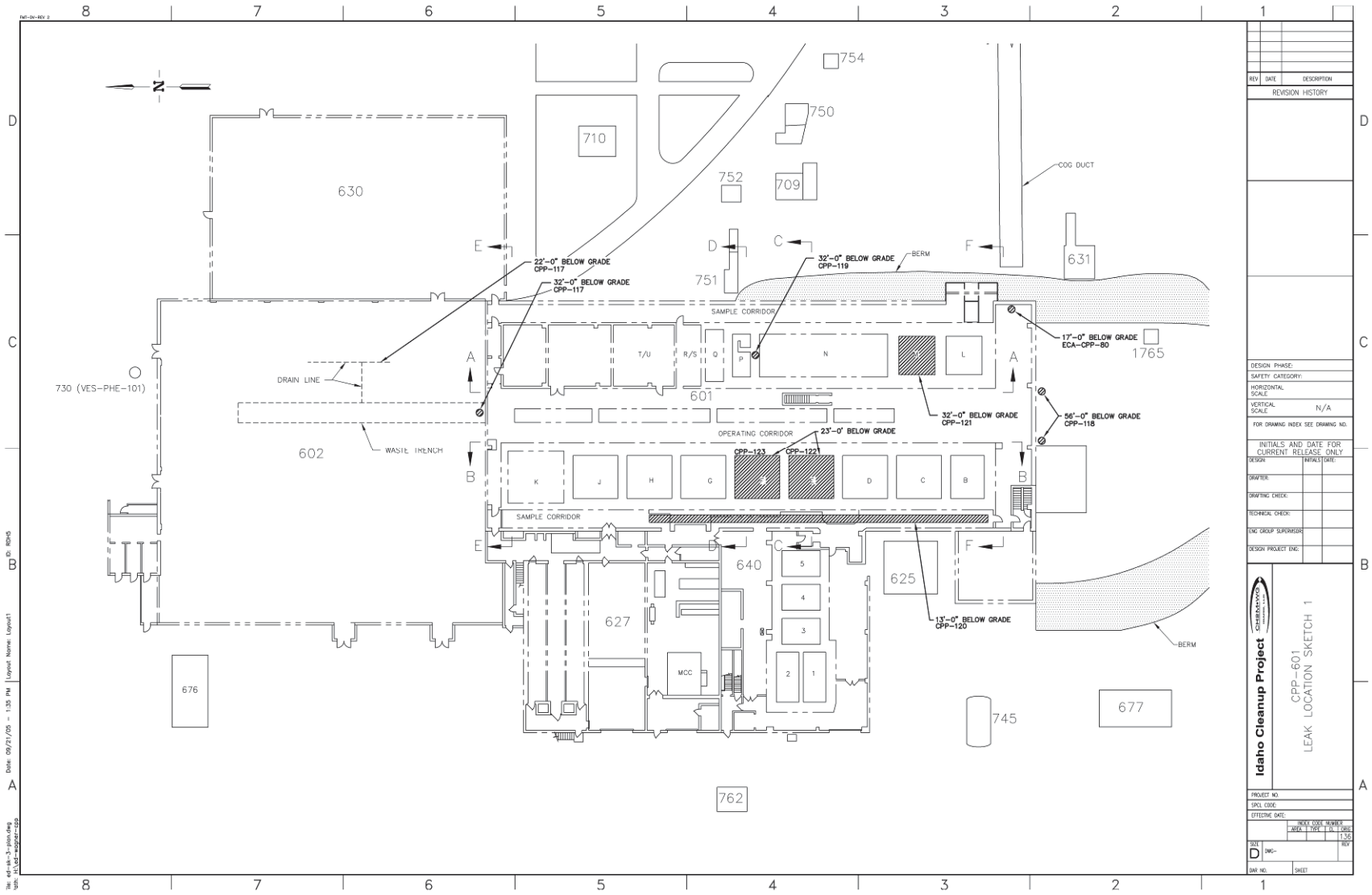


Figure 3. CERCLA release sites beneath CPP-601 and CPP-602.

2.1.1 CPP-80, Building CPP-601 Vent Tunnel Drain Leak

The CPP-80 release was the result of redirecting acidic condensate from a stainless steel line to a cast iron drain line beneath the south vent tunnel floor. The point of release was approximately 17 ft below surrounding grade. The release volume was bounded by an estimate of what could have been released to the soil beneath the building. The estimate of over 105,000 gal accounts for over 90% of the total volume released beneath CPP-601 and CPP-602. The condensate contained moderate concentrations of radionuclides. No soil sampling was performed due to the inaccessibility of the site.

2.1.2 CPP-86, CPP-602 Waste Trench and Sump

Site CPP-86 was originally identified as releases from the CPP-602 waste trench and sump. This site was encompassed in the CPP-117 site when the new site identification process was completed in 2005 for CPP-117.

2.1.3 CPP-117, CPP-602 Sump and Abandoned Piping

CPP-117 includes releases beneath CPP-602. Those releases include those from the CPP-602 waste trench and sump (originally identified as CPP-86), as well as releases from cast iron pipes that were direct-buried in the soils beneath the building.

The waste trench and sump ran underneath CPP-602, which was a laboratory and office building that also housed a liquid uranium product denitrator. The trench, which lay approximately 24 ft below the surrounding grade, provided a location for piping used to collect liquid waste from various CPP-602 operations. The waste subsequently was routed through the sump (approximately 32 ft below surrounding grade) to CPP-601 and on to the process equipment waste evaporator system. The release from piping and then from the sump to the soils was discovered during modifications in 1990. CPP-117 also addressed releases from the direct-buried piping beneath CPP-602 that failed when inadvertently used for corrosive service. These releases occurred approximately 22 ft below surrounding grade.

2.1.4 CPP-118, WG/WH Vaults Ventilation Outlet Ducts

The CPP-118 release occurred between 1983 and 1984, when liquid waste collected in the WG/WH tank vaults and may have been released through unsealed joints in a ventilation duct leaving the tank vault approximately 56 ft below surrounding grade. The liquid waste released would be similar to the typical waste received by these tanks during that time.

2.1.5 CPP-119, P-Cell Wall Drain

The CPP-119 site was discovered during pipe inspection activities during the summer of 1989. An incomplete weld in a vertical portion of the 2-in., stainless steel drain line was identified. The release point would have been 32 ft below surrounding grade. The drain line was used to route second-cycle condensate from the P-110 product condenser to the WH/WG deep tanks. The concentration of the potential release was estimated through mathematical modeling based on historical process flowcharts.

2.1.6 CPP-120, CPP-601 West Vent Corridor (Tunnel) and Drains

The primary release beneath the west vent corridor was the result of cast iron waste piping receiving unplanned acidic releases between 1971 and 1978 during electrolytic campaigns and Cell 5 decontaminations. Data from the decontamination of G- and H-Cell in 1982 were used to estimate the solution concentrations. The release point would have been 13 ft below surrounding grade.

2.1.7 CPP-121, M-Cell Floor Liner

The release beneath the M-Cell floor liner occurred during preprocess testing. A small release of process solution might have allowed approximately 1 L of radioactive solution and 1,000 L of clean water to leak behind the liner. The process solution was third-cycle product solution, which is 0.13 molar nitric acid and high in uranium. The release point would have been 32 ft below surrounding grade.

2.1.8 CPP-122, E-Cell Floor Liner Pinholes

The CPP-122 release occurred when contaminated solutions leaked to the floor of E-Cell during operations in 1980 and 1981. Decontamination efforts mobilized the remaining radioactive solutions and might have allowed some to leak to the soil below the cell. This release is estimated to have a potential release of 11 L of dissolver product. The release point would have been 23 ft below surrounding grade.

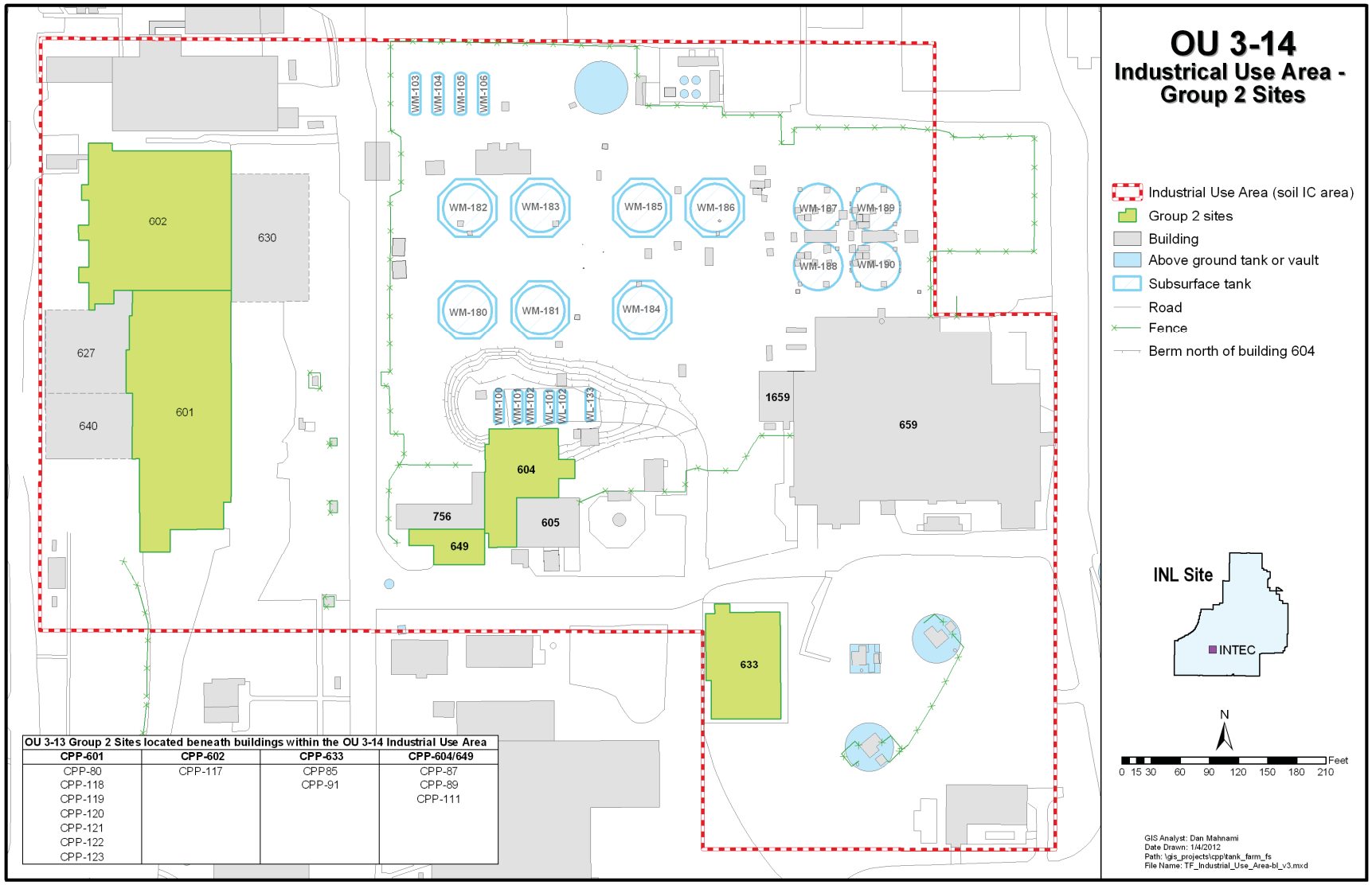
2.1.9 CPP-123, F-Cell Sump

The CPP-123 release was the result of approximately 285 L dissolver offgas scrubber solution entering the area beneath the F-Cell liner through an unsealed bolt hole. The release would have been highly acidic and have high concentrations of radioactive constituents. The radionuclides released from CPP-123 account for approximately 57 of the total radionuclides released from beneath CPP-601 and CPP-602. The release point would have been 23 ft below surrounding grade.

