DOE/ID-11282
Revision 1

U.S. Department of Energy
Idaho Operations Office

HWMA/RCRA Closure Plan for the TRA Fluorinel Dissolution Process Mockup and Gamma Facilities Waste System

Voluntary Consent Order SITE-TANK-005 Tank System TRA-009

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 the Test Reactor Area Fluorinel Dissolution Process Mockup and Gamma Facilities Waste System, located in Building TRA-641 at the Reactor Technology Complex, Idaho National Laboratory Site, to meet a further milestone established under the Voluntary Consent Order SITE-TANK-005 Action Plan for Tank System TRA-009. The tank system to be closed is identified as VCO SITE-TANK-005 Tank System TRA-009 (catch tank [98TRA00483] and receiver tank [99TRA00004]). The catch tank and receiver tank were characterized as managing hazardous waste. The tank system will be closed in accordance with the interim status requirements of the Hazardous Waste Management Act/Resource Conservation and Recovery Act as implemented by 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

ABS	acrylonitrile-butadiene-styrene copolymer
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	contaminant of concern
CSM	conceptual site model
DEQ	State of Idaho Department of Environmental Quality
DOE-ID	U.S. Department of Energy Idaho Operations Office
EDF	engineering design file
EPA	U.S. Environmental Protection Agency
FDP	fluorinel dissolution process
FFA/CO	Federal Facility Agreement and Consent Order
FR	Federal Register
HI	hazard index
HQ	hazard quotient
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
NSID	New Site Identification
PE	professional engineer
PPE	personal protective equipment
PRG	preliminary remediation goals
PVC	polyvinyl chloride polymer
RCRA	Resource Conservation and Recovery Act

RfD	reference dose
RTC	Reactor Technology Complex
RWMC	Radioactive Waste Management Complex
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 Fluorinel Dissolution Process Mockup and Gamma Facilities Waste System

Voluntary Consent Order SITE-TANK-005 Tank System TRA-009

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 the Test Reactor Area (TRA) Fluorinel Dissolution Process (FDP) Mockup and Gamma Facilities Waste System (Voluntary Consent Order [VCO] SITE-TANK-005 Tank System TRA-009), located in Building TRA-641 at the Reactor Technology Complex (RTC) (formerly TRA), Idaho National Laboratory (INL) Site.

The tank system to be closed is identified as VCO SITE-TANK-005 Tank System TRA-009 in the VCO SITE-TANK-005 Action Plan (DEQ 2000), a consent order between the U.S. Department of Energy Idaho Operations Office (DOE-ID) and the State of Idaho Department of Environmental Quality (DEQ). The tank system components requiring HWMA/RCRA closure are the catch tank (98TRA00483) and receiver tank (99TRA00004). The system boundaries were established in the system identification document (INEEL 2005). The tank system components were characterized and system boundaries requiring HWMA/RCRA closure (for those components characterized as managing HWMA/RCRA-hazardous waste) were established in the characterization documentation (EDF-803). These HWMA/RCRA closure boundaries were finalized with the approval of the characterization engineering design file (EDF) (EDF-803) by DEQ (Gregory 2005).

This HWMA/RCRA tank system closure plan includes a general description of the catch tank, receiver tank, and ancillary equipment and piping requiring closure, and identifies the current and maximum hazardous waste inventory. Closure activities include removal and disposal of the hazardous waste inventory, removal and disposal of the catch and receiver tanks, and removal and disposal and/or decontamination of ancillary equipment and piping. The closure also includes verification of piping and tank integrity, soil sampling for direct-buried piping that does not have integrity verification, and action levels for piping that will remain in place. The VCO SITE-TANK-005 Tank System TRA-009 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 (previously TRA) is situated on the south-central portion of the INL Site (see Figure 1) and occupies an enclosed and secured area.

2.2 Gamma Facilities Warm Waste System Description and Operating History

The Gamma Building (TRA-641) was originally constructed in 1955 to conduct gamma irradiation experiments using spent fuel elements from the Materials Test Reactor (Phillips 1957) in the TRA-641 canal. The spent fuel emitted gamma rays that had a penetrating power similar to x-rays that could, among other things, kill pathogens. The variety of products irradiated included meat, grain, fruit, plastics, drugs, coal, gold, and diamonds (DOE-ID 2000). By 1971, the gamma irradiation experiments ended, all the radioactive components were removed from TRA-641, and the canal was drained and decontaminated (Rolfe and Wills 1984).

Between 1955 and 1971, warm (radioactive) wastewater generated from the irradiation experiments in TRA-641 was collected in two piping systems prior to being discharged from the building. The first system collected wastewater from the canal overflow weir (which also acted as the building floor drain) and the laboratory sinks and hood drains via the chemical drain line, which gravity-drained to the canal sump in the bottom of the pipe tunnel. A float-controlled sump pump discharged wastewater to the building discharge line (4" WDC-641) (see Figures 2 and 3).

The second TRA-641 warm wastewater piping system was used to discharge canal water. The canal wastewater piping consisted of piping from four canal floor drains to a common header in the pipe tunnel. The header utilized a 3-hp pump located in the pipe tunnel to discharge the canal water out the building warm waste discharge line (4" WDC-641). At some point (timeframe unknown), the canal weir overflow/floor drain discharge piping was changed to discharge directly to line 4" WDC-641 with an overflow line to the canal sump.

