DOE/ID-11284
Revision 1

U.S. Department of Energy
Idaho Operations Office

HWMA/RCRA Closure Plan for the TRA/MTR Warm Waste System

Voluntary Consent Order SITE-TANK-005 Tank System TRA-007

January 2007

Idaho Cleanup Project

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ABSTRACT

This Hazardous Waste Management Act/Resource Conservation and Recovery Act closure plan was developed for portions of the Test Reactor Area/ Materials Test Reactor Warm Waste System located in the Materials Test Reactor Building (TRA-603) at the Reactor Technology Complex, Idaho National Laboratory Site, to meet a further milestone established under Voluntary Consent Order Action Plan SITE-TANK-005 for Tank System TRA-007. The reactor drain tank and canal sump to be closed are included in the Test Reactor Area/Materials Test Reactor Warm Waste System. The reactor drain tank and the canal sump were characterized as having managed hazardous waste. The reactor drain tank and canal sump will be closed in accordance with the interim status requirements of the Hazardous Waste Management Act/ Resource Conservation and Recovery Act as implemented by the Idaho Administrative Procedures Act 58.01.05.009 and 40 Code of Federal Regulations 265. This closure plan presents the closure performance standards and methods for achieving those standards.

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ACRONYMS

AL	action level
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	contaminant of concern
CSM	conceptual site model
CTS	Catch Tank System
DEQ	State of Idaho Department of Environmental Quality
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
FR	Federal Register
HI	hazard index
HQ	hazard quotient
HWD	hazardous waste determination
HWMA	Hazardous Waste Management Act
IDAPA	Idaho Administrative Procedures Act
INL	Idaho National Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center
IRIS	Integrated Risk Information System
MTR	Materials Test Reactor
NSID	New Site Identification
PE	professional engineer
PRG	preliminary remediation goals
RCRA	Resource Conservation and Recovery Act
RfD	reference dose
RWMC	Radioactive Waste Management Complex

RTC	Reactor Technology Complex (formerly the Test Reactor Area)
SF	slope factor
TCLP	toxicity characteristic leaching procedure
TRA	Test Reactor Area
TSDF	treatment, storage, and disposal facility
UCL	upper confidence limit
USC	United States Code
VCO	Voluntary Consent Order

HWMA/RCRA Closure Plan for the TRA/MTR Warm Waste System

Voluntary Consent Order SITE-TANK-005 Tank System TRA-007

1. INTRODUCTION

This Hazardous Waste Management Act (HWMA) (State of Idaho 1983)/Resource Conservation and Recovery Act (RCRA) (42 United States Code [USC] 6901 et seq. 1976) closure plan has been prepared for portions of the Test Reactor Area (TRA)/Materials Test Reactor (MTR) Warm Waste System (hereinafter referred to as Voluntary Consent Order [VCO] SITE-TANK-005 Tank System TRA-007), located in the MTR Building (TRA-603) at the Reactor Technology Complex (RTC) (formerly TRA), Idaho National Laboratory (INL) Site. The portions of VCO SITE-TANK-005 Tank System TRA-007 to be closed are the reactor drain tank and the canal sump.

The reactor drain tank (TRA-603-M-314; 98TRA00380) and the canal sump (00TRA00002) are identified in Tank System TRA-007 in the VCO SITE-TANK-005 Action Plan (DEQ 2000), a consent order between the U.S. Department of Energy (DOE) Idaho Operations Office and the State of Idaho Department of Environmental Quality (DEQ). Portions of this system were characterized as managing HWMA/RCRA-hazardous waste (EDF-2749).

This HWMA/RCRA closure plan includes a general description of the reactor drain tank and canal sump, and identifies the current and maximum hazardous waste inventories. Closure activities include removal and disposal of the hazardous waste inventory and removal or decontamination of the reactor drain tank. The reactor drain tank system, described in Subsection 4.1.1.1, and the MTR canal sump will be considered HWMA/RCRA "clean closed" when the closure activities identified in this plan are complete, as certified by an independent, registered professional engineer (PE) and accepted by DEQ.

2. FACILITY DESCRIPTION

2.1 Site Description

The INL Site encompasses approximately 890 mi^2 on the northern edge of the Eastern Snake River Plain in southeastern Idaho. The RTC is situated on the south-central portion of the INL Site (see Figure 1) and occupies an enclosed and secured area. The MTR Building (TRA-603) housed the MTR, a high-flux, heterogeneous-enriched fuel reactor used for testing of various materials in high-intensity radiation.

The reactor drain tank is located in a concrete vault below the TRA-603 basement floor on the west side of the building. The canal sump is located below the TRA-603 basement floor on the east side of the building. See Figures 2 and 3 for the location of the reactor drain tank and the canal sump.

2.2 VCO SITE-TANK-005 Tank System TRA-007 and Operating History

The VCO SITE-TANK-005 Tank System TRA-007 was comprised of five VCO units, the reactor drain tank (TRA-603-M-314; 98TRA00380), the reactor building sump (98TRA00379), the canal sump (00TRA00002), the pipe tunnel sump (00TRA00001), and the MTR warm sump tank (98TRA00378), and associated ancillary equipment and piping.

Between 1952 and 1971, warm (radiologically) liquid waste generated in TRA-603 was collected in the reactor building sump, the canal sump, or the pipe tunnel sump. The warm wastewater collected in these units was discharged to the retention basin (TRA-712) and, subsequently, to the TRA-758 leaching pond.

The reactor building sump was designed to receive discharges from the MTR canal gutter drains, MTR warm waste drains, deep well drains, TRA-604 basement drains, and pipe tunnel sump. The MTR warm waste drain system would have primarily carried demineralized cooling water, but the system has been inactive since the reactor was shut down in 1971 and the drains have been capped (EDF-2794). The TRA-604 basement floor drains discharge process water such as fire protection water, potable water, or demineralized water; and the deep well drains discharged emergency raw water.

The canal sump received demineralized wastewater from the MTR canal floor drains, a canal overflow weir and drain line, and raw water from the Dowtherm pumps and coolers. The canal floor drains and piping were capped and out of service by 1968 (INEEL 2001). The Dowtherm pumps and coolers have been removed and the drain lines are out of service (EDF-2794). Since the MTR was taken out of service in 1971, the only active discharge to the canal sump has been wastewater from the MTR storage canal. The MTR storage canal used demineralized water as the storage medium for containment of stored fuel rods and test trains until 2004 when the canal was emptied and drained (EDF-5116). After the MTR storage canal was emptied, some of the overflow weir drains were left uncapped in order to allow precipitation infiltration into the canal area to drain to the canal sump.

Figure 1. Map of the INL Site showing the Reactor Technology Complex.

The pipe tunnel sump was designed to collect wastewater from the process water drains, air duct drains, and experimental cubical drains. The sources of liquid wastes to the pipe tunnel sump have been out of service since the reactor was shut down in 1971; subsequently, this sump is normally dry. Any liquid waste collected in the pipe tunnel sump would be pumped to the reactor building sump (EDF-2749).

The reactor drain tank was originally designed to collect hot waste from the MTR Building and the vent scrubber sump drain in the adjacent laboratory wing and discharged to the TRA-630 catch tank system. Since the deactivation of the reactor in 1971, the drains, cleanouts, and piping from MTR have been inactive, and the drains and cleanouts have been capped. In addition, following the decommissioning of the MTR in 1971, the waste collected in the reactor drain tank no longer exceeded the warm waste disposal criteria and was handled exclusively as warm waste.

In 1984, the reactor building sump, the reactor drain tank, and the canal sump wastewater discharges were rerouted to the MTR warm sump tank. The MTR warm sump tank was constructed in 1984 from a preexisting 30-in. primary coolant pipe that has welded caps on each end. The MTR warm sump tank is the final collection point for VCO SITE-TANK-005 Tank System TRA-007, prior to discharging to the Warm Waste Treatment Facility (WWTF) in the Process Water Building (TRA-605) (VCO SITE-TANK-005 Tank System TRA-010), and finally to the TRA-758 leaching pond (prior to 1993) and TRA-715 evaporation pond (after 1993).

In 1991, the TRA-604 and TRA-661 laboratory drains were rerouted to the vent scrubber sump drain, which discharged to the reactor drain tank. This was the only active discharge to the reactor drain tank until 2004, when the reactor drain tank was taken out of service and the liquid laboratory waste was rerouted to the reactor building sump. The radiochemistry laboratory drain line, the MTR hot drain header lines, and the 2” HDA-603-A discharge line have all been isolated in the reactor drain tank containment vault.[a] The only remaining piping connected to the reactor drain tank is the 3-in. vent piping.