2.2 Operable Unit 3-13 Group 2 Selected Remedy

The OU 3-13 ROD (DOE-ID 1999) addressed the soils beneath CPP-601 and CPP-602 as part of Group 2 soil sites (soils under buildings and structures). The Group 2 sites (see Figure 4) include CPP-80, CPP-118, CPP-119, CPP-120, CPP-121, CPP-122, CPP-123 below CPP-601, and CPP-117 below CPP-602 (see Figures 3 and 4). Group 2 site CPP-86 initially was identified as a site beneath CPP-602, but that site was encompassed by CPP-117 when the new site identification for CPP-117 was approved in 2005. The contamination that was left within CPP-601, CPP-602, CPP-627, and CPP-640 as a result of the completed non-time-critical removal actions and the contamination historically released beneath those buildings (CERCLA sites CPP-80, CPP-117 [encompasses CPP-86], CPP-118, CPP-119, CPP-120, CPP-121, CPP-122, and CPP-123) were included in the residual source term and were evaluated in the risk assessment described in this document.

The Group 2 selected remedy in the OU 3-13 ROD is deferred remedial action until the buildings above the soils were subject to D&D. At that time, the soils were to be assessed for compliance with the OU 3-13 ROD remedial action objectives, remediation goals, and applicable or relevant and appropriate requirements for the Group 2 soils as described in the OU 3-13 Group 2 Closure Evaluation Criteria and Checklist (DOE-ID 2000). The remedial action objectives and remediation goals were predicated on the current and future land uses established in the OU 3-13 ROD, which included industrial land use until at least 2095 and the potential for residential land use thereafter.



OU 3-13 Group 2 Sites located beneath buildings within the OU 3-14 Industrial Use Area			
CPP-601	CPP-602	CPP-633	CPP-604/649
CPP-80	CPP-117	CPP85	CPP-87
CPP-118		CPP-91	CPP-89
CPP-119			CPP-111
CPP-120			
CPP-121			
CPP-122			
CPP-123			

Figure 4. Group 2 sites within the Operable Unit 3-14 industrial use area.

The OU 3-14 ROD, issued in 2007, designated the area surrounding the Tank Farm Facility, including the location of these four buildings, as an industrial use area (see Figure 4). The regulatory agencies agreed that potential future residential use within the industrial use area was not a reasonable anticipated future use. The OU 3-14 ROD stated that the OU 3-13 Group 2 sites within the industrial use area (including those under CPP-601 and CPP-602) would be cleaned up under OU 3-13 in accordance with the process identified in the OU 3-13 Group 2 Closure Evaluation Criteria and Checklist using the OU 3-14 remediation goals for soil in the industrial use area.

The *Action Memorandum for Decommissioning CPP-601/640 Fuel Reprocessing Facilities* (DOE-ID 2008a) determined that the CPP-601/640 non-time-critical removal action met the substantive requirements of the process identified in the Closure Evaluation Criteria and Checklist (DOE-ID 2000), and the checklist was not required. Because the non-time-critical removal actions for CPP-602 followed the same process as CPP-601/640 and is included in this removal action report, no Closure Evaluation Criteria and Checklist is required to close the remedial activities for CPP-602.

2.3 Snake River Plain Aquifer

The OU 3-14 Snake River Plain Aquifer remedial action objectives are as follows:

I. Prior to 2095, prevent current workers and the general public from ingesting Snake River Plain Aquifer groundwater contaminated by INTEC releases that exceeds (1) maximum contaminant levels, currently identified as 8 pCi/L for Sr-90, 900 pCi/L for Tc-99, 1 pCi/L for I-129, and 10 mg/L for nitrate measured as nitrogen; (2) a cumulative excess cancer risk from all carcinogens of 1 in 10,000; or (3) a hazard index of 1

II. In 2095 and beyond, ensure that concentrations of all contaminants in Snake River Plain Aquifer groundwater contaminated by INTEC releases do not exceed (1) maximum contaminant levels; (2) a cumulative excess cancer risk from all carcinogens of 1 in 10,000; or (3) a hazard index of 1.

Groundwater remediation goals are based on meeting the maximum contaminant levels in the portion of the Snake River Plain Aquifer contaminated by INTEC releases by 2095 and beyond and are presented in Table 2. The remediation goal for beta-gamma-emitting radionuclides (H-3, I-129, Tc-99, and Sr-90 and its daughters) is restricted to a cumulative dose of 4 mrem/yr in 2095 and beyond. The cumulative dose is determined by contaminants that overlap in space and time. The cumulative dose from alpha-emitting radionuclides (such as Am-241, Np-237, and Pu isotopes) is much lower than the maximum contaminant level of 15 pCi/L for all alpha-emitting radionuclides.

Table 2. Groundwater remediation goals for the year 2095 and beyond.

Contaminant of Concern	Remediation Goal
Sr-90	8 pCi/L
Total (Sr-90, I-129, and Tc-99)	4 mrem/yr

2.4 Surface Soil

The OU 3-14 industrial use area surface soil remedial action objective is to reduce risk from external radiation exposure to Cs-137 for current and future workers to a total excess cancer risk of less than 1E-4 (i.e., 1 in 10,000). The soil remediation goal for Cs-137 in the OU 3-14 industrial use area is back-calculated to current soil concentrations that correspond to a risk of 1 in 10,000 in 2095 for the top 4 ft of alluvium. The current-year values are then calculated to meet a Cs-137 concentration of 11.3 pCi/g

in 2095. Therefore, the remediation goal for the industrial use area in 2011 when the removal action was complete was calculated as a Cs-137 concentration of 78 pCi/g.

2.5 Removal Action Objectives

The Action Memorandum for CPP-601 and CPP-640 (DOE-ID 2008a) summarized these requirements as removal action objectives in the following manner:

- Reduce risk from external radiation exposure to Cs-137 for current and future workers to a total excess cancer risk of less than 1E-4 (i.e., 1 in 10,000)
- Prevent release of contaminants to the Snake River Plain Aquifer that could result in exceeding the drinking water maximum contaminant levels, a cumulative cancer risk from all carcinogens of 1E-4 (1 in 10,000, or a hazard index of 1)
- Prevent unacceptable internal exposure to biota that would result in the lack of maintenance or recovery of healthy local populations or communities of ecological receptors.

3. FACILITY BACKGROUNDS AND DESCRIPTIONS OF CPP-601, CPP-602, CPP-627, CPP-630, AND CPP-640

3.1 CPP-601 Facility Background and Description

CPP-601, Fuel Reprocessing Building, began operations in 1952 at INTEC. The primary mission was reprocessing uranium for defense purposes. Irradiated nuclear fuels were reprocessed to recover unused uranium. In 1992, the reprocessing mission was phased out.

The Fuel Reprocessing Building was a 244 × 102-ft building, consisting of six levels, with the primary portion located below ground. The primary operations included fuel dissolution, separation, chemical makeup and transfer, and liquid waste receiving processes. The top level, constructed of transite panels on post and beam, was 10 ft above grade and contained an open area used for transferring fuel elements to the process equipment and for chemical storage, makeup, and transfer. The lower levels, constructed of steel-reinforced concrete, contained process cells, corridors, and auxiliary cells that housed equipment and controls. The CPP-601 Deep Tanks System was located in the lowest level of Building CPP-601 and consisted of four 4,500-gal stainless steel tanks located in two stainless-steel-lined concrete vaults. This system collected liquid waste generated from separations processes performed in CPP-601. Laboratories and process systems from other buildings (i.e., CPP-602, CPP-627, CPP-640, CPP-666, and CPP-684) also sent waste to these tanks. This waste piping system was permitted under the Hazardous Waste Management Act/Resource Conservation and Recovery Act (HWMA/RCRA) as part of the INTEC Liquid Waste Management System.

Most of the floor, cell walls, and equipment were lined with stainless steel. The processing equipment, which was designed for remote operations, generally was enclosed in the heavily shielded cells. Often, lead was used as the shielding material. A significant amount of lead shielding also was encased in the concrete structures (floors and walls) (DOE-ID 2009a). Building CPP-601 was made up of heavily reinforced concrete walls up to 5 ft thick. The building was 80% underground.

3.2 CPP-602 Facility Background and Description

CPP-602, Laboratory and Office Building, began operations providing laboratory and office space in 1953. Those operations continued until D&D began in 2009. The primary purpose of CPP-602 was to support operations of the Fuel Reprocessing Complex at INTEC. The building contained 52,393 ft^2 on three floors. One of those floors was a basement approximately 14 ft below surrounding grade.

All three floors contained laboratory space for analysis of radiological samples, along with office space. Liquid radiological wastes were collected in the process equipment waste piping system that fed into a central waste collection piping system located in a central trench in the basement. Those wastes then were routed to the CPP-601 tanks for accumulation and storage until they were sent to the process equipment waste evaporator for processing. This waste piping system was permitted under the HWMA/RCRA as part of the INTEC Liquid Waste Management System.

3.3 CPP-627 Facility Background and Description

D&D of CPP-627, Remote Analytical Facility, was documented in the *Final Report for the Decontamination and Decommission of the CPP-627 Remote Analytical Facility* (ICP 2006a). That work was completed in 2005, leaving only a concrete pad essentially at grade covering some contaminated piping. CPP-627 is immediately adjacent to CPP-601 and CPP-640. Due to the proximity of CPP-627 to the non-time critical removal actions described in this document, that facility is included in this report so that the remaining contamination would be included in the overall assessment of residual risk remaining from the INTEC Fuel Reprocessing Complex.

3.4 CPP-630 Facility Background and Description

CPP-630, Spectrometry and Safety Building, was originally constructed to provide maintenance facilities to support operation of CPP-601. CPP-630 began operations in 1956. CPP-630 was a two-story building with masonry walls and built slab on grade. The facility occupied 21,510 ft^2. After construction of other maintenance facilities, the building was converted primarily to offices and minor laboratory space. The facility ceased operations in 2009.

3.5 CPP-640 Facility Background and Description

CPP-640, Headend Processing Plant, was a 66 × 89-ft structure constructed in 1961 to support research and process development for the uranium reprocessing mission in CPP-601. Building CPP-640 was made up of heavily reinforced walls up to 4.5 ft thick and was mostly underground. Fuel processing at CPP-640 ended in June 1984 (DOE-ID 2008a).The building contained two shielded waste-collection tank vaults at the lowest level, five shielded test cells at the mid-level, and an open crane loft with space for chemical makeup equipment and access to the cells through roof hatches at the upper level (DOE-ID 2007). A major modification in the late 1970s added the shielded mechanical handling cave within the crane loft. The CPP-640 Headend Storage Tank System received decontamination fluids generated in the plant. The tank system comprised two radiological waste tanks and a non-radiological waste tank. This waste piping system was permitted under the HWMA/RCRA as part of the INTEC Liquid Waste Management System.

4. END STATE DETERMINATION

Initial deactivation work began on CPP-601 and CPP-640 under the Action Memorandum for General Decommissioning (DOE-ID 2006b) that was approved in October 2006. Because that action memorandum considers these major facilities, a separate EE/CA and subsequent action memorandum was prepared. The EE/CA for CPP-601 and CPP-640 (DOE-ID 2008b) was approved in February 2008, and the Action Memorandum for CPP-601 and CPP-640 (DOE-ID 2008a) was approved in August 2008. That action memorandum selected Alternative 2 as the appropriate end state for these facilities.