The reactor drain tank, reactor drain tank pump, reactor drain tank containment vault and drain pipe, and the canal sump have been characterized as having managed hazardous waste (EDF-2749; VCO Action Plan VCO-5.8.d) and are addressed in this closure plan. No further actions are required for the reactor building sump, pipe tunnel sump, or MTR warm sump tank, or their associated ancillary equipment and piping in VCO SITE-TANK-005 Tank System TRA-007 as they were characterized as nonhazardous (EDF-2749) or addressed under a milestone deliverable completion document (Gregory 2005; Wessman 2005).

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a. FCF No. 8.9-11/7441, Facility Change Form: “TRA-603 Reactor Drain Tank Isolation and TRA-604 Basement Piping Modification,” December 2, 2004.

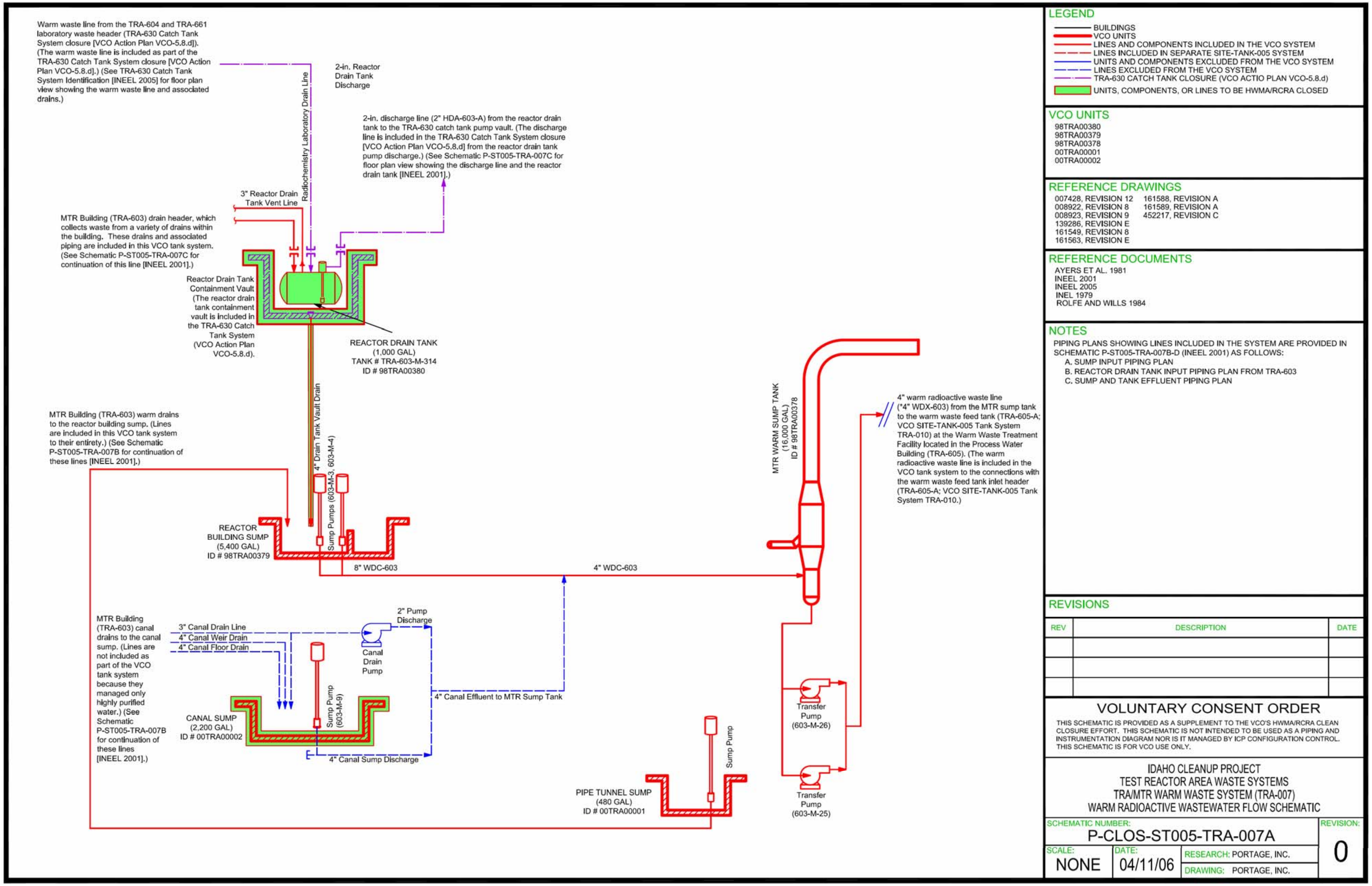

Figure 2. Schematic P-CLOS-ST005-TRA-007A. Units and components to be HWMA/RCRA closed.

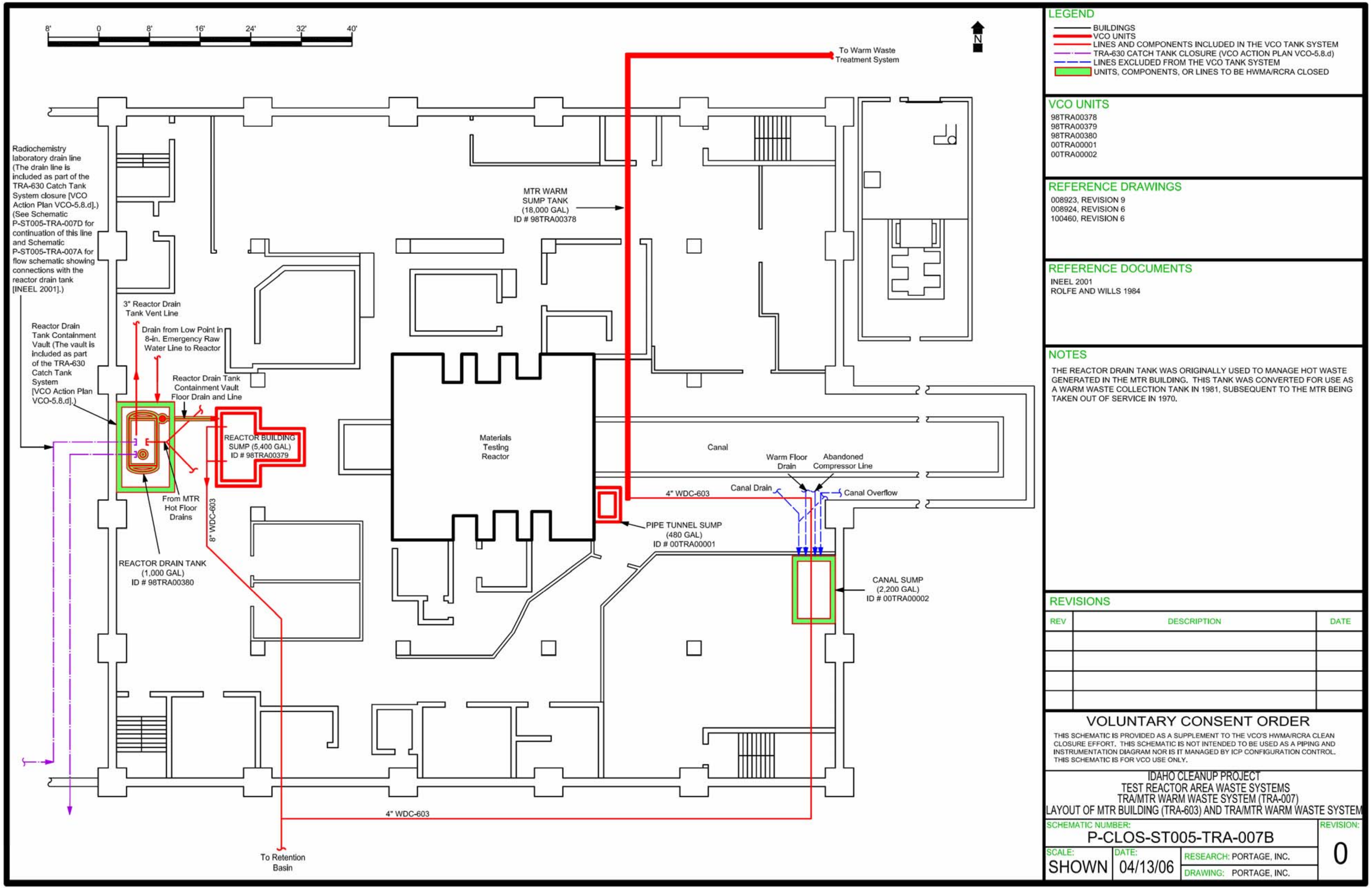

Figure 3. Schematic P-CLOS-ST005-TRA-007B. Layout of MTR Building (TRA-603) and VCO SITE-TANK-005 Tank System TRA-007.