The selected alternative required:

- Removing the buildings to the top deck level, with the exception of the tops of the P, Q, and R cells and the bottom 2.5 ft of the mechanical handling cave
- Filling the void spaces with grout or other inert material
- Placing an earthen cover over the remaining concrete monolith.

The selected alternative:

- Meets the remedial action objectives regarding long-term risk
- Minimizes short-term worker risk and radiation exposure
- Is cost effective
- Provides a safe and stable configuration that is environmentally sound.

Alternative 2 provides an end state consistent with the Department of Energy goal to reduce risk and minimize long-term surveillance and maintenance costs.

CPP-602 and CPP-630 were added to the General Decommissioning Action Memorandum as minor facilities in 2009.

5. REMOVAL ACTION WORK ACTIVITIES

The actions described in this report for CPP-601 and CPP-640 are consistent with the alternative selected in the *Action Memorandum for Decommissioning CPP-601/640 Fuel Reprocessing Facilities* (DOE-ID 2008a). The actions described in this report for CPP-602 and CPP-630 are consistent with the alternative selected in the *Action Memorandum for General Decommissioning Activities under the Idaho Cleanup Project* (DOE-ID 2009a).

5.1 CPP-601 Activities

Initial deactivation work began on CPP-601 under the Action Memorandum for General D&D (DOE-ID 2006b) that was approved in October 2006. Completion of deactivation activities and facility demolition were completed under the Action Memorandum for CPP-601 and CPP-640 (DOE-ID 2008a) that was approved in August 2008. The non-time-critical removal action for CPP-601 was completed in 2011. Photographs of the non-time-critical removal action are included in Appendix A.

Radiological and hazardous constituents were removed to the extent practicable prior to building demolition. The outer structure of CPP-601 was removed, leaving the process cells intact. Void spaces, such as process cells and other open areas, were filled with grout to form a solid concrete monolith. Larger pipes and vessels also were filled. A sloped grout sealing layer (approximately 1 ft thick) then was poured over the top surfaces of the entire facility. The soils east of the facility were paved with asphalt in coordination with the OU 3-14 recharge control zone requirements to prevent infiltration of precipitation. An earthen weather protection barrier at least 3 ft thick then was placed and compacted over the entire facility.

D&D of CPP-601 included removing hazardous components that were shipped off the INL Site to a permitted facility for appropriate treatment and disposal. They included various components, such as lead shielding, instrument caves, circuit boards, and other items that met the definition of hazardous waste. Asbestos (e.g., in pipe insulation, fireproof doors, transite panels) was removed for disposal at the Idaho CERCLA Disposal Facility. Closure of the CPP-601 tank system was conducted and certified under a Idaho Department of Environmental Quality (DEQ)-approved HWMA/RCRA closure plan (DOE-ID 2010a). Because sections of the CPP-601 tank system were impracticable to clean-close, the final closure of CPP-601 was performed as a landfill closure.

5.2 CPP-602 Activities

The Action Memorandum for General D&D (DOE-ID 2006b) was approved in October 2006. Approval to add CPP-602, Laboratory and Office Building, was obtained from DOE-ID, Environmental Protection Agency (EPA), and DEQ in 2009 (Cooper 2009; Faulk 2009; Koch 2009). D&D of CPP-602 began in 2009. D&D of CPP-602 included removing hazardous components that were shipped off the INL Site to a permitted facility for appropriate treatment and disposal. They included various components, such as lead-shielded caves, circuit boards, and other items that met the definition of hazardous waste. Asbestos (e.g., in pipe insulation, fireproof doors, transite panels) was removed for disposal at the Idaho CERCLA Disposal Facility. A significant quantity of Freon was recovered from the cooling system and turned over to the Department of Defense for reuse. Closure was conducted under a DEQ-approved HWMA/RCRA closure plan (DOE-ID 2009b) for that section of the INTEC Liquid Waste Management System that was within the CPP-602 footprint. That closure included removing all piping associated with the waste system except for the sections that were direct-buried beneath the basement floor that were within CERCLA site CPP-117 (see Figure 3). The removed piping was disposed of in accordance with the approved closure plan at on- or off-INL-Site facilities, depending upon the remaining contamination levels after flushing, with the more contaminated piping going to off-Site facilities. A main

hub (dial room) for electronic communications, alarms systems, and security systems was located within the CPP-602 basement. That hub was relocated from the northwest corner of the basement to east of CPP-602 adjacent to the Tank Farm Facility western fence. Photographs of the non-time-critical removal action are included in Appendix B.

Upon completion of deactivation and closure activities, the entire CPP-602 building was removed (other than the basement floor, direct-buried piping mentioned previously, and belowgrade walls) and transported to the Idaho CERCLA Disposal Facility for disposal. The basement walls were removed to approximately 3 ft below surrounding grade. The basement floor was effectively left in place, and specific areas within the basement were grouted to fill specific voids (below basement floor level) to minimize potential transport of contamination from historic releases beneath the basement floor to the aquifer. These grouted areas included the waste trench, waste sumps, elevator shaft, and denitrator pit. To prevent the entire basement from filling like a bathtub, the northwest corner of the basement floor (former location of dial room) was fractured to allow water to infiltrate in that area. That corner was chosen for fracturing because it was the point farthest from the areas of contaminated soils. Then, the basement was backfilled with clean pit run soils and the area graded to prevent pooling and divert natural precipitation flow away from the residual basement structure to the extent practical.

5.3 CPP-627 Activities

CPP-627, Remote Analytical Facility, is included in this report to ensure that remaining contamination for that facility was included in the residual source term for the INTEC Fuel Reprocessing Complex. D&D of this facility was documented as complete in 2005 (ICP 2006a). The concrete slab over CPP-627 was included in the landfill closure of CPP-601 and CPP-640. As such, the concrete slab was covered by the earthen weather protection barrier placed over these three facilities.

5.4 CPP-630 Activities

The Action Memorandum for General D&D (DOE-ID 2006b) was approved in October 2006. Approval to add CPP-630, Spectrometry and Safety Building, was obtained from DOE-ID, EPA, and DEQ in 2009 (Cooper 2009; Faulk 2009; Koch 2009). D&D of CPP-602 and CPP-630 began in 2009. Hazardous components and asbestos were removed from CPP-630 prior to demolition. CPP-630 was completely demolished, with most waste being shipped to the Idaho CERCLA Disposal Facility for disposal. This included the concrete floor slab at grade. There were no releases to the soils beneath CPP-630. Because the building was located within the OU 3-14 established recharge control zone, the area was covered with asphalt to prevent infiltration of precipitation. Photographs of the non-time-critical removal action are included in Appendix C.

5.5 CPP-640 Activities

D&D of CPP-640, Headend Process Plant, included removal of hazardous components that were shipped off the INL Site to a permitted facility for appropriate treatment and disposal. They included various components, such as lead shielding, circuit boards, and other items that met the definition of hazardous waste. Asbestos (e.g., in pipe insulation, fireproof doors, transite panels) was removed for disposal at the Idaho CERCLA Disposal Facility. Clean closure of the CPP-640 tank system was conducted under a DEQ-approved HWMA/RCRA Closure Plan (DOE-ID 2010a). Because there was lead impracticable to remove, CPP-640 was included in the landfill closure of CPP-601. As with CPP-601, the outer structure of CPP-640 was removed, leaving the process cells intact. Void spaces, such as process cells and other open areas, were filled with grout to form a solid concrete monolith. Larger pipes and vessels also were filled. A sloped grout sealing layer (approximately 1 ft thick) then was poured over the

top surfaces of the entire facility. An earthen weather protection barrier at least 3 ft thick then was placed and compacted over the entire facility. Photographs of the non-time-critical removal action are included in Appendix D.

6. PROJECT COMPLETION

6.1 Residual Contamination

Contamination that was left within CPP-601, CPP-602, CPP-627, and CPP-640 as a result of the completed non-time-critical removal actions and the contamination historically released beneath those buildings (CERCLA sites CPP-80, CPP-117 [encompasses CPP-86], CPP-118, CPP-119, CPP-120, CPP-121, CPP-122, and CPP-123) were included in the residual source term and were evaluated in the risk assessment described in this document. Residual contamination from CPP-601, CPP-602, CPP-627, CPP-640, and the CERCLA sites is evaluated as one source term because these facilities are adjacent to each other. Tables 3 and 4 present the radiological and non-radiological source term for contamination remaining upon completion of the non-time-critical removal actions. These tables are primarily derived from the "Residual Radioactive Inventory for Fuel Reprocessing Complex Removal Action Report" (EDF-10239) for radionuclides and "Non-radiological Material Inventory for CPP-601, CPP-602, CPP-627, and CPP-640 Landfill Closure" (EDF-9367, Rev. 2) for non-radionculides. This information will be used in the "Groundwater Risk Assessment for CPP-601, CPP-602, CPP-627, and CPP-640 Fuel Reprocessing Complex Non-Time-Critical Removal Action" (EDF-10195, Rev. 1).

The source term for that risk assessment was based upon an update of the source term that was used for the risk assessment in the EE/CA for CPP-601/640 in 2008. That source term for the EE/CA was documented in EDF-8293, Rev. 2, for radionuclides and EDF-8192, Rev. 1, for non-radionuclides. The source term for the EE/CA included estimates of the contamination that would remain within and beneath the building based upon the anticipated end state to be selected in the Action Memorandum. The estimated contaminants from the CERCLA sites were included in the 2008 evaluation with the exception of the non-radionuclides for CPP-117 (encompassing CPP-86) beneath CPP-602.

The updated residual source term used for the risk assessment that supports this removal action report took those two primary source-term documents (EDF-8192 and EDF-8293) and updated them with information obtained during the non-time-critical removal actions as illustrated in Figure 5. EDF-9367, Rev. 2, updates the non-radiological source presented in EDF-8192 by adding the estimates of the contaminants left in the CPP-601 deep tanks, contaminants left in the CPP-627 piping, contaminants from the CPP-602 release (CPP-117), and additional lead that was determined to be impracticable to remove. EDF-10239 updates the radiological source term. The radiological source term for the CERCLA sites remains unchanged from EDF-8293, Rev. 2, and was updated in Technical Baseline (TBL)-226. EDF-10239 provides additional minor corrections to the information presented in TBL-226. TBL-247 presents the residual radioactive source term for CPP-627, and TBL-324 presents the residual source term for CPP-602. EDF-10239 then summarizes this information and provides the total residual radiological source term to be used in the risk assessment that supports this removal action report.

Table 3. Remaining radionuclide inventory.[a]

Radionuclide	Radionuclide Decay Half-Life (yr)	CPP-601/640 Complex Totals (Ci)	CPP-627 Pipe Residual (Ci)	CPP-602 Basement (Ci)	CERCLA Soils (Ci)	Total Activity (Ci)
Ac-227	2.18E+01	1.77E-06	—	—	1.74E-06	3.51E-06
Am-241	4.32E+02	4.71E-02	1.63E-05	2.36E-06	1.82E-01	2.29E-01
Am-242m	1.41E+02	2.87E-05	—	—	2.78E-05	5.65E-05
Am-243	7.37E+03	1.96E-04	—	—	1.89E-04	3.85E-04
Bi-212[b]	1.15E-04	—	—	2.17E-07	--	2.17E-07
C-14	5.70E+03	4.69E-04	—	3.48E-09	4.49E-04	9.18E-04
Cm-242[b]	4.46E-01	4.25E-03	8.89E-10	—	4.10E-03	8.36E-03
Cm-243	2.91E+01	3.68E-06	—	—	3.56E-06	7.25E-06
Cm-244	1.81E+01	3.63E-03	3.19E-06	—	3.51E-03	7.15E-03
Co-60	5.27E+00	7.20E-01	4.52E-07	—	1.54E-01	8.75E-01
Cs-134[b]	2.07E+00	1.44E-01	2.22E-06	—	1.40E-01	2.84E-01
Cs-135	2.30E+06	4.63E-03	—	—	4.47E-03	9.09E-03
Cs-137	3.01E+01	4.89E+02	7.41E-03	1.38E-03	1.78E+02	6.67E+02
Eu-152	1.35E+01	5.84E-01	—	—	5.64E-01	1.15E+00
Eu-154	8.59E+00	2.70E+00	3.56E-05	—	2.61E+00	5.31E+00
Eu-155[b]	4.76E+00	4.91E-01	5.11E-06	—	4.74E-01	9.66E-01
H-3	1.23E+01	4.15E-01	—	3.11E-06	2.50E+00	2.91E+00
I-129	1.57E+07	4.31E-04	—	3.21E-09	1.80E-04	6.11E-04
Ni-59	7.60E+04	2.69E-04	—	—	2.60E-04	5.29E-04
Ni-63	1.00E+02	3.48E-02	—	—	3.37E-02	6.85E-02
Np-237	2.14E+06	2.44E-02	8.89E-06	1.80E-07	1.06E-01	1.31E-01
Pa-231	3.28E+04	6.22E-06	—	—	6.01E-06	1.22E-05
Pa-233[b]	7.38E-02	—	—	1.15E-07	—	1.15E-07
Pa-234m[b]	2.22E-06	—	—	3.87E-08	—	3.87E-08
Pb-212[b]	1.21E-03	—	—	2.17E-07	—	2.17E-07
Pd-107	6.50E+06	1.16E-04	—	—	1.12E-04	2.27E-04
Pm-146	5.53E+00	3.27E-04	—	—	3.15E-04	6.42E-04
Pm-147[b]	2.62E+00	2.47E+00	—	—	2.39E+00	4.85E+00
Pu-236[b]	2.86E+00	3.27E-06	—	—	3.16E-06	6.42E-06
Pu-238	8.77E+01	2.17E+00	4.52E-04	2.21E-05	6.12E+00	8.29E+00
Pu-239	2.41E+04	1.41E-01	1.48E-05	5.10E-07[c]	1.73E-01	3.14E-01
Pu-240	6.56E+03	1.81E-02	—	5.10E-07[c]	1.75E-02	3.55E-02
Pu-241	1.43E+01	5.23E+00	—	2.21E-05	5.04E+00	1.03E+01

Table 3. (continued).

Radionuclide	Radionuclide Decay Half-Life (yr)	CPP-601/640 Complex Totals (Ci)	CPP-627 Pipe Residual (Ci)	CPP-602 Basement (Ci)	CERCLA Soils (Ci)	Total Activity (Ci)
Pu-242	3.73E+05	3.94E-05	—	—	3.80E-05	7.73E-05
Ra-224[b]	1.00E-02	--	—	2.17E-07	—	2.17E-07
Ra-226	1.60E+03	1.73E-03	—	—	—	1.73E-03
Rn-220[b]	1.76E-06	—	—	2.17E-07	—	2.17E-07
Sb-125[b]	2.76E+00	3.10E+00	—	—	2.81E+00	5.91E+00
Se-79	1.10E+06	1.73E-03	—	—	1.68E-03	3.41E-03
Sm-151	9.00E+01	1.06E+00	—	—	1.02E+00	2.08E+00
Sn-121m	5.50E+01	2.34E-03	—	—	2.27E-03	4.61E-03
Sn-126	1.00E+05	1.18E-03	—	—	1.13E-03	2.31E-03
Sr-90	2.88E+01	1.18E+02	4.15E-03	1.09E-04	1.78E+02	2.96E+02
Tc-99	2.11E+05	9.73E-02	—	6.90E-06	2.06E-02	1.18E-01
Th-228[b]	1.91E+00	—	—	2.30E-08	—	2.30E-08
Th-231[b]	2.91E-03	—	—	3.22E-07	—	3.22E-07
Th-234[b]	6.60E-02	—	—	3.87E-08	—	3.87E-08
U-232	6.89E+01	5.76E-05	—	2.19E-07	5.56E-05	1.13E-04
U-233	1.59E+05	5.21E-07	—	—	2.71E-06	3.23E-06
U-234	2.46E+05	2.32E-01	2.74E-06	1.43E-05	1.81E-01	4.13E-01
U-235	7.04E+08	1.05E-02	9.63E-08	3.58E-07	3.19E-02	4.24E-02
U-236	2.34E+07	2.55E-03	—	2.58E-06	2.46E-03	5.01E-03
U-238	4.47E+09	1.02E-03	1.41E-08	7.55E-08	8.94E-04	1.92E-03
Zn-65[b]	6.69E-01	1.54E-04	—	—	—	1.54E-04
Zr-93	1.53E+06	8.24E-03	—	—	7.96E-03	1.62E-02

a. Based on EDF-10239, Table 9, and EDF-10195, Table 1,

b. Radionuclides with half-lives less than 5 years were screened out from further assessment. They will decay before reaching the aquifer.

c. The inventory for Pu-239 and Pu-240 were listed together in TBL-324, Table 1. For this analysis, the combined Pu-239 and Pu-240 was counted twice, both assuming it was all Pu-239 and all Pu-240.

Table 4. Remaining non-radiological source term.[a]

Constituent	CPP-601 (kg)	CPP-640 (kg)	CPP-627 (kg)	CERCLA Soils (kg)	Total Nonradionuclide Inventory (kg)
Aluminum	1.90E-01	0.00E+00	2.39E-02	1.25E+00	1.46E+00
Antimony	1.05E+00	1.95E-01	0.00E+00	0.00E+00	1.25E+00
Arsenic	2.70E-02	5.00E-03	2.45E-03	0.00E+00	3.45E-02
Barium	1.37E+01	2.50E+00	4.28E-02	0.00E+00	1.63E+01
Beryllium	5.00E-03	9.00E-05	0.00E+00	0.00E+00	5.09E-03
Boron	9.07E+02	0.00E+00	0.00E+00	0.00E+00	9.07E+02
Cadmium	4.40E+01	8.40E+00	0.00E+00	2.08E-03	5.24E+01
Calcium	5.00E-02	0.00E+00	4.07E-01	0.00E+00	4.57E-01
Chloride	0.00E+00	0.00E+00	0.00E+00	3.74E+00	3.74E+00
Chromium	1.04E+05	3.36E+03	5.43E+00	2.39E+00	1.08E+05
Cobalt	1.00E-02	0.00E+00	3.02E-02	0.00E+00	4.02E-02
Copper	1.05E+05	8.44E+03	9.50E-02	0.00E+00	1.13E+05
Di-n-butylphthalate	0.00E+00	0.00E+00	3.00E-03	0.00E+00	2.91E-03
Fluoride	0.00E+00	0.00E+00	0.00E+00	1.25E+00	1.25E+00
Hexone	0.00E+00	0.00E+00	0.00E+00	2.76E+02	2.76E+02
Iron	1.51E+01	0.00E+00	2.09E+01	0.00E+00	3.60E+01
Lead	3.15E+02	7.80E+01	1.47E-01	9.18E+01	4.85E+02
Lead -bulk, impractical to remove	1.16E+05	1.64E+03	0.00E+00	0.00E+00	1.17E+05
Magnesium	4.00E-02	0.00E+00	1.30E-02	0.00E+00	5.30E-02
Manganese	8.00E-02	0.00E+00	5.22E-01	0.00E+00	6.02E-01
Mercury	2.40E-02	3.00E-03	1.81E-03	1.30E+00	1.33E+00
Nickel	5.50E+04	3.18E+03	3.33E+00	1.13E+00	5.82E+04
Nitrate	0.00E+00	0.00E+00	0.00E+00	1.06E+03	1.06E+03
Polychlorinated biphenyls (PCBs)	9.09E+01	1.76E+01	0.00E+00	0.00E+00	1.09E+02
Potassium	4.00E-02	0.00E+00	3.41E-03	0.00E+00	4.34E-02
Selenium	2.00E-02	4.00E-03	0.00E+00	0.00E+00	2.40E-02
Silver	5.60E-01	4.00E-03	0.00E+00	0.00E+00	5.64E-01
Sodium	0.00E+00	0.00E+00	7.39E-02	0.00E+00	7.39E-02
Sulfates	0.00E+00	0.00E+00	0.00E+00	2.20E+00	2.20E+00
Thallium	3.00E-02	5.00E-03	0.00E+00	0.00E+00	3.50E-02
Tin	1.20E+02	9.00E+00	0.00E+00	0.00E+00	1.29E+02
Uranium	2.52E-01	8.94E-01	0.00E+00	0.00E+00	1.15E+00
Vanadium	3.00E-02	4.00E-03	1.47E-02	0.00E+00	4.87E-02
Zinc	2.72E+02	2.72E+01	3.27E-03	0.00E+00	3.00E+02

a. Source: EDF-9367, Table 7.

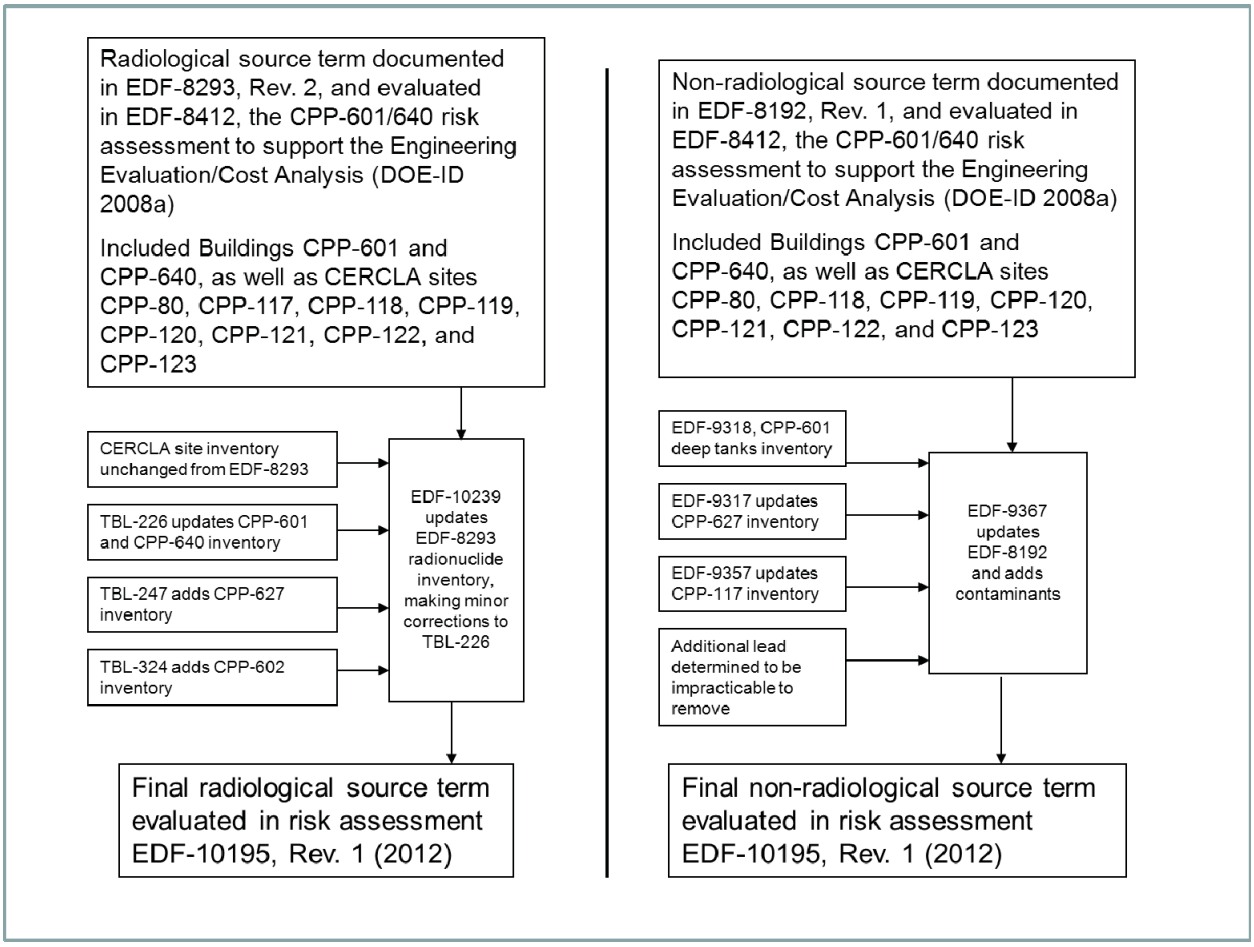


Figure 5. Development of residual source term.