2.2.1 Reactor Drain Tank (TRA-603-M-314; 98TRA00380)

The reactor drain tank is a 1,000-gal glass-lined, carbon steel tank located in the reactor drain tank containment vault beneath the basement floor of the MTR Building (TRA-603). Also located in the vault are the reactor drain tank ancillary equipment and piping, including the reactor drain tank pump, the radiochemistry laboratory drain line, the two MTR hot drain header lines, the 2” HDA-603-A discharge line, and a 3-in. vent line and associated blower (out of service). Access to the tank is through a hatchway and down a ladder in the southwest corner of the vault. Four larger hatch covers are located to the north through which the tank was installed.

The reactor drain tank discharged to the MTR warm sump tank via lines 2” HDA-603-A and 4” WDA-630-B, and the 4-in. cross-tie warm waste discharge line, and then through lines 8” WDC-603 and 4” WDC-603 (see Figures 2 and 3; Schematics P-CLOS-ST005-TRA-007A and -007B). Lines 2” HDA-603-A, 4” WDA-630-B, the 4-in. cross-tie warm waste discharge line, and the reactor drain tank containment vault are included in the TRA-630 Catch Tank System (CTS) closure (VCO Action Plan VCO-5.8.d).

These CTS lines are included in ongoing closure activities; however, the reactor drain tank containment vault will be included in this closure plan, thus completing all VCO closure-related activities associated with the reactor drain tank and associated system components. The radiochemistry laboratory drain line, the two MTR hot drain header lines, and the 2” HDA-603-A discharge line have all been isolated from the reactor drain tank in the reactor drain tank containment vault. The only remaining piping connected to the reactor drain tank is the 3-in. vent piping (see Figure 4).

The liquids and solids in the reactor drain tank were sampled in 2000 and, based on the analytical data, characterized as nonhazardous (EDF-2749). The MTR drain header and associated MTR building drain lines were also characterized as nonhazardous. However, in 2004, the reactor drain tank vault was found to contain residue that failed for the RCRA metals lead (D008) and mercury (D009).

Lead has been observed in other sumps and vaults within the MTR complex and is generally attributed to the use of lead-based paint in the containment vault and accumulation of lead particulates from the widespread use of lead shielding throughout the building. The source of the mercury is less certain. However, based on the assumption that the tank has overflowed in the past, the most plausible explanation for the presence of mercury residue is that wastewater received via the radiochemistry laboratory drain line (referred to as the vent scrubber drain line in the TRA-630 CTS closure; VCO Action Plan VCO-5.8.d) overfilled the reactor drain tank, passing through the vent line blower to the vault floor.

Therefore, even though the solids and liquids in the reactor drain tank were characterized as nonhazardous, the reactor drain tank and associated pump were declared hazardous based on the possibility that the tank received wastewater containing hazardous levels of mercury in the past. In addition, because it is possible that wastewater hazardous for mercury entered the reactor drain tank vault drain, the drain line from the vault to the reactor building sump was also declared hazardous. The reactor drain tank containment vault drain line was plugged in 2004 to prevent any discharges to this line (see Figure 5).

The reactor drain tank containment vault was cleaned and decontaminated in 2004 during the work activities to reroute the TRA-604 laboratory drain lines to the reactor building sump and isolate the reactor drain tank and the containment vault drain line. The residue removed from the vault floor was characterized and managed as HWMA/RCRA-hazardous waste (Wessman 2005).

Based on the analysis of the reactor drain tank liquids and solids, and based on the determination that the MTR warm sump tank and the reactor building sump directly downstream of the reactor drain tank are nonhazardous, the wastes discharged through the reactor drain tank, associated piping, and ancillary equipment were determined to be nonhazardous (EDF-2749) (Gregory 2004; Wessman 2004).

Figure 4. The 3-in. reactor drain tank vent line.

Figure 5. Isolation of the reactor drain tank containment vault floor drain.

2.2.2 Canal Sump (00TRA00002)

The canal sump is located beneath a hatch on the east side of the MTR Building (TRA-603) basement (see Figures 2 and 3; Schematics P-CLOS-ST005-TRA-007A and -007B). The canal sump is constructed of concrete and has a capacity of 2,200 gal. The canal sump collected wastewater from canal operations. The canal sump also included two sump pumps (TRA-603-M-8; TRA-603-M-9) as ancillary equipment. One of the canal sump pumps (TRA-603-M-8) was removed during the VCO interim action canal sump cleanup activities in April/May 2004 and dispositioned as low-level radioactive waste.[b]

Sampling was performed in 2001 to determine if the solids or liquids in the canal sump were HWMA/RCRA hazardous for toxicity characteristic leaching procedure (TCLP) metals. Analytical data from the sampling indicate the liquids in the canal sump were not characteristically HWMA/RCRA hazardous, but the solids in the canal sump were characteristically HWMA/RCRA hazardous for cadmium (D006) and lead (D008) (EDF-2749). Therefore, the canal sump was determined to be managing HWMA/RCRA hazardous waste. The two canal sump pumps and associated ancillary piping were determined to have managed only nonhazardous wastewater and, therefore, were characterized as nonhazardous (EDF-2749).

The solids in the canal sump were removed as a VCO interim action and shipped to a RCRA-permitted treatment, storage, and disposal facility (TSDF) for treatment and disposal per HWMA/RCRA regulations.[c] The canal sump was rinsed and the rinsate sampled and analyzed for TCLP metals as part of the interim action. Analytical data from the sampling indicate that the rinsate levels for TCLP metals were all below the U.S. Environmental Protection Agency (EPA) Universal Treatment Standard wastewater regulatory limits.[d]

In November 2003, DOE requested and DEQ concurred that the MTR canal sump could be used for nonhazardous wastewater management in support of ongoing MTR canal decommissioning activities (Gregory 2003; Wessman 2003). In 2004, approximately 25,000–50,000 gal of deionized water and nonhazardous canal wastewater were discharged through the canal sump to the TRA-715 evaporation ponds. This activity resulted in approximately 1,300 gal of nonhazardous wastewater remaining in the canal sump (volume estimated based on depth of liquids measured during video inspection of canal sump in April 2006). In August 2006, the wastewater remaining in the canal sump was removed and discharged to the TRA-715 evaporation ponds.[e]

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b. TRA Work Order #63020-02, “Remove Waste from MTR Canal Sump,” January 20, 2004.

c. Integrated Waste Tracking System, Material and Waste Characterization Profile, 3140N: VCO MTR Sump Liquids and Solids, November 18, 2004

d. Kirchner, D. P., to A. L. Moncur, January 20, 2004, “Closure Report for Sampling Test Reactor Area-603 Materials Test Reactor Canal Sump Rinsate,” WGS-023-03.

e. PWO-06-400, Planned Work Order: “VCO-TRA-007 MTR Canal Sump,” July 17, 2006.

3. CURRENT AND MAXIMUM HAZARDOUS WASTE INVENTORY AND CHARACTERISTICS

The reactor drain tank, which has a capacity of 1,000 gal, was characterized under the VCO as managing a nonhazardous waste (EDF-2749). When the reactor drain tank was accessed in 2001 and 2004, the tank was full, containing mostly liquids with 6–8 in. of sediment on the bottom. The tank currently contains approximately 1,000 gal of nonhazardous liquids and solids. Although the tank contents are nonhazardous, the tank is subject to closure based on potentially hazardous historical discharges.

The reactor drain tank containment vault was characterized as having managed waste that was HWMA/RCRA hazardous for lead (D0008) and mercury (D009) (EDF-2749). The reactor drain tank containment vault was cleaned of visible solids in 2004. The only remaining hazardous waste would be any residual waste that has adhered to the containment vault concrete or the containment vault drain pipe. The containment vault drain was plugged in 2004, preventing any potential discharges to this line.

The canal sump is constructed of concrete and has a capacity of 2,200 gal. The solids in the canal sump were removed as a VCO interim action in 2003 and shipped to a RCRA-permitted TSDF for treatment and disposal per HWMA/RCRA regulations. In 2006, the remaining nonhazardous wastewater in the canal sump was discharged to the TRA-715 evaporation ponds. The canal sump is currently empty; however, the canal sump is subject to closure due to solids that were removed in 2004 that contained HWMA/RCRA hazardous levels of cadmium (D006) and lead (D008).

4. CLOSURE PERFORMANCE STANDARDS

The following subsections describe the closure performance standards for VCO SITE-TANK-005 Tank System TRA-007 and the activities to achieve compliance with the closure performance standards for interim status tank systems (Idaho Administrative Procedures Act [IDAPA] 58.01.05.009 [40 Code of Federal Regulations (CFR) 265.111 and 265.197]).

The closure performance standards for tank systems identified in IDAPA 58.01.05.009 (40 CFR 265.111 and 265.197) applicable to the VCO SITE-TANK-005 Tank System TRA-007 are:

Standard 1: The owner or operator must close the facility in a manner that minimizes the need for further maintenance (IDAPA 58.01.05.009 [40 CFR 265.111(a)]).

Standard 2: The owner or operator must close the facility in a manner that controls, minimizes, or eliminates to the extent necessary to protect human health and the environment, post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated runoff, or hazardous waste decomposition products to the ground or surface waters or to the atmosphere (IDAPA 58.01.05.009 [40 CFR 265.111(b)]).

Standard 3: The owner or operator must remove or decontaminate all waste residues, contaminated containment system components (liners, etc.), contaminated soils, and structures and equipment contaminated with waste, and properly manage all hazardous wastes generated during closure activities (IDAPA 58.01.05.009 [40 CFR 265.197(a)]).

4.1 Activities to Achieve Compliance with the Closure Performance Standards

The HWMA/RCRA closure and waste management activities to be performed to achieve the closure performance standards are described below.

4.1.1 Standard 1

Standard 1: The owner or operator must close the facility in a manner that minimizes the need for further maintenance (IDAPA 58.01.05.009 [40 CFR 265.111(a)]).

- Tank system and waste inventory removal
- Tank system isolation.

4.1.1.1 Reactor Drain Tank and Vault Waste Inventory Removal. The reactor drain tank system is comprised of the reactor drain tank, reactor drain tank pump, reactor drain tank containment vault (the reactor drain tank containment vault is part of the TRA-630 CTS system, VCO Action Plan VCO-5.8.d, but will be closed under the TRA-007 closure activities), and reactor drain tank vault discharge line. The reactor drain tank (TRA-603-M-314; 98TRA00380) currently contains nonhazardous water and nonhazardous sediment. The nonhazardous water will be removed and dispositioned as low-level radioactive waste. Two options exist for the removal of the reactor drain tank, tank pump, and nonhazardous sediment.

One option is to remove the reactor drain tank and pump assembly with the nonhazardous sediment remaining inside. The tank (including the nonhazardous sediment) and pump would undergo a hazardous waste determination (HWD) and be disposed of in accordance with applicable regulations. This option would provide contamination control associated with the removal of the sediment from the tank.

The second option is to remove the nonhazardous sediment from the tank (i.e., cut the tank and vacuum or scrape out the sediment, or use other suitable methods for sediment removal), and transport the containerized sediment to an appropriate disposal site based on a HWD (i.e., Radioactive Waste Management Complex [RWMC]). The empty tank would then be decontaminated, which may include the use of dry methods (wipes, vacuum, scraper, etc.) and rinsing with water. Multiple rinses may be used. For disposition of the tank and to demonstrate compliance with the closure performance standards, the components would be decontaminated until site-specific action levels (ALs) in Table 1 have been achieved.

If the empty tank or pump cannot be adequately decontaminated, then it would be removed, undergo a HWD, and be disposed of in accordance with applicable regulations. Either option would fulfill the closure performance standard for the reactor drain tank and pump; the option ultimately selected will be documented in the closure certification documentation.

The reactor drain tank containment vault was cleaned and decontaminated during the work activities to isolate the reactor drain tank piping. The isolation activities included isolating the radiochemistry laboratory drain line, the two MTR hot drain header lines, and the 2" HDA-603-A discharge line in the reactor drain tank containment vault, and plugging the reactor drain tank containment vault drain line in the containment vault.

If waste remains in the reactor drain tank containment vault, the vault waste will be removed and disposed of based on a HWD and in accordance with applicable regulations. The surface layer of the reactor drain tank concrete vault floor, the lower 1 ft of the side walls, and any wall surface with visible staining will be scrubbed and/or scabbled to a clean concrete surface (40 CFR 268.45). If concrete is removed, a HWD will be conducted, and the vault concrete disposed of in accordance with applicable regulations.

To confirm that all hazardous waste vault residue has been removed and the containment vault concrete is clean, a visual inspection will document that it will be "free of visible contaminated soil and hazardous waste except that residual staining from soil and waste consisting of light shadows, slight streaks, or minor discolorations, and soil and waste in cracks, crevices, and pits may be present provided that such staining and waste and soil in cracks and crevices, and pits shall be limited to no more than 5% of each square inch of surface area" (40 CFR 268.45).

If the containment vault fails to meet the visual criteria described above, the containment vault floor, lower 1 ft of the side walls, and surfaces with visible staining will be scrubbed, wet mopped, and/or rinsed. To demonstrate compliance with the performance standards, the vault components will be decontaminated until site-specific ALs have been achieved.

The reactor drain tank containment vault drain line will undergo integrity testing and, if integrity of the pipe is confirmed, the line will either be removed or cleaned to meet ALs. If the piping integrity cannot be confirmed, then the line will be removed and the soils under the line will be sampled (see Subsection 4.1.2.3).

4.1.1.2 Reactor Drain Tank System Isolation. All piping to and from the reactor drain tank has been isolated inside the reactor drain tank containment vault, except for the 3-in. vent line (including the vent blower). The 3-in. vent line (and blower) will be isolated and removed at the reactor drain tank and the reactor drain tank containment vault interior wall. All isolations will be confirmed by visual inspection before completion of closure activities and by the independent PE for the closure certification.

4.1.1.3 Canal Sump Waste Inventory Removal. The canal sump was cleaned as a VCO interim action in 2003.[f,g] To confirm that all waste has been removed, a visual inspection of the sump was conducted and the results were video recorded and documented. The inspection of the canal sump will be documented in the closure certification.

4.1.1.4 Canal Sump Isolation. There is no hazardous equipment or piping in the canal sump; therefore, no isolation activities are required.

4.1.2 Standard 2

Standard 2: The owner or operator must close the facility in a manner that controls, minimizes or eliminates to the extent necessary to protect human health and the environment, post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated run-off, or hazardous waste decomposition products to the ground or surface waters or to the atmosphere (IDAPA 58.01.05.009 [40 CFR 265.111(b)].

- Reactor drain tank and vault, and the canal sump waste inventory removal: Addressed under Standard 1, Subsections 4.1.1.1 and 4.1.1.3

- Reactor drain tank and vault, and the canal sump isolation: Addressed under Standard 1, Subsections 4.1.1.2 and 4.1.1.4.

4.1.3 Standard 3

Standard 3: At closure of a tank system, the owner or operator must remove or decontaminate all waste residues, contaminated system components (liners, etc.), contaminated soils, and structures and equipment contaminated with waste, and manage them as hazardous waste, unless §261.3 of this chapter (CFR Title 40) applies. The closure plan, closure activities, cost estimates for closure, and financial responsibility for the tank systems must meet all the requirements specified in Subparts G and H of this part (IDAPA 58.01.05.009 [40 CFR 265.197(a)]).

- System and waste inventory removal: Addressed under Standard 1, Subsection 4.1.1.1

- System isolation: Addressed under Standard 1, Subsection 4.1.1.2

- Soils.

4.1.3.1 Reactor Drain Tank and Vault Integrity Verification. Based on the TRA-007 characterization (EDF-2749), it is assumed that the reactor drain tank has overflowed in the past, and therefore, waste from the tank was released into the reactor drain tank vault. Since it has already been assumed that the waste from the reactor drain tank has been released to the reactor drain tank vault, no verification of integrity of the tank will be conducted.

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f. VCO Records, VCO/DEQ Conference Call Meeting Minutes for January 2002, February 14, 2002.

g. INEEL Work Order Package 63020-02, Remove Waste from MTR Canal Sump, January 20, 2004.

The reactor drain tank containment vault floor was constructed to slope to a gravity-flow drain pipe in the northeast corner of the vault floor and then to the adjacent reactor building sump (INL Reference Drawings 100454, 100598). The reactor drain tank containment vault concrete floor is in good condition with no significant deterioration that would allow liquids to reach the environment. Since no liquid wastes would be maintained in the vault to be released to the environment, the only potential release would be from residual solids in the vault. A visual integrity verification of the vault concrete floor will be conducted to verify that the vault residues would not be released to the environment.

4.1.3.2 Reactor Drain Tank Vault Soils. The reactor drain tank containment vault is located inside of Building TRA-603 with adequate roof and walls, and there have been no known releases to the environment from the vault. The characterization of the contents of the reactor drain tank determined that the current liquids and solids managed by the reactor drain tank were nonhazardous, but the reactor drain tank containment vault had collected solids that were hazardous. Since the reactor drain tank containment vault would have prevented the solids from entering the environment, there is no potential for contamination and any action with regard to potentially contaminated soils is not required.

Any liquids that entered the reactor drain tank containment vault would have immediately gravity-drained to the MTR reactor building sump via the containment vault drain line. An integrity test will be conducted on the containment vault drain line to determine if associated soils were potentially contaminated by HWMA/RCRA constituents. The integrity evaluation may include internal video inspection and/or process knowledge, and, where applicable, would be verified by a qualified quality assurance engineer or inspector. If these evaluations cannot be made or are inconclusive, then other alternatives may be used.