6.2 Residual Source-Term Validation

The contamination remaining within the buildings is primarily present within the residual structure of CPP-601 and CPP-640. Smaller amounts can be found within the residual structure of CPP-602 and CPP-627 and beneath the CPP-601 and CPP-602 facility. No contamination was left in place upon completion of non-time-critical removal actions for CPP-630. The source terms developed for the residual risk assessment are believed to be conservative. For example, in both CPP-601 and CPP-627, certain lines were not able to be completely flushed. For the purposes of developing this source term, the contaminants left in those lines were estimated based upon the assumption that those lines were 100% full of the typical solutions.

The source terms presented in Table 3 and Table 4 are based upon adding the additional contaminants that were identified during these removal actions to the inventories established and evaluated in the EE/CA for Decommissioning of the CPP-601/CPP-640 Fuel Reprocessing Facilities (DOE-ID 2008b), as presented in EDF-8293, Rev. 2, and EDF-8192 and subjected to a risk assessment in EDF-8214 in 2008. The following new minor radionuclides were identified at the less-than-microcurie total inventory levels: Bi-212, Pa-233, Pa-234m, Pb-212, Ra-224, Rn-220, Th-228, Th-231, and Th-234.

All of these new radionuclides, along with Ce-144, Cm-242, Cs-134, Eu-155, Pm-147, Pu-236, Sb-125, and Zn-65 from the previous inventory, have half-lives of less than five years and, therefore, based upon travel time to the aquifer, do not present an unacceptable risk.

The radionuclide inventory presented in Table 3 for Co-60 and Cs-137 represents approximately a two-fold increase for the radionuclides left within the facilities. This increase is primarily attributable to the heels left within the waste tanks in CPP-601 and CPP-640. As discussed in the risk assessment section (Section 7), these contaminants do not contribute significantly to long-term risk due to their relatively short half lives. Am-241, Np-237, Pu-238, Pu-239, U-233, and U-235 significantly decreased because substantial efforts were made to reduce the amount of special nuclear material left behind in the facilities. These changes are shown in Table 5. For non-radionuclides, the only significant change in source term is that an additional 4.7E4 kg of lead was left within the CPP-601 and CPP-640 facilities because it was impracticable to remove.

Table 5. Percent change from EDF-8293, Rev. 2, to updated inventory.

Isotope	EDF-8293, Rev. 2 (Ci)	EDF-10239 (Ci)	% Change
Ac-227	3.54E-06	3.51E-06	−1%
Am-241	3.71E-01	2.29E-01	−38%
Am-242m	5.65E-05	5.65E-05	0%
Am-243	3.84E-04	3.85E-04	0%
Bi-212	0.00E+00	2.17E-07	New
C-14	9.17E-04	9.18E-04	0%
Cm-242	8.35E-03	8.36E-03	0%
Cm-243	7.26E-06	7.25E-06	0%
Cm-244	7.15E-03	7.15E-03	0%
Co-60	3.85E-01	8.75E-01	127%
Cs-134	2.84E-01	2.84E-01	0%
Cs-135	9.09E-03	9.09E-03	0%
Cs-137	3.71E+02	6.67E+02	80%
Eu-152	1.15E+00	1.15E+00	0%
Eu-154	5.32E+00	5.31E+00	0%
Eu-155	9.66E-01	9.66E-01	0%
H-3	2.91E+00	2.91E+00	0%
I-129	6.11E-04	6.11E-04	0%
Ni-59	5.29E-04	5.29E-04	0%
Ni-63	6.85E-02	6.85E-02	0%
Np-237	2.16E-01	1.31E-01	−39%
Pa-231	1.22E-05	1.22E-05	0%
Pa-233	0.00E+00	1.15E-07	New
Pa-234m	0.00E+00	3.87E-08	New
Pb-212	0.00E+00	2.17E-07	New

Table 5. (continued).

Isotope	EDF-8293, Rev. 2 (Ci)	EDF-10239 (Ci)	% Change
Pd-107	2.28E-04	2.27E-04	0%
Pm-146	6.41E-04	6.42E-04	0%
Pm-147	4.86E+00	4.85E+00	0%
Pu-236	6.42E-06	6.42E-06	0%
Pu-238	1.24E+01	8.29E+00	−33%
Pu-239	4.27E-01	3.14E-01	−26%
Pu-240	3.56E-02	3.55E-02	0%
Pu-241	1.03E+01	1.03E+01	0%
Pu-242	7.73E-05	7.73E-05	0%
Ra-224	0.00E+00	2.17E-07	New
Ra-226	1.73E-03	1.73E-03	0%
Rn-220	0.00E+00	2.17E-07	New
Sb-125	5.78E+00	5.91E+00	2%
Se-79	3.41E-03	3.41E-03	0%
Sm-151	2.08E+00	2.08E+00	0%
Sn-121m	4.61E-03	4.61E-03	0%
Sn-126	2.31E-03	2.31E-03	0%
Sr-90	2.93E+02	2.96E+02	1%
Tc-99	1.18E-01	1.18E-01	0%
Th-228	0.00E+00	2.30E-08	New
Th-231	0.00E+00	3.22E-07	New
Th-234	0.00E+00	3.87E-08	New
U-232	1.13E-04	1.13E-04	0%
U-233	5.51E-06	3.23E-06	−41%
U-234	4.15E-01	4.13E-01	0%
U-235	6.64E-02	4.24E-02	−36%
U-236	5.01E-03	5.01E-03	0%
U-238	2.01E-03	1.92E-03	−4%
Zn-65	1.54E-04	1.54E-04	0%
Zr-93	1.62E-02	1.62E-02	0%
Total	**7.12E+02**	**1.01E+03**	**141%**

Yellow highlight indicates increased residual source term for specific isotope.
Green highlight indicates decreased residual source term for specific isotope.

6.3 Project Cost and Waste Generation

Completion dates, waste generation, and accumulated costs for the non-time-critical removal actions for these buildings are listed in Table 6.

Table 6. Non-time-critical removal actions completion dates, waste generation, and costs.

Building	Completion Date	Mixed and Hazardous Waste Generated (m^3)	ICDF Generated (m^3)	Industrial Waste (m^3)	Cost (millions)
CPP-601	July 2011	174	7,714	12	$44.2[a]
CPP-602	July 2011	111[b]	13,326[b]	281[b]	$10.3[b]
CPP-630	June 2010	0[b]	1,734[b]	514[b]	$0.8[b]
CPP-640	July 2011	45	4,038	1	$0.0[a]
Total		**329**	**26,812**	**808**	**$55.3**

a. CPP-601 and CPP-640 costs were tracked as one project.

b. For part of the CPP-630 deactivation and decommissioning project, costs and waste generation were managed as part of the CPP-602 project.

ICDF Idaho CERCLA Disposal Facility

7. END STATE COMPLIANCE WITH CERCLA REQUIREMENTS

7.1 Risk Assessment

This removal action was implemented consistent with the remedial action objectives and remediation goals established in the *Final Record of Decision Idaho Nuclear Technology and Engineering Center Operable Unit 3-13* (DOE-ID 1999), as modified by the *Record of Decision for Tank Farm Soil and INTEC Groundwater Operable Unit 3-14* (DOE-ID-2007). Compliance with the groundwater remedial action objectives and remediation goals for these removal actions is documented in "Groundwater Pathway Risk Assessment for CPP-601, CPP-602, CPP-627, and CPP-640 Fuel Reprocessing Complex Non-Time-Critical Removal Action" (EDF-10195). That EDF was based upon GWSCREEN modeling of the contamination remaining upon completion of the removal actions. The modeling approach was based upon a bounding case that assumed no impact to contaminant movement as a result of the majority of the remaining contaminants being held within the stainless steel vessels, pipes, and secondary containment systems that are encased in the concrete monolith. The EDF documents:

- Peak risk less than 1E-04
- Compliance with the maximum contaminant levels at peak concentrations
- Cumulative dose from beta-gamma-emitting radionuclides of less than 4 mrem/yr
- Hazard index of less than 1.

Tables 7 through 9 of this removal action report summarize the information from EDF-10195, documenting that the remedial action objectives and remediation goals are met.

The results of the radionuclide risk assessment indicate the peak cumulative risk is less than 4E-07 over the next 1,000 years (from I-129 and Tc-99) and about 2E-06 in the long term (primarily from U-234, peaking at approximately 14,000 years). The long-term risk is overestimated as a result of how GWSCREEN estimates the concentration of progeny in the aquifer (see discussion in Section 4 of EDF-10195). The risk for all radionuclides are orders of magnitude below the EPA cumulative carcinogenic risk level of 1E-04 and near the bottom of the acceptable target risk range of 1E-06 to 1E-04. Table 8 compares the predicted aquifer concentrations to the maximum contaminant levels. The predicted peak concentration of I-129 is less than 6% of the maximum contaminant level, and total alpha is less than 2% of the maximum contaminant level. The predicted peak concentrations for the other radionuclides are well below the maximum contaminant levels in all cases.

For chemicals exhibiting noncarcinogenic effects, the hazard quotients are all much less than 1, indicating it is unlikely for even sensitive subpopulations to experience adverse health effects. For chemicals exhibiting carcinogenic effects, the risks are all well below the EPA target risk range of 1E-04 to 1E-06. The predicted maximum groundwater concentrations for the chemicals of concern were compared to the State of Idaho maximum contaminant levels. All predicted maximum groundwater concentrations are much less than the chemical's respective maximum contaminant level.

This risk assessment demonstrates that the inventory left in place after the D&D of CPP-601, CPP-602, CPP-627, CPP-630, CPP-640, and the contaminated CERCLA soils meet the CERCLA remedial action objectives for groundwater.