- Negative Pressure Evaluation: A slight vacuum will be applied to the section of piping to be tested. The negative pressure will be monitored.

- Positive Pressure Evaluation: Positive pressure will be applied to the section of piping and the pressure monitored. This evaluation is less desirable than negative pressure as it has the potential to compromise the integrity of the piping during testing.

- Hydrostatic Testing: A section of piping is filled with water and the water is contained within the pipe for specified time period. The water is then drained from the piping and properly dispositioned per HWMA/RCRA regulations.

Following the integrity evaluation, the containment vault drain line will have any bulk waste removed and the drain will be decontaminated. Decontamination may include the use of dry methods (e.g., pig, plunger, scraper) and rinsing with water. Multiple rinses may be used. To demonstrate compliance with the performance standards, the components will be decontaminated and samples will be collected in accordance with the sampling and analysis plan associated with this closure plan (RPT-205) until site-specific ALs have been achieved.

Table 1. Contaminants of concern and action levels for VCO SITE-TANK-005 Tank System TRA-007 closure.

Contaminant of Concern	Action Level (mg/kg - mg/L rinsate)
Acetone	1.2E+02
Acetophenone	1.2E+02
Antimony	1.2E+02
Arsenic	3.0E+00
Barium	6.0E+01
Bis-(2-ethylhexyl) phthalate	4.6E+00
Cadmium	6.0E–01
Chromium	3.0E+00
Cyanide	1.2E+02
Dimethyl phthalate	1.2E+02
Di-n-butyl phthalate	1.2E+02
Lead	3.0E+00
Mercury	1.2E–01
Methylene chloride	4.6E+00
Nickel	1.2E+02
Selenium	6.0E-01
Silver	3.0E+00
Vanadium	1.2E+02
Zinc	1.2E+02
1,4-Dichlorobenzene	4.5E+00
2-Butanone (MEK)	1.2E+02
3&4-methylphenol	1.2E+02

If the integrity of the containment vault drain piping cannot be demonstrated, the piping will be removed and soil samples will be collected in accordance with the sampling and analysis plan associated with this closure plan (RPT-205). Soil samples will be analyzed for the applicable contaminants of concern (COCs) listed in Table 1. The COCs for this project were developed based on previous characterization data and process knowledge.

A site-specific risk assessment will be conducted for all soil samples associated with VCO SITE-TANK-005 Tank System TRA-007 (see Appendix A). The risk assessment will be used to determine if the concentration of contaminants in the soils pose a risk to human health and the environment based on an excess cancer risk threshold of 1.0E–06 and a hazard index threshold of 1. If the soils exceed the cancer risk threshold or hazard index threshold, then these soils will be addressed using the Federal Facility Agreement and Consent Order (DOE-ID 1991) New Site Identification (NSID) process. Approval of the new site by the Agencies (i.e., State of Idaho, DOE, and EPA) is a criterion for certification of closure.

4.1.3.3 Canal Sump Integrity Verification. The canal sump concrete floor is in good condition with no significant deterioration or cracking that would allow liquids or solids to reach the environment. Since the liquid wastes were characterized as nonhazardous (EDF-2749), the only potential release would be from residual solids in the sump. A visual integrity verification of the sump concrete floor will be conducted to verify that the sump residues would not be released to the environment.

4.1.3.4 Canal Sump Soils. The canal sump is located inside of Building TRA-603 with intact roof and walls. There have been no known releases to the environment from this sump. The characterization of the contents of the canal sump determined that the liquids managed by the sump were nonhazardous, but the canal sump had collected solids that were hazardous and have been removed. Since the canal sump would have prevented the solids from entering the environment, there is no potential for contamination and any action with regard to potentially contaminated soils is not required.

5. WASTE MANAGEMENT

Waste generated during closure activities may include nonhazardous industrial waste and mixed low-level waste (both radioactive and HWMA/RCRA hazardous). All closure-generated wastes will undergo a HWD in accordance with the requirements of IDAPA 58.01.05.006 (40 CFR 262.11) and will be managed per the HWD. Table 2 identifies the anticipated waste streams that will be generated during HWMA/RCRA closure activities and the anticipated disposal pathways. Information regarding waste management during closure activities, as well as associated wastes managed prior to the closure activities, will be provided to the independent PE for closure certification and will be maintained as part of the project files.

Table 2. Anticipated waste streams and disposition pathways.

Waste Stream	Description	Anticipated Disposal Pathway
Industrial Waste	Personal protective equipment, equipment not in contact with hazardous waste, other miscellaneous wastes	INL Landfill
Radioactive Waste (Low-Level Waste)	Personal protective equipment/nonhazardous tank sediment/other miscellaneous wastes	RWMC (radiological only)
	Wastewater from the reactor drain tank or canal sump	TRA-715 evaporation pond, or disposal at RWMC
Mixed Low-Level Waste	Sediment/debris from the reactor drain tank vault	RCRA-permitted TSDF
	Reactor drain tank system components removed during closure	To be determined based on HWD; RMWC or RCRA-permitted TSDF

6. CLOSURE SCHEDULE

Table 3 identifies the closure schedule that will be initiated following DEQ approval of the closure plan. This schedule reflects the time required for conducting closure activities and submitting information to the PE for certification.

IDAPA 58.01.05.009 (40 CFR 265.113) requires waste removal activities to be completed 90 days from the approval of the closure plan and closure to be completed within 180 days from the initiation of closure activities. An extension to these time periods is being requested at this time, pursuant to IDAPA 58.01.05.009 (40 CFR 265.113). The following constraints necessitate an extension in the timeframe to complete waste removal activities:

- The reactor drain tank will require removal from a vault beneath the basement of the MTR building. Removing the reactor drain tank from the vault and out of the MTR building will require hoisting and rigging plans to ensure the safety of workers and the environment. Removing the radioactive tank from the vault may require relocation of TRA-603 utility systems installed above the reactor drain tank vault; and/or

- The reactor drain tank will require that the sediment be removed from the reactor drain tank while the tank remains in the containment vault. This work will require working in a combined radiological area and confined space. The tank may require cleaning, rinsing, and rinsate sampling multiple times to verify the tank has been decontaminated to site-specific ALs.

- Isolating the reactor drain tank in preparation for removal from the reactor drain tank containment vault will require working in confined spaces. The removal and isolation of nonhazardous waste piping and components will be necessary to ensure direct access to the reactor drain tank.

- Removal of the 4-in. reactor drain tank containment vault drain line from under the TRA-603 building footprint will require cutting or coring through concrete and excavation of buried piping with unrelated buried piping and structures in close proximity to the HWMA/RCRA closure piping. Excavations must be completed in such a manner that does not impact the integrity of this piping, the integrity of the building, or place workers in danger due to interaction with energized systems.

- As low as reasonably achievable radiological dose concerns associated with radiation fields in the tank vault and associated with the tank sediment.

Table 3. Schedule for closure of VCO SITE-TANK-005 Tank System TRA-007.

Planned Work Tasks	Completion
DEQ approval of closure plan	Day 0
Access the reactor drain tank vault and remove liquid waste inventory from the tank,	Day 120
Clean and decontaminate the tank, or remove the tank from the vault	Day 330[a]
Clean or remove layer of reactor drain tank vault concrete	Day 390
Integrity test drain line, if integrity confirmed then rinse and sample/analysis; if integrity not confirmed then remove drain line	Day 480
Closure-generated hazardous waste transferred to TSDF	Day 530
Closure Waste Management Activities complete	Day 590
Submittal of NSID (if required)	Day 600
Approval of NSID (if required)	Day 680
PE and owner/operator certification submitted to DEQ[b]	Day 740[b]

a. Sediment may be disposed of in the waste tank. In this case, the tank and sediment will undergo a HWD and be appropriately managed. If sediment is removed from the waste tank, the sediment and empty tank will undergo separate HWDs and both will be appropriately managed.

b. If closure activities are completed ahead of the proposed schedule, the PE and owner/operator closure certification will be submitted to DEQ within 60 days of the completion of closure activities.

7. CERTIFICATION OF CLOSURE

Within 60 days of completing the closure activities, a certification of closure of VCO SITE-TANK-005 Tank System TRA-007 will be provided, in accordance with IDAPA 58.01.05.009 (40 CFR 265.115), by an independent PE to the Idaho Cleanup Project operating contractor and the DOE Idaho Operations Office. The PE and owner/operator signatures on the closure certification, which is submitted to the DEQ, will document the completion of closure activities in accordance with the approved closure plan and State of Idaho HWMA/RCRA requirements. The closure certification may also identify any minor deviations to the approved closure plan made without prior approval of the DEQ that do not impact the closure performance standard. Closure of VCO SITE-TANK-005 Tank System TRA-007 will be considered complete upon receipt of written acceptance issued by DEQ.

Copies of documentation supporting the closure of VCO SITE-TANK-005 Tank System TRA-007 will remain in the VCO project files in the event that this information is requested by DEQ. The VCO SITE-TANK-005 Tank System TRA-007 is not a hazardous waste disposal facility, and therefore, a “Notice in Deed” and a survey plat are not required.

8. CLOSURE PLAN AMENDMENTS

The conditions described in IDAPA 58.01.05.009 (40 CFR 265.112), "Closure Plan; Amendment of Plan," will be followed to implement changes to the approved closure plan. Should unexpected events during the closure period require modification of the approved closure plan or closure schedule, the closure plan will be amended within 90 days of the unexpected event or the DEQ will be otherwise notified. A written request detailing the proposed changes and the rationale for those changes and a copy of the amended closure plan will be submitted for DEQ approval. Minor deviations from the approved closure plan, which are equivalent to or do not compromise the closure requirements and performance standards identified in the approved closure plan, may be made without prior notification to DEQ. Minor deviations will be identified in the documentation supporting the independent PE's certification.

9. COST AND LIABILITY REQUIREMENTS

The federal government, as owner of the INL, is exempt from the requirements to provide cost estimates for closure, to provide a financial assurance mechanism for closure, and regarding a state-required mechanism and state assumption of responsibility per IDAPA 58.01.05.009 [40 CFR 265.1409(c)]. The federal government, as owner of the INL, is also exempt from liability requirements per the same exclusion.

10. REFERENCES

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Appendix A

HWMA/RCRA Closure Risk Assessment Methodology for Environmental Media

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HWMA/RCRA Closure Risk Assessment Methodology for Environmental Media

This appendix presents the methodology that will be used to complete a site-specific risk assessment for the purpose of certifying HWMA (State of Idaho 1983)/RCRA (42 USC 6901 et seq. 1972) closure of VCO SITE-TANK-005 Tank System TRA-007, at the RTC, INL Site. Section A-1 provides the regulatory basis for conducting a site-specific risk assessment to demonstrate compliance with the closure performance standards for media associated with tank systems (IDAPA 58.01.05.009 [40 CFR 265.111 and 265.197(a)]. The remaining sections present the conceptual site model (CSM) used to demonstrate the link between contaminated environmental media and potential receptors, identifies the potentially complete exposure routes that will be evaluated by risk assessment, and summarizes the equations and associated input parameters (both site-specific and, as applicable, EPA default) that will be used to complete the risk assessment. The site-specific risk assessment will be conducted in accordance with EPA guidance (EPA 1989, 2001a).

A-1. REGULATORY BASIS

Since 1987, EPA guidance has interpreted the regulations governing closure of hazardous waste management units as requiring complete removal of all hazardous wastes and liners, and removal or decontamination of leachate, soils, and other materials contaminated with hazardous waste or hazardous constituents to the extent necessary to protect human health and the environment (52 Federal Register [FR] 8704, 1987). The EPA further clarified that this interpretation means that, except for hazardous waste and liners, the regulations do not require complete removal of all contamination (e.g., removal to background levels) from a unit being closed to achieve clean closure. Rather, some limited quantity of hazardous constituents might remain in environmental media after clean closure provided that their concentrations are below levels that may pose a risk to human health and the environment. The EPA also took the position that the amount of hazardous constituents that might remain in environmental media after clean closure should be identified through appropriate application of risk information using available constituent-specific limits or factors that have undergone agency review (e.g., maximum contaminant levels or health-based limits calculated using a verified reference dose [RfD], using toxicity information submitted by a facility owner/operator and approved by the EPA when such limits or factors were not available, or using background comparisons).

The EPA has provided additional guidance on identifying the amount of hazardous constituents that might remain in environmental media after clean closure. The EPA's position is that the procedures and guidance generally used to develop protective, risk-based, media cleanup standards for the RCRA corrective action and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (42 USC 9601 et seq. 1980) cleanup programs are also appropriate to define the amount of hazardous constituents that may remain in environmental media after clean closure. In other words, site-specific, risk-based media cleanup levels developed under the RCRA corrective action and CERCLA cleanup programs are appropriate levels at which to define clean closure (55 FR 8666, 1990; 55 FR 30798, 1990; 61 FR 19432, 1996; Cotsworth 1998). In addition, EPA has interpreted current closure regulations to allow appropriate use of nonresidential exposure assumptions when identifying the amount of decontamination necessary to satisfy the "remove or decontaminate" standard (Cotsworth 1998).

A-2. SITE-SPECIFIC RISK THRESHOLD

Protective media cleanup standards for human health are defined as contaminant concentrations that result in the total excess cancer risk to an individual exposed to the medium over a lifetime falling within a range from 1.0E–04 to 1.0E–06 (EPA 1990). For noncarcinogenic effects, the EPA generally interprets protective cleanup standards to mean constituent concentrations that an individual could be exposed to on a daily basis without appreciable risk of deleterious effect during a lifetime. For purposes of clean closure certification of VCO SITE-TANK-005 Tank System TRA-007, the risk presented by the environmental media of concern will be considered acceptable if the total excess cancer risk does not exceed 1.0E–06 and the hazard index (HI) is less than 1.

A-3. EXPOSURE ASSESSMENT

An exposure assessment will be completed to estimate the type, duration, and magnitude of exposure that receptors may experience because of contact with the COCs. A CSM, which illustrates the contaminant sources, primary release mechanisms, secondary sources and release mechanisms, exposure pathways, exposure routes, and receptors that will be evaluated by the site-specific risk assessment, is presented as Figure A-1. The CSM graphically presents the potentially complete exposure routes. Each potentially complete exposure route will be evaluated in detail during the risk assessment using available site-specific parameters and post-closure characterization (sampling of environmental media as part of closure activities) data collected at the conclusion of HWMA/RCRA closure activities.

The exposure assessment has both qualitative and quantitative components. The qualitative component consists primarily of evaluating potentially exposed receptor populations and potential exposure pathways. The quantitative evaluation consists of estimating the exposure-point concentrations within the environmental media and quantifying the intake factor associated within each pathway. The qualitative evaluation is presented in the CSM (see Figure A-1) and the quantitative evaluation will be completed using post-closure certification sampling data.

A-3.1 Identification of Potentially Exposed Receptor Populations

As shown in Figure A-1, the only potentially exposed receptor population that will be evaluated is an occupational receptor. The *INEEL Comprehensive Land Use Plan* (INEEL 2006) describes the land use of the INL, which is currently government-controlled industrial use. The term “controlled” means that unrestricted public access to the INL is not available. Access to INL facilities requires proper clearance, training, or escort and controls for security reasons and to limit the potential for unacceptable exposures. A security force is used to limit access to approved personnel and visitors. These controls are estimated to be in place until at least 2095. Because the current land use includes continued utilization of operating facilities and access to these facilities is controlled, the only potential receptor is an occupational worker during the current land use scenario.

Future land use scenarios are identified in the *Long-Term Land Use Future Scenarios for the Idaho National Engineering Laboratory* (DOE-ID 1995). This document was developed using a stakeholder process that involved a public participation forum, a public comment period, and the INL Citizens Advisory Board. Following review and comment by the public participation forum the document underwent a 30-day public comment period and was subsequently submitted to the Board for review and recommendations. No recommendations for residential use of any portion of the INL until at least 2095 have been received to date.