Table 7. Groundwater pathway risk assessment results for radionuclides of concern.[a]

Radionuclide	Progeny	Initial Inventory (Ci)	Carcinogenic Risk Slope Factor[b] (risk/Ci)	Kd Source (mL/g)	Kd Vadose Zone (mL/g)	Kd Aquifer (mL/g)	Peak Time (yr)	Peak Concentration (pCi/L)	Peak Risk	Total Risk
Ac-227		3.51E-06	4.86E+02	450	450	18	NA	0.00E+00	0.00E+00	0E+00
Am-241 (Np-237)[c]		4.70E-05	6.74E+01	8	8	0.32	18,691	7.71E-05	1.09E-10	1E-10
	U-233		7.18E+01			0.24		7.89E-06	1.19E-11	
	Th-229		5.28E+02			4		2.77E-07	3.08E-12	
Am-242m (U-234)[c]		3.35E-08	7.07E+01	6	6	0.24	13,908	7.04E-17	1.04E-13	1E-13
	Th-230		9.10E+01			4		5.65E-19	1.08E-15	
	Ra-226		3.86E+02			4		4.77E-19	3.86E-15	
	Pb-210		1.27E+03			4		4.75E-19	1.27E-14	
Am-243[d]		3.85E-04	1.08E+02	340	340	13.6	86,500	4.56E-12	1.04E-17	4E-15
	Pu-239		1.35E+02			5.6		1.38E-09	3.90E-15	
	U-235		7.18E+01			0.24		7.41E-12	1.12E-17	
	Pa-231		1.73E+02			22		5.55E-14	2.02E-19	
	Ac-227		4.86E+02			18		6.78E-14	6.91E-19	
C-14		9.18E-04	1.55E+00	0.1[e]	0.1[e]	0.004	563	4.78E-02	1.55E-09	2E-09
Cm-243 (Pu-239)[c]		8.90E-09	1.35E+02	140	22	5.6	38,627	3.56E-10	1.01E-15	1E-15
	U-235		7.18E+01			0.24		5.29E-13	7.97E-19	
	Pa-231		1.73E+02			22		2.32E-15	8.43E-21	
	Ac-227		4.86E+02			18		2.83E-15	2.89E-20	
Cm-244 (Pu-240)[c]		2.00E-05	1.35E+02	140	22	5.6	21,298	9.65E-08	2.74E-13	3E-13
	U-236		6.70E+01			0.24		4.89E-09	6.88E-15	
	Th-232		1.01E+02			4		2.26E-16	4.80E-22	
	Ra-228		1.04E+03			4		2.26E-16	4.94E-21	
	Th-228		3.00E+02			4		2.26E-16	1.42E-21	
Co-60		8.75E-01	1.57E+01	10	10	0.4	NA	0.00E+00	0.00E+00	0E+00
Cs-135		9.09E-03	4.74E+00	500	500	20	1,007,300	1.77E-04	1.76E-11	2E-11
Cs-137		6.67E+02	3.04E+01	500	500	20	NA	0.00E+00	0.00E+00	0E+00
Eu-152		1.15E+00	6.07E+00	340	340	13.6	NA	0.00E+00	0.00E+00	0E+00

Table 7. (continued).

Radionuclide	Progeny	Initial Inventory (Ci)	Carcinogenic Risk Slope Factor[b] (risk/Ci)	Kd Source (mL/g)	Kd Vadose Zone (mL/g)	Kd Aquifer (mL/g)	Peak Time (yr)	Peak Concentration (pCi/L)	Peak Risk	Total Risk
Eu-154		5.31E+00	1.03E+01	340	340	13.6	NA	0.00E+00	0.00E+00	0E+00
H-3		2.91E+00	1.12E-01	0	0	0	81	1.47E-01	3.28E-10	3E-10
I-129		6.11E-04	1.48E+02	0	0	0	343	5.84E-02	1.81E-07	2E-07
Ni-59		5.29E-04	2.74E-01	100	100	4	134,200	1.50E-05	8.62E-14	9E-14
Ni-63		6.85E-02	6.70E-01	100	100	4	NA	0.00E+00	0.00E+00	0E+00
Np-237		1.31E-01	6.74E+01	8	8	0.32	18,691	2.15E-01	3.04E-07	3E-07
	U-233		7.18E+01			0.24		2.19E-02	3.31E-08	
	Th-229		5.28E+02			4		7.72E-04	8.56E-09	
Pa-231		1.22E-05	1.73E+02	550	550	22	233,650	5.88E-11	2.13E-16	9E-16
	Ac-227		4.86E+02			18		7.19E-11	7.33E-16	
Pd-107		2.27E-04	2.50E-01	55	55	2.2	126,020	5.47E-05	2.87E-13	3E-13
Pm-146		6.42E-04	4.18E+00	240	240	9.6	NA	0.00E+00	0.00E+00	0E+00
Pu-238 (U-234)[c]		3.00E-03	7.07E+01	6	6	0.24	13,908	6.32E-03	9.38E-09	1E-08
	Th-230		9.10E+01			4		5.07E-05	9.69E-11	
	Ra-226		3.86E+02			4		4.28E-05	3.47E-10	
	Pb-210		1.27E+03			4		4.27E-05	1.14E-09	
Pu-239		3.14E-01	1.35E+02	140	22	5.6	38,627	1.26E-02	3.56E-08	4E-08
	U-235		7.18E+01			0.24		1.87E-05	2.81E-11	
	Pa-231		1.73E+02			22		8.19E-08	2.97E-13	
	Ac-227		4.86E+02			18		9.99E-08	1.02E-12	
Pu-240		3.55E-02	1.35E+02	140	22	5.6	21,298	1.71E-04	4.85E-10	5E-10
	U-236		6.70E+01			0.24		8.67E-06	1.22E-11	
	Th-232		1.01E+02			4		4.01E-13	8.51E-19	
	Ra-228		1.04E+03			4		4.01E-13	8.76E-18	
	Th-228		3.00E+02			4		4.01E-13	2.53E-18	
Pu-241 (Np-237)[c]		6.97E-05	6.74E+01	8	8	0.32	18,691	1.14E-04	1.62E-10	2E-10
	U-233		7.18E+01			0.24		1.17E-05	1.76E-11	
	Th-229		5.28E+02			4		4.11E-07	4.56E-12	

Table 7. (continued).

Radionuclide	Progeny	Initial Inventory (Ci)	Carcinogenic Risk Slope Factor[b] (risk/Ci)	Kd Source (mL/g)	Kd Vadose Zone (mL/g)	Kd Aquifer (mL/g)	Peak Time (yr)	Peak Concentration (pCi/L)	Peak Risk	Total Risk
Pu-242		7.73E-05	1.28E+02	140	22	5.6	78,120	1.25E-05	3.35E-11	3E-11
	U-238		8.71E+01			0.24		3.46E-09	6.33E-15	
	U-234		7.07E+01			0.24		3.63E-10	5.38E-16	
	Th-230		9.10E+01			4		4.94E-12	9.43E-18	
	Ra-226		3.86E+02			4		4.56E-12	3.69E-17	
	Pb-210		1.27E+03			4		4.55E-12	1.21E-16	
Ra-226		1.73E-03	3.86E+02	100	100	4	NA	0.00E+00	0.00E+00	0E+00
	Pb-210		1.27E+03			4		0.00E+00	0.00E+00	
Se-79		3.41E-03	7.29E+00	4	4	0.16	9,522	1.10E-02	1.68E-09	2E-09
Sm-151		2.08E+00	5.55E-01	240	240	9.8	NA	0.00E+00	0.00E+00	0E+00
Sn-121m		4.61E-03	2.34E+00	130	130	5.2	NA	0.00E+00	0.00E+00	0E+00
Sn-126		2.31E-03	2.56E+01	130	130	5.2	175,150	5.11E-05	2.75E-11	3E-11
Sr-90		2.96E+02	7.40E+01	12	12	0.48	NA	0.00E+00	0.00E+00	0E+00
Tc-99		1.18E-01	2.75E+00	0.2	0.2	0.008	809	4.63E+00	2.67E-07	3E-07
U-232		1.13E-04	2.92E+02	6	6	0.24	NA	0.00E+00	0.00E+00	0E+00
	Th-228		3.00E+02			4		0.00E+00	0.00E+00	
U-233		3.23E-06	7.18E+01	6	6	0.24	13,784	6.65E-06	1.00E-11	1E-11
	Th-229		5.28E+02			4		3.25E-07	3.60E-12	
U-234		4.13E-01	7.07E+01	6	6	0.24	13,908	8.68E-01	1.29E-06	2E-06
	Th-230		9.10E+01			4		6.97E-03	1.33E-08	
	Ra-226		3.86E+02			4		5.88E-03	4.76E-08	
	Pb-210		1.27E+03			4		5.86E-03	1.56E-07	
U-235		4.24E-02	7.18E+01	6	6	0.24	14,143	9.27E-02	1.40E-07	1E-07
	Pa-231		1.73E+02			22		2.87E-04	1.04E-09	
	Ac-227		4.86E+02			18		3.50E-04	3.57E-09	

Table 7. (continued).

Radionuclide	Progeny	Initial Inventory (Ci)	Carcinogenic Risk Slope Factor[b] (risk/Ci)	Kd Source (mL/g)	Kd Vadose Zone (mL/g)	Kd Aquifer (mL/g)	Peak Time (yr)	Peak Concentration (pCi/L)	Peak Risk	Total Risk
U-236		5.01E-03	6.70E+01	6	6	0.24	14,141	1.10E-02	1.54E-08	2E-08
	Th-232		1.01E+02			4		5.00E-10	1.06E-15	
	Ra-228		1.04E+03			4		4.99E-10	1.09E-14	
	Th-228		3.00E+02			4		4.99E-10	3.15E-15	
U-238		1.92E-03	8.71E+01	6	6	0.24	14,143	4.19E-03	7.67E-09	8E-09
	U-234		7.07E+01			0.24		1.64E-04	2.43E-10	
	Th-230		9.10E+01			4		6.74E-07	1.29E-12	
	Ra-226		3.86E+02			4		4.93E-07	4.00E-12	
	Pb-210		1.27E+03			4		4.90E-07	1.31E-11	
Zr-93		1.62E-02	1.11E+00	600	600	24	1,107,200	2.08E-04	4.84E-12	5E-12

a. Source: EDF-10195, Table 4.

b. The carcinogenic risk slope factors are from "Cancer Risk Coefficients for Environmental Exposure to Radionuclides" (EPA 1999).

c. Am-241 and Pu-241 are simulated as Np-237; Am-242m is simulated as U-234; Cm-243 is simulated as Pu-239; Cm-244 is simulated as Pu-240; and Pu-238 is simulated as U-234.

d. If Am-243 is assumed to decay instantaneously to Pu-239, it would create 1.27E-06 Ci of Pu-239 or only 0.001% of the Pu-239 inventory. Am-243 is an insignificant contributor to the Pu-239 inventory and need not be simulated as Pu-239.

e. C-14 was not simulated in the 2003 ICDF Performance Assessment, and Jenkins (2001) lists a relatively high Kd value of 5 mL/g. A conservative value of 0.1 mL/g was used (from the 2000 Radioactive Waste Management Complex Performance Assessment [Case et al. 2000]).

ICDF Idaho CERCLA Disposal Facility
Kd Adsorption coefficient
NA not applicable

Table 8. Comparison of maximum contaminant levels to predicted peak groundwater concentrations for radionuclides of concern.[a]

Radionuclide	Initial Inventory (Ci)	Peak Concentration (pCi/L)	Peak Concentration (µg/L)	Beta-Gamma Dose (mrem/yr)	Maximum Contaminant Level
C-14	9.18E-04	4.78E-02	NA	9.55E-05	2,000 pCi/L
Co-60	8.75E-01	0.00E+00	NA	0.00E+00	100 pCi/L
Cs-135	9.09E-03	1.77E-04	NA	1.77E-06	400 pCi/L
Cs-137	6.67E+02	0.00E+00	NA	0.00E+00	200 pCi/L
Eu-152	1.15E+00	0.00E+00	NA	0.00E+00	200 pCi/L
Eu-154	5.31E+00	0.00E+00	NA	0.00E+00	60 pCi/L
H-3	2.91E+00	1.47E-01	NA	2.94E-05	20,000 pCi/L
I-129	6.11E-04	5.84E-02	NA	2.34E-01	1 pCi/L
Ni-59	5.29E-04	1.50E-05	NA	2.00E-07	300 pCi/L
Ni-63	6.85E-02	0.00E+00	NA	0.00E+00	50 pCi/L
Np-237[b]	1.31E-01	**2.15E-01**	NA	NA	Total alpha <15 pCi/L
Total Pu[c,e,g]	3.50E-01	**1.28E-02**	NA	NA	Total alpha <15 pCi/L
Ra-226 and -228[f]	1.73E-03	**5.92E-03**	NA	NA	5 pCi/L
Sm-151	2.08E+00	0.00E+00	NA	0.00E+00	1,000 pCi/L
Sr-90	2.96E+02	0.00E+00	NA	0.00E+00	8 pCi/L
Tc-99	1.18E-01	4.63E+00	NA	2.06E-02	900 pCi/L
U-232	**1.13E-04**	0.00E+00	**0.00E+00**	NA	NA
U-233	**3.23E-06**	2.20E-02	**2.27E-06**	NA	NA
U-234	**4.13E-01**	8.74E-01	**1.40E-04**	NA	NA
U-235	**4.24E-02**	9.27E-02	**4.29E-02**	NA	NA
U-236	**5.01E-03**	1.10E-02	**1.69E-04**	NA	NA
U-238	**1.92E-03**	4.19E-03	**1.24E-02**	NA	NA
Total uranium[d,e,g]	**4.65E-01**	NA	**5.56E-02**	NA	30 µg/L
Total alpha[g]	NA	**2.33E-01**	NA	NA	Total alpha <15 pCi/L
Total beta-gamma[g]	NA	NA	NA	2.55E-01	Total beta-gamma dose <4 mrem/yr

a. Source: EDF-10195, Table 5.

b. Np-237 includes the contributions from decay of Am-241 and Pu-241.

c. Total Pu inventory includes the inventory from Pu-239, Pu-240, and Pu-242. Pu-238 and Pu-241 decay in the vadose zone.

d. Total uranium inventory includes the uranium isotopes plus the uranium contribution from the decay of Am-242m and Pu-238.

e. Total Pu and U concentrations includes contributions from decay of other actinides (insignificant contributors in all cases).

f. Ra-226 and Ra-228 are included in the total alpha limit and have a 5-pCi/L limit. For this analysis all inventory is from Ra-226.

g. An inventory is shown for total uranium and total plutonium because those simulate the transport of unique chemicals. The alpha and beta-gamma are the result of transport of a number of different chemicals. Addition of these chemicals to define a total inventory is not meaningful; therefore, the total alpha and total beta-gamma inventory are not applicable for this table.

NA not applicable

Bold red text identifies total alpha contributors.

Bold blue text identifies total uranium contributors.

Table 9. Groundwater pathway risk assessment results for chemical contaminants of concern.[a]

		Hazard Quotient for Chemicals with Reference Doses			Risk for Chemicals with Carcinogenic Slope Factors			Comparison of Peak Concentration to MCL			
Chemical	Residual Inventory (kg)	Noncarcinogenic Intake (mg/kg/d)	Reference Dose[b] (Oral) (mg/kg/d)	Hazard Quotient	Carcinogenic Intake (mg/kg/d)	Oral Slope Factor[b] $(mg/kg/d)^{-1}$	Risk	Time to Peak (yr)	Predicted Peak Concentration (mg/L)	MCL[c] (mg/L)	MCL Notes[c]
Aluminum	1.46E+00	2.15E-09	1.0E+00	2E-09	9.20E-10	—	—	5.75E+05	7.84E-08	5.0E-02	1
Antimony	1.25E+00	9.17E-09	4.0E-04	2E-05	3.93E-09	—	—	1.15E+05	3.35E-07	6.0E-03	
Arsenic	3.45E-02	4.04E-09	3.0E-04	1E-05	1.73E-09	1.5E+00	3E-09	7.25E+03	1.47E-07	1.0E-02	
Barium	1.63E+01	1.20E-07	2.0E-01	6E-07	5.13E-08	—	—	1.15E+05	4.37E-06	2.0E+00	
Beryllium	5.09E-03	7.49E-12	2.0E-03	4E-09	3.21E-12	—	—	5.75E+05	2.73E-10	4.0E-03	
Boron	9.07E+02	6.49E-05	2.0E-01	3E-04	2.78E-05	—	—	1.18E+04	2.37E-03	No MCL	
Cadmium	5.24E+01	3.14E-06	5.0E-04	6E-03	1.35E-06	—	—	1.41E+04	1.15E-04	5.0E-03	
Calcium	4.57E-01	3.27E-08	—	—	1.40E-08	—	—	1.18E+04	1.19E-06	No MCL	2
Chloride	3.74E+00	9.80E-06	—	—	4.20E-06	—	—	3.43E+02	3.58E-04	2.5E+02	1
Chromium-III[d]	1.08E+05	2.39E-06	1.5E+00	2E-06	1.03E-06	—	—	>2.01E+03	8.74E-05	1.0E-01	
Chromium-VI[d]	1.08E+05	2.39E-06	3.0E-03	8E-04	1.03E-06	5.0E-01	5E-07	>2.00E+03	8.74E-05	1.0E-01	
Cobalt	4.02E-02	1.46E-09	3.0E-04	5E-06	6.25E-10	—	—	2.33E+04	5.32E-08	No MCL	
Copper	1.13E+05	2.06E-03	4.0E-02	5E-02	8.85E-04	—	—	4.63E+04	7.53E-02	1.3E+00	3
D-n- butylphthalate	2.91E-03	7.63E-09	1.0E-01	8E-08	3.27E-09	—	—	3.43E+02	2.78E-07	No MCL	
Fluoride	1.25E+00	3.28E-06	6.0E-02	5E-05	1.40E-06	—	—	3.43E+02	1.20E-04	4.0E+00	
Hexone	2.76E+02	7.24E-04	8.0E-02	9E-03	3.10E-04	—	—	3.43E+02	2.64E-02	No MCL	
Iron	3.60E+01	6.02E-08	7.0E-01	9E-08	2.58E-08	—	—	5.06E+05	2.20E-06	3.0E-01	1,2
Lead[d]	1.17E+05	7.59E-06	—	—	3.25E-06	8.5E-03	3E-08	>2.00E+05	2.77E-04	1.5E-02	3
Magnesium	5.30E-02	3.79E-09	—	—	1.63E-09	—	—	1.18E+04	1.38E-07	No MCL	2
Manganese	6.02E-01	4.42E-09	2.4E-02	2E-07	1.89E-09	—	—	1.15E+05	1.61E-07	5.0E-02	1
Mercury	1.33E+00	4.89E-09	3.0E-04	2E-05	2.09E-09	—	—	2.30E+05	1.78E-07	2.0E-03	
Nickel	5.82E+04	2.14E-04	2.0E-02	1E-02	9.16E-05	—	—	2.30E+05	7.80E-03	1.0E-01	4
Nitrate	1.06E+03	2.78E-03	1.6E+00	2E-03	1.19E-03	—	—	3.43E+02	1.01E-01	4.5E+01	5
PCB[e]	1.09E+02	2.67E-08	7.0E-06	4E-03	1.15E-08	2.0E+00	2E-08	3.45E+06	9.76E-07	5.0E-04	
Potassium	4.34E-02	1.05E-09	—	—	4.52E-10	—	—	3.48E+04	3.85E-08	No MCL	2
Selenium	2.40E-02	2.13E-09	5.0E-03	4E-07	9.14E-10	—	—	9.55E+03	7.78E-08	5.0E-02	
Silver	5.64E-01	2.30E-09	5.0E-03	5E-07	9.87E-10	—	—	2.07E+05	8.40E-08	1.0E-01	1
Sodium	7.39E-02	3.57E-10	—	—	1.53E-10	—	—	1.75E+05	1.30E-08	No MCL	2
Sulfate	2.20E+00	5.77E-06	—	—	2.47E-06	—	—	3.43E+02	2.11E-04	2.5E+02	1
Thallium	3.50E-02	1.29E-10	1.0E-05	1E-05	5.51E-11	—	—	2.30E+05	4.69E-09	2.0E-03	

Table 9. (continued).

		Hazard Quotient for Chemicals with Reference Doses			Risk for Chemicals with Carcinogenic Slope Factors			Comparison of Peak Concentration to MCL			
Chemical	Residual Inventory (kg)	Noncarcinogenic Intake (mg/kg/d)	Reference Dose[b] (Oral) (mg/kg/d)	Hazard Quotient	Carcinogenic Intake (mg/kg/d)	Oral Slope Factor[b] $(mg/kg/d)^{-1}$	Risk	Time to Peak (yr)	Predicted Peak Concentration (mg/L)	MCL[c] (mg/L)	MCL Notes[c]
Tin	1.29E+02	3.65E-07	6.0E-01	6E-07	1.56E-07	—	—	2.99E+05	1.33E-05	No MCL	
Uranium	1.15E+00	6.89E-08	3.0E-03	2E-05	2.95E-08	—	—	1.41E+04	2.52E-06	3.0E-02	
Vanadium	4.87E-02	1.79E-11	5.0E-03	4E-09	7.68E-12	—	—	2.30E+06	6.54E-10	No MCL	
Zinc	3.00E+02	6.84E-06	3.0E-01	2E-05	2.93E-06	—	—	3.71E+04	2.50E-04	5.0E+00	1

a. Source: EDF-10195, Table 6.
b. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/xls/master_sl_table_run_NOV2011.xls .
c. MCLs and related values are from the National Primary Drinking Water Regulations (EPA 2011). MCL notes are:
1. Secondary drinking water standards (aluminum, chloride, iron, silver, sulfate, and zinc)
2. Essential elements (calcium, iron, magnesium, potassium, and sodium)
3. Action level (copper)
4. Remanded MCL (nickel)
5. The nitrate MCL is 10 mg/L as N and 45 mg/L as NO_3.
d. Chromium and lead were simulated separately to simulate the entire inventory (instead of a unit inventory) in order to evaluate the impact of the solubility limits.
e. The reference dose for Arochlor-1254 was used as a conservative value for all PCBs.

MCL maximum contaminant level
PCB polychlorinated biphenyl

The groundwater pathways analysis demonstrates that residual contamination does not exceed the remediation goals for the Snake River Plain Aquifer. The predicted future concentrations of contaminants in the aquifer, as a result of leaving contaminants in place, are far below the limit. Overall the risk within the first 1,000 years and longer term did not change substantially from the risk determined in 2008 as compared to this risk assessment.

In all cases, all of the contamination (both radiological and non-radiological) left in place upon completion of these non-time critical removal actions is covered by more than 4 ft of clean material. In accordance with the HWMA/RCRA closure plan, a minimum 1-ft-thick sealing layer of grout was poured over upper horizontal surfaces of CPP-601, CPP-627, and CPP-640, followed by a minimum of 3 ft of pit run material. In addition, the contamination remaining at or below the CPP-602 basement floor level is now covered with at least 14 ft of pit run material. No contamination was left upon removal of CPP-630. Therefore, there is not a viable surface soil risk scenario (0–4 ft) from leaving that contamination in place from these removal actions. The residual contamination is also unavailable (protected by depth, grout, and stainless steel) from exposure to biota that would result in the lack of maintenance or recovery of healthy local populations or communities of ecological receptors.

7.2 Operable Unit 3-13 Group 2 Site Closure

Radiological and hazardous constituents from the CERCLA OU 3-13 Group 2 sites beneath CPP-601 (i.e., CPP-80, CPP-118, CPP-119, CPP-120, CPP-121, CPP-122, and CPP-123) and CPP-602 (i.e., CPP-117, which encompasses CPP-86) were left in place upon the completion of these non-time critical removal actions. A groundwater risk assessment demonstrated that the remaining contaminants (including the contamination remaining within CPP-601, CPP-602, CPP-627, and CPP-640, as well as the contaminants released to CERCLA sites CPP-80, CPP-117 (encompasses CPP-86), CPP-118, CPP-119, CPP-120, CPP-121, CPP-122, and CPP-123) do not exceed the OU 3-13-based remediation goals. All the remaining contamination is more than 4 ft below the current ground surface, demonstrating compliance with the OU 3-14 surface soil remediation goals. Therefore, no further remedial action is required for these OU 3-13 Group 2 sites. Because these sites are within the OU 3-14 industrial use area, the institutional controls applied to that industrial use area provide adequate protection for these sites and will be continued under that program.