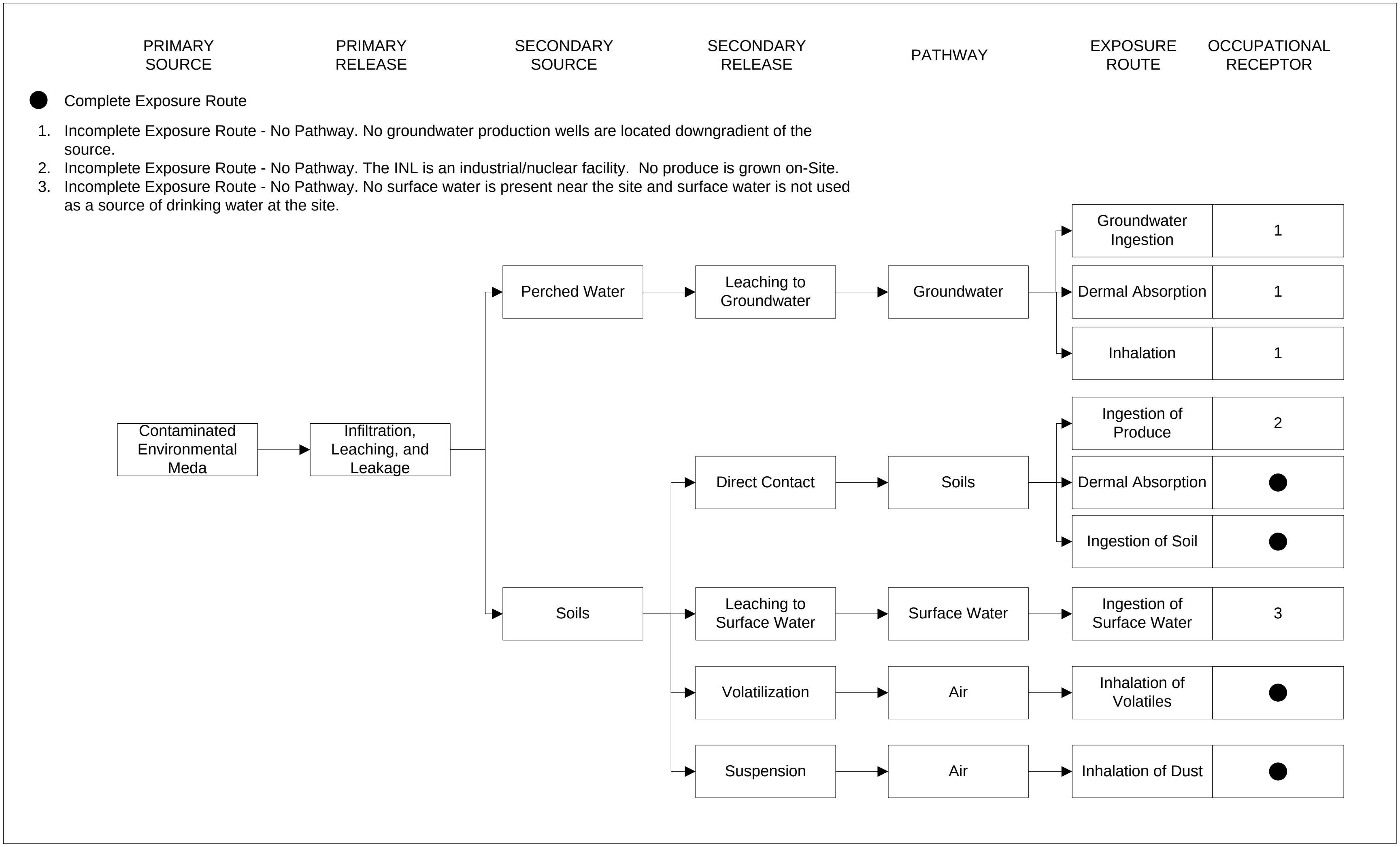

Figure A-1. HWMA/RCRA closure risk assessment conceptual site model.

The INL is an industrial nuclear facility that is located in a very rural area with a low population density and projected low growth. Future residential use, especially those areas that are currently or have historically been utilized by INL operations, is extremely unlikely. Therefore, for purposes of the site-specific risk assessment, no residential receptors populations will be evaluated.

A-3.2 Identification of Potential Exposure Pathways

The CSM includes various exposure pathways that were determined to be potentially complete and were selected for further evaluation based on the nature of the contamination that may be left in place following HWMA/RCRA closure activities. These pathways are summarized in Table A-1. It should be noted that potentially complete exposure pathways are expected to vary between different closure sites due to the variation of site-specific contaminants or the presence of engineering features that prevent exposure from occurring. Each potentially complete exposure pathway will be evaluated and the results documented in the site-specific risk assessment.

Table A-1. Potentially complete exposure pathways to be quantitatively evaluated.

Potentially Exposed Population	Scenario	Potentially Complete Exposure Pathways
Occupational worker	Current and future land use	• Inhalation of volatile organic compounds • Inhalation of airborne particulates • Ingestion of surface soil • Dermal absorption.
Residential	Current land use	Current use of the INL is for government-controlled industrial activities (unrestricted public access to the INL is not available); there are no potentially complete residential exposure scenarios.
Residential	Future land use	Future land use scenarios are identified in the *Long-Term Land Use Future Scenarios for the Idaho National Engineering Laboratory* (DOE-ID 1995). The document identifies anticipated activities through 2095 and projects that the current industrial uses will continue at the INL through at least 2095. Therefore, a future residential exposure scenario is unlikely and is not a complete exposure pathway.

A-3.3 Derivation of Exposure-Point Concentrations

Validated analytical data from post-closure sampling and analysis activities will be used to estimate exposure-point concentrations for each COC. The COCs were established, for purposes of HWMA/RCRA closure, based on process knowledge and historical analytical data from sampling of the tank system being closed or related processes. The risk assessment will account for all contaminants detected, regardless of their inclusion as COCs in the closure plan, during post-closure characterization of the tank system, except as outlined below:

- Data that are rejected per the method validation may be eliminated from the data set used to determine the exposure point concentrations. Rejected data will be evaluated to determine usefulness to the project and whether they can be used with limitations in the exposure-point concentrations.

- Contaminants that are not detected in any samples will be screened from further consideration

- Contaminants for which there are both true detects and non-detects will be retained for evaluation and non-detect data will be assigned an appropriate concentration during DQA using EPA recommended strategies, as presented in *Data Quality Assessment: Statistical Methods for Practitioners* (EPA 2006a)

- Contaminants for which there is no EPA approved toxicity information (e.g., EPA's Integrated Risk Information System [IRIS] [EPA 2006b] or Region 9 preliminary remediation goals [PRG] table [EPA 2006c]) will be screened from further consideration

- Additional screening methodologies may be used in accordance with EPA guidance as necessary and appropriate and will be documented in the site-specific risk assessment.

The screening process is designed to be conservative such that all contaminants that have a reasonable potential for causing adverse human health effects pass the screening and, therefore, will be evaluated in the site-specific risk assessment. Because of the uncertainty associated with any estimate of exposure concentration, the 95% upper confidence limit (UCL) is the most appropriate estimate for the COC concentrations (EPA 2001a). Specific calculations for the 95% UCL are dependent upon data distribution (i.e., are the data distributed normally or log normally). For purposes of sampling, it has been assumed that the data will be normally distributed; however, this assumption will be checked and confirmed during the DQA and the appropriate distribution applied to the data to obtain the 95% UCL.

While radiological samples will be collected during closure activities to support waste management activities and future decontamination and dismantlement activities, the risk assessment will not address radionuclides. Residual radioactive contamination is not subject to HWMA/RCRA regulations and will be addressed under a separate regulatory authority.

A-3.3.1 Estimate of Soil Exposure Concentrations

Estimates of soil exposure concentrations will be based directly on the analytical data obtained during closure activities for the environmental media of concern. This assumes that source term concentrations remain constant over time and is conservative.

A-3.3.2 Estimate of Air Exposure Concentrations

Estimates of air exposure concentrations due to emissions will be calculated as average values over the entire area and, therefore, will be the same regardless of location. The air exposure-point concentrations will be estimated assuming the release mechanisms are fugitive dust emissions and volatilization. The following sections describe how these concentrations will be estimated.

A-3.3.2.1 Inhalation of Fugitive Dust. A respirable particulate (R) value will be used to estimate the contaminant concentration in the air (C_{AIR}). The R value will be based on the respirable particulate emissions from wind erosion measured at the Idaho Nuclear Technology and Engineering Center (INTEC) (Mitchell 1994), which is assumed to be analogous to RTC. The emissions will be assumed to be steady state with the concentration of the COCs not depleting with time. Equation (A-1) will be used to estimate this value.

$$C_{AIR} = CF \times R \times C_{SOIL} \tag{A-1}$$

where

C_{AIR} = contaminant concentration in the air (mg/m^3)

CF = conversion factor (1.0E–09 kg/*u*g)

R = RTC respirable particulate matter (14 ug/m^3) (Mitchell 1994). (This value represents the 95% UCL of the arithmetic mean of weekly airborne particulate matter concentration measured at the INTEC low volume air sampling station, which is assumed to be analogous to RTC.)

C_{SOIL} = contaminant concentration in the soil (mg/kg).

A-3.3.2.2 Inhalation of Volatiles. Appropriate air emission models will be used to predict volatile contaminant exposure concentrations in the air.

A-3.4 Development of Chemical Intakes

Route-specific exposures or intakes will be quantified through the use of standard intake equations, site-specific or default exposure parameters, and exposure-point concentrations (as defined in Section A-3.3). Each chemical intake equation (EPA 1989, 2001a) that will be used along with a description of the associated exposure parameters for each scenario is given in Figures A-2 through A-5. In general, site-specific parameters will be used in the intake equations, where available. Where such information is not available, default EPA parameters will be used.

$$\text{Intake (mg/kg} - \text{day)} = C_{soil} \times \left[\frac{(IR \times FI \times EF \times ED) \times CF}{BW \times AT} \right]$$

where

C_{soil} = contaminant concentration in the soil (mg/kg based on 95% UCL)

IR = ingestion rate (50 mg/d)

FI = fraction ingested (1)

EF = exposure frequency (200 d/yr)[h]

ED = exposure duration (25 yr)

CF = conversion factor (10^{-6} kg/mg)

BW = body weight (70 kg)

AT = averaging time (25,550 d for carcinogenic, 9,125 d for noncarcinogenic).