7.3 Institutional Controls

Residual contamination was left in place within CPP-601, CPP-602, CPP-627, and CPP-640. Additionally, contamination from OU 3-13 Group 2 sites (i.e., historic releases) was left in place beneath CPP-601 and CPP-602. This removal action report documents that contamination left in place. This report also documents that the end state meets remedial action objectives and remediation goals established by the OU 3-13 ROD, as modified by the OU 3-14 ROD. Institutional controls are required to ensure that the remaining contamination below 4 ft is not disturbed. The institutional controls applied to the OU 3-14 industrial use area in the OU 3-14 ROD provide that protection. The OU 3-14 ROD determined that the area surrounding the Tank Farm (including the locations of CPP-601, CPP-602, CPP-627, CPP-630, and CPP-640) would be restricted to industrial use for the foreseeable future. Accordingly, no end date for institutional control can be determined.

Institutional controls will be maintained for this area under the *INL Site-Wide Institutional Controls, and Operations and Maintenance Plan for CERCLA Response Actions* (DOE-ID 2010b).

8. NON-TIME-CRITICAL REMOVAL ACTION CLOSURE

This removal action report for CPP-601, CPP-602, CPP-627, CPP-630, and CPP-640 documents completion of the non-time-critical removal actions and meeting of the remedial action objectives, remediation goals, and applicable or relevant and appropriate requirements as described in the OU 3-13 ROD (DOE-ID 1999) and the OU 3-14 ROD (DOE-ID 2007). This report provides the necessary information on residual contamination and site status for the Environmental Restoration Program to ensure continued protection of human health and the environment.

This report is subject to review by the CERCLA agencies. The agencies approval of this removal action report will document their approval of the end-state configuration for these facilities. That approval will be recorded in the CERCLA Administrative Record.

In addition, the removal action incorporated the Department of Energy goal of reducing the risk and long-term surveillance and maintenance costs on legacy buildings and structures. Actions conducted under this non-time-critical removal action will be reviewed with DEQ and EPA for continued protectiveness during the Sitewide CERCLA 5-year review process, prescribed under the *Federal Facility Agreement and Consent Order for the Idaho National Engineering Laboratory* (DOE-ID 1991).

9. LESSONS LEARNED

Upon assignment of a facility for D&D, it is important to contact the workers who previously worked in the facility to obtain their assistance in identifying potential issues and to assist in determining the appropriate disposition of residual items that may not have been removed when the facility was deactivated.

Depending upon specific circumstances, a facility subject to a CERCLA non-time critical removal action also may be subject to specific requirements from other regulatory agencies, such as a Resource Conservation and Recovery Act-permitted treatment or storage unit located within the facility that has not been closed to the specific requirements of that regulation. It is important to document in the initial phases of the non-time-critical removal action how the programs will interact and cooperate to the extent practicable to complete the objectives of both programs.

Projects that span several years sometimes have significant manpower turnover. Even minor assumptions, such as those of radiological engineers, may significantly impact the final evaluation of project success if not documented and carried forward in a consistent manner.

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Appendix A

Photographs of CPP-601 Non-Time-Critical Removal Action

Appendix A

Photographs of CPP-601 Non-Time-Critical Removal Action

Figure A-1. CPP-601 before deactivation and decommissioning.

Figure A-2. Operating corridor before deactivation and decommissioning.

Figure A- 3. Operating corridor after deactivation and decommissioning.

Figure A-4. Access corridor before deactivation and decommissioning.

Figure A-5. Access corridor after deactivation and decommissioning.

Figure A-6. Process makeup deck before deactivation and decommissioning.

Figure A-7. Process makeup deck before deactivation and decommissioning.

Figure A-8. Process makeup deck after deactivation and decommissioning.

Figure A-9. Removing lead bricks from a sample gallery.

Figure A-10. Pumping grout into CPP-601.

Figure A-11. Pumping grout into one of the cells below process makeup deck.

Figure A-12. South stairwell grouted to access corridor.

Figure A-13. Deep tank vault partially grouted.

Figure A-14. Removing transite panel wall.

Figure A-15. Removing transite panel roof.

Figure A-16. CPP-601 nearing completion of demolition.

Figure A-17. Process makeup deck after demolition.

Figure A-18. Installing new grout layer on top of CPP-601 monolith.

Figure A-19. Installing asphalt as part of recharge control zone east of CPP-601.

Figure A-20. Installing earthen weather protection barrier east of CPP-601.

Figure A-21. CPP-601 after deactivation and decommissioning.

Appendix B

Photographs of CPP-602 Non-Time-Critical Removal Action

Appendix B

Photographs of CPP-602 Non-Time-Critical Removal Action

Figure B-1. CPP-602 before deactivation and decommissioning.

Figure B-2. CPP-602 before laboratories stripped out.

Figure B-3. CPP-602 after laboratories stripped out.

Figure B-4. Removing asbestos from piping.

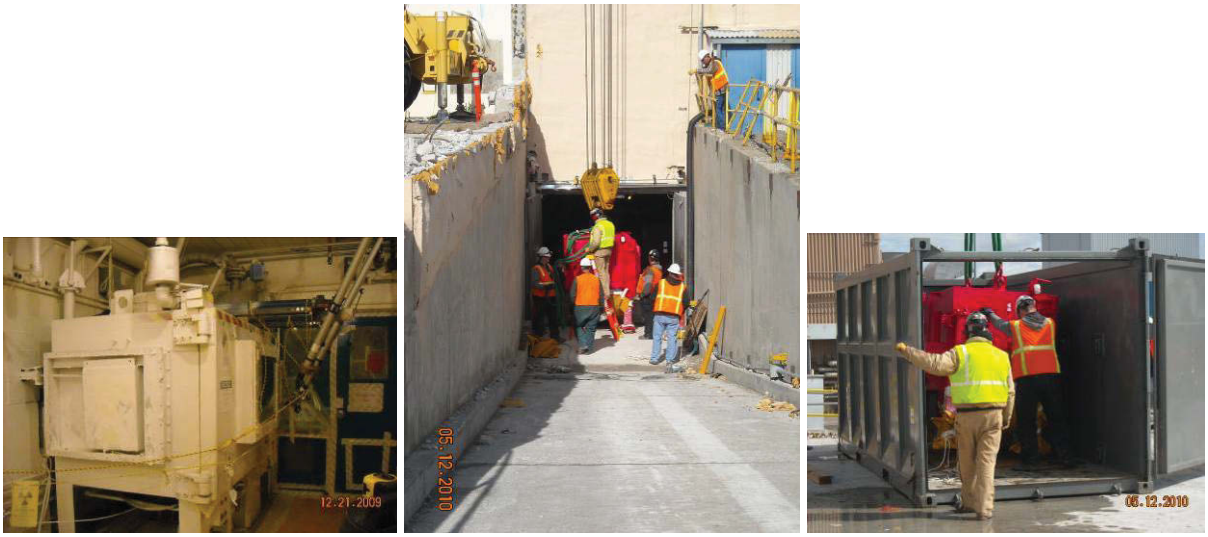

Figure B-5. Removing lead-shielded cave (shielded glovebox) from basement.

Figure B-6. Grouting the denitrator pit and waste trench.

Figure B-7. Recovering Freon from cooling system.

Figure B-8. Removing transite roof panels.

Figure B-9. Demolition in progress.

Figure B-10. Demolition stalled by late spring snow.

Figure B-11. New dial room that replaced old dial room from CPP-602 basement.

Figure B-12. Fracturing northwest corner of basement floor (location of former dial room).

Figure B-13. Backfilling and compacting basement.

Figure B-14. Former location of CPP-602 from the west after deactivation and decommissioning.

Figure B-15. Former location of CPP-602 after deactivation and decommissioning.

Appendix C

Photographs of CPP-630 Non-Time-Critical Removal Action

Appendix C

Photographs of CPP-630 Non-Time-Critical Removal Action

Figure C-1. CPP-630 before demolition.

Figure C-2. CPP-630 during demolition.

Figure C-3. CPP-630 after demolition.

Figure C-4. Installing asphalt over CPP-630 to prevent infiltration within Operable Unit 3-14 recharge control zone.

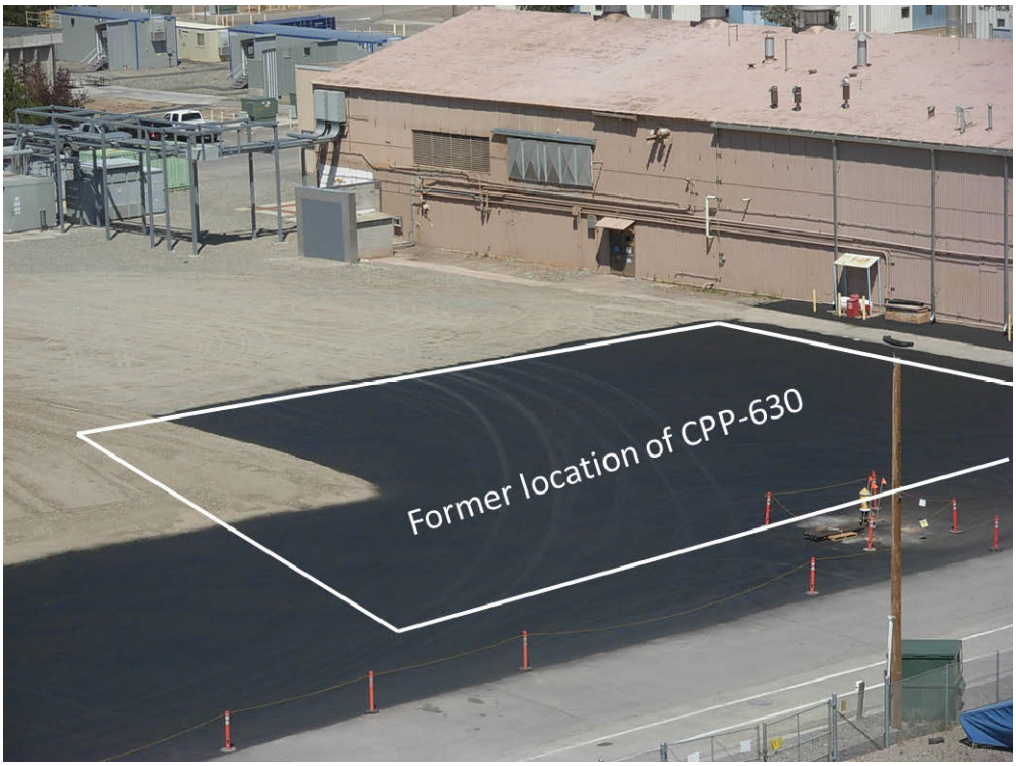

Figure C-5. Former location of CPP-630.

Appendix D

Photographs of CPP-640 Non-Time-Critical Removal Action

Appendix D

Photographs of CPP-640 Non-Time-Critical Removal Action

Figure D-1. CPP-640 before demolition.

Figure D-2. CPP-640 basement level.

Figure D-3. CPP-640 basement level with first layer of grout.

Figure D-4. Filling Cell 4 with grout.

Figure D-5. Top of Cell 2 filled with grout.

Figure D-6. Removing transite panel roof.

Figure D-7. Waste packaging of transite panels.

Figure D-8. CPP-640 during demolition.

Figure D-9. CPP-640 monolith after demolition.

Figure D-10. Pouring the grout sealing coat on belowgrade sections of CPP-640.

Figure D-11. CPP-640 earthen weather protection barrier.