Figure A-2. Soil ingestion chemical intake parameters.[i]

h. Exposure frequency is based on 4 days per week (at 10 hours per day) for 50 weeks per year.

i. Values shown are default values for the INL unless otherwise noted.

$$AD = \frac{C_{soil} \times SA \times AF \times ABS \times EF \times ED \times CF}{BW \times AT}$$

where

AD	=	absorbed dose (mg/kg-d)
C_{soil}	=	contaminant concentration in the soil (mg/kg based on 95% UCL)
SA	=	skin surface area available for contact (3,300 cm^2/event) (EPA 2001b)
AF	=	soil to skin adherence factor (0.2 mg/cm^2) (EPA 2001b)
ABS	=	absorption factor (unitless) (mass absorbed/mass applied)
EF	=	exposure frequency (200 events/yr)[j]
ED	=	exposure duration (25 yr)
CF	=	conversion factor (10^{-6} kg/mg)
BW	=	body weight (70 kg)
AT	=	averaging time (25,550 d for carcinogenic, 9,125 d for noncarcinogenic).

Figure A-3. Dermal absorption parameters.[k]

j. Exposure frequency is based on one event per day, 4 days per week, 50 weeks per year.

k. Values shown are default values for the INL unless otherwise noted.

$$\text{Intake (mg/kg - d)} = \frac{C_{air} \times IR \times ET \times EF \times ED \times CF}{BW \times AT}$$

where

C_{air}	=	contaminant concentration in respirable fugitive dust (mg/m^3)
IR	=	inhalation rate (20 m^3/d)
ET	=	exposure time (10 hr/d)
EF	=	exposure frequency (200 d/yr)[l]
ED	=	exposure duration (25 yr)
CF	=	conversion factor (0.04167 d/hr)
BW	=	body weight (70 kg)
AT	=	averaging time (25,550 d for carcinogenic, 9,125 d for noncarcinogenic).

Figure A-4. Inhalation of fugitive dust intake parameters.[m]

l. Exposure frequency is based on 4 days per week (at 10 hours per day) for 50 weeks per year.

m. Values shown are default values for the INL unless otherwise noted.

$$\text{Intake (mg/kg - d)} = \frac{C_{air} \times IR \times ET \times EF \times ED \times CF}{BW \times AT}$$

where

C_{air}	=	volatile contaminant concentration in the air (mg/m^3)
IR	=	inhalation rate (20 m^3/d)
ET	=	exposure time (10 hr/d)
EF	=	exposure frequency (200 d/yr)[n]
ED	=	exposure duration (25 yr)
CF	=	conversion factor (0.04167 d/hr)
BW	=	body weight (70 kg)
AT	=	averaging time (25,550 d for carcinogenic, 9,125 d for noncarcinogenic).

Figure A-5. Inhalation of volatiles intake parameters.[o]

A-4. TOXICITY ASSESSMENT

Toxicity values will be used to characterize risk for the COCs. Consistent with the Risk Assessment Guidance for Superfund (EPA 1989, 2001a), the toxicity information will be summarized for two categories of potential effects: carcinogens and noncarcinogens. The toxicity values that will be used quantitatively in the risk assessment will be obtained from two major sources, IRIS (EPA 2006b) and EPA Region 9 PRG table (EPA 2006c).

A-4.1 Carcinogens

Potential carcinogenic risks will be expressed as an estimated probability that an individual might develop cancer from a lifetime exposure to a specific concentration of a contaminant. This probability is based on projected intakes and chemical-specific dose-response data called SFs. Slope factors and the estimated daily intake of a compound, averaged over the 24-year exposure duration, will be used to estimate the incremental cancer risk of an occupational worker exposed to that contaminant.

The oral and inhalation SFs for the COCs will be compiled in a table, including the weight-of-evidence (carcinogen groups), source reference, and date. Slope factors will also be provided for the inhalation route as unit risks in units of “microgram per cubic meter” $(\mu g/m^3)^{-1}$.

n. Exposure frequency is based on 4 days per week (at 10 hours per day) for 50 weeks per year.

o. Values shown are default values for the INL unless otherwise noted.

A-4.2 Noncarcinogens

Potential noncarcinogenic effects will be evaluated in the risk characterization by comparing daily intakes (calculated in the exposure assessment) with chronic RfDs developed by the EPA. If the chronic daily intake is below the RfD, there should be no adverse effects. Conversely, if chronic daily intakes exceed the RfD, there is a potential that some adverse noncarcinogenic health effects might be observed in exposed individuals.

A-5. RISK CHARACTERIZATION

Risk characterization involves estimating the magnitude of the potential adverse effects of the COCs under study and summarizing risks to the receptor. Risk characterization combines the results of the exposure and toxicity assessments to provide numerical estimates of health risk. These estimates are for lifetime cancer risk and comparisons of exposure levels with RfDs for a given intake. The process of characterizing risk includes the following:

- Calculating and characterizing carcinogenic and noncarcinogenic effects
- Conducting uncertainty analysis.

To quantify the health risks, the intakes are first calculated for each COC for each applicable pathway and scenario. The specific intakes are then compared to the applicable chemical-specific toxicological data to determine health risks. The health risks from each COC will be calculated to first determine potential carcinogenic effects and secondly to determine potential noncarcinogenic effects. Each of these calculations is discussed in the following subsections.

A-5.1 Determining Carcinogenic Effects

Equation (A-2) will be used to determine carcinogenic effects by obtaining numerical estimates, (i.e., unitless probability) of lifetime cancer risks.

$$RISK = INTAKE \times SF \tag{A-2}$$

where

RISK = potential lifetime excess cancer risk (unitless)

INTAKE = chemical intake (mg/kg-d)

SF = slope factor $(mg/kg\text{-}d)^{-1}$.

Inhalation and oral ingestion SFs will be used with respective inhalation and ingestion intakes to estimate risks. Cancer risks will be summed separately across all potential chemical carcinogens in the risk assessment using the following equation:

$$RISK_t = \sum RISK_i \tag{A-3}$$

where

$RISK_t$ = total cancer risk, expressed as a unitless probability

$RISK_i$ = risk estimate for the i^{th} contaminant.

The excess cancer risk posed by the COCs will be determined by accounting for INL background concentrations of each contaminant, as summarized in *Background Dose Equivalent Rates and Surficial Soil Metal and Radionuclide Concentrations for the Idaho National Engineering Laboratory* (INEL 1995). The pathways and contaminants driving the risk will be noted in the site-specific risk assessment and will be accompanied by any necessary qualifying statements. The numerous conservative assumptions involved in the risk assessment methodology will be documented in the site-specific risk assessment.

A-5.2 Determining Noncarcinogenic Effects

Health risks associated with exposure to individual noncarcinogenic compounds will be determined by calculating hazard quotients (HQs) and summing the HQs to obtain an HI. The noncarcinogenic HQ is the ratio of the intake or exposure level to the RfD as follows:

$$HQ = \frac{INTAKE}{RfD} \tag{A-4}$$

where

HQ = noncarcinogen hazard quotient

$INTAKE$ = chemical intake (mg/kg-d)

RfD = reference dose (mg/kg-d).

If the HQ for any chemical exceeds 1 there may be concern for potential health effects. The HI is obtained by adding the HQs for each chemical across the exposure pathways. The HI will be calculated using Equation (A-5):

$$HI = \sum \frac{E_i}{RfD_i} \quad or \quad HI = \sum HQ_i \tag{A-5}$$

where

HI = hazard index

E_i = chemical intake for the i^{th} toxicant (mg/kg-d)

RfD_i = reference dose for the i^{th} toxicant (mg/kg-d)

HQ_i = noncarcinogen hazard quotient for the i^{th} toxicant.

The excess noncarcinogenic hazard posed by the COCs will be determined by accounting for INL background concentrations of each contaminant, as summarized in *Background Dose Equivalent Rates and Surficial Soil Metal and Radionuclide Concentrations for the Idaho National Engineering Laboratory* (INEL 1995). The pathways and contaminants driving the hazard will be noted in the site-specific risk assessment and will be accompanied by any necessary qualifying statements. The numerous conservative assumptions involved in the risk assessment methodology will be documented in the site-specific risk assessment.

A-6. UNCERTAINTY ANALYSIS

There are many sources of uncertainty introduced during the risk assessment process. These emerge during all aspects of the process beginning with site field investigations and sampling and analysis through risk characterization. The various aspects within the different steps in the evaluation that may influence the outcome of the risk characterization will be documented in the site-specific risk assessment along with a qualitative evaluation of the likelihood for a particular feature to overestimate, or underestimate the results.

A-7. REFERENCES

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