While the gamma irradiation experiments were being conducted (1955–1971), the TRA-641 warm wastewater was discharged to the retention basins (TRA-712; VCO SITE-TANK-005 Tank System TRA-011) and then to the TRA-758 leaching pond. The warm wastewater was routed to the retention basins via the 4" WDC-641 discharge line, which tied into line 4" WDA-630-A just east of the TRA-630 catch tank pump vault. Line 4" WDA-630-A discharged directly to the retention basin inlet. In the early 1980s, with wastewater no longer being transferred through the canal drains or the canal sump, both the 3-hp canal header pump and the canal sump pump were tagged out of service, and line 4" WDA-630-A was cut and capped on both sides of the junction with line 4" WDC-641, which essentially isolated line 4" WDC-641 from any further discharges (INEEL 2005).

The component associated with the Gamma Facilities Warm Waste System subject to HWMA/RCRA closure, per EDF-803, is line 4" WDA-630-A from where it is cut and capped in the TRA-630 vault to the point it is cut and capped under TRA-635. The canal sump (98TRA00505), four 2-in. canal drain lines, the canal header drain line, the canal overflow weir/floor drain, and the 1-in. drain will be addressed under another follow-on VCO milestone.

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

2.3 Fluorinel Dissolution Process Mockup System Description and Operating History

In 1975, TRA-641 was modified to house mockup experiments in support of work being conducted at the Idaho Nuclear Technology and Engineering Center (INTEC). The modifications included the addition of a catch tank and a receiver tank in the bottom of the canal to collect liquid waste from the mockup experiments. In addition, the chemical drain line from the lab sinks and hood was rerouted from the canal sump to the receiver tank. The catch tank and receiver tank received waste from the FDP mockup experiment and the TRA Gamma Facility Off-Gas Scrubber System (VCO SITE-TANK-005 Tank System TRA-019). The off-gas scrubber system was used to treat off-gas from both the glass melter and calcine pelletizer experiments.

The dissolution mockup was a full-scale test platform for the FDP located at INTEC. The mockup was designed for process experimentation, design testing, and determination of operational parameters. This mockup was built to test various aspects of the dissolution process before project implementation, including flow characteristics during sparging (INEEL 2000).

The FDP mockup system (see Figure 2; Schematic P-CLOS-ST005-TRA-009A) included a batch Plexiglas mockup tank (VCO SITE-TANK-005 Tank System TRA-013) in which tests were conducted. An air tank used for sparging was connected to the bottom of the Plexiglas mockup tank to agitate the system. The liquid wastes from the mockup tank gravity-drained to the catch tank. The catch tank then drained into a 60-gal receiving tank from which the waste was pumped to the TRA cold waste system.

The TRA-009 FDP Process Mockup System components subject to HWMA/RCRA closure, per EDF-803, are the catch tank (98TRA00483), receiver tank (99TRA00004), and associated piping.

2.4 TRA-009 HWMA/RCRA Closure Boundaries

The HWMA/RCRA closure boundaries for VCO SITE-TANK-005 Tank System TRA-009 were established in the characterization EDF (EDF-803), which was approved by DEQ (Gregory 2005). The following tanks, drains, and piping shown on Schematics P-CLOS-ST005-TRA-009A and -009B (see Figures 2 and 3) were determined to have managed hazardous waste and are the components of VCO SITE-TANK-005 Tank System TRA-009 requiring HWMA/RCRA closure:

- Catch tank (98TRA00483) including the following ancillary piping:
  - The drain line from the scrub tank (98TRA00488; VCO SITE-TANK-005 Tank System TRA-019) to the catch tank that carried waste scrub solution. The piping is included from the scrub tank outlet to the catch tank. The piping will be isolated at the scrub tank outlet at a point as close to the scrub tank as technically practicable.
  - The drain lines from the Plexiglas mockup tank (98TRA00484; VCO SITE-TANK-005 Tank System TRA-013) are included. The 1 1/2-in. acrylonitrile-butadiene-styrene copolymer (ABS) line is included up to the point where it is cut and capped in the canal (the line was historically isolated at this point in the canal). The purpose of this 1 1/2-in. ABS piping is not known; however, it has conservatively been managed the same as the RCRA closure piping. The 2-in. polyvinyl chloride polymer (PVC) bottom discharge lines are included to the catch tank. (Note: A portion of the lines were cut and removed in fall 2005 from the Plexiglas mockup tank to the top/north wall of the canal as a pre-closure activity

and disposed of as hazardous waste.[a,b] The disposition of the drain lines will be documented in the closure certification.) Visual inspection verified that the TRA-641 floor located where the drain lines originally connected to the Plexiglas mockup tank was free of waste-related staining; therefore, no integrity issues were identified for these portions of the drain lines. Therefore, the floor under the Plexiglas mockup tank drain lines is not part of this closure.

- The drain line from the catch tank to the receiver tank, including the valve and short section of the chemical drain line from the valve to the catch tank drain line.

• Receiver tank (99TRA00004) including the following ancillary equipment and piping:

  - Two receiver tank pumps.

  - Line 2” SWB-641 from the receiver tank to the TRA cold waste system. The line is included in VCO SITE-TANK-005 Tank System TRA-009 from the receiver tank to the junction with line 10” SWC-671. Line 2” SWB-641 will be isolated (i.e., plugged, capped, etc.) from line 10” SWC-671 at a point as close to 10” SWC-671 as technically practicable. Line 10” SWC-671 is not included in the VCO tank system.

• Line 4” WDA-630-A from where it is cut and capped in the TRA-630 vault to the point it is cut and capped under TRA-635.

• The portion of the TRA-641 canal floor with waste-related staining from the failure of a receiver tank pump gasket.

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a. Work Order # 600948: “TRA-641 Remove the Plexiglas Mockup Tank,” September 14, 2005.

b. IWTS Container Profile VCO050065: TRA Hazardous Waste Debris Characteristic Only, Waste/Material Characterization Profile 4014N.R1, shipped for treatment and disposal October 11, 2005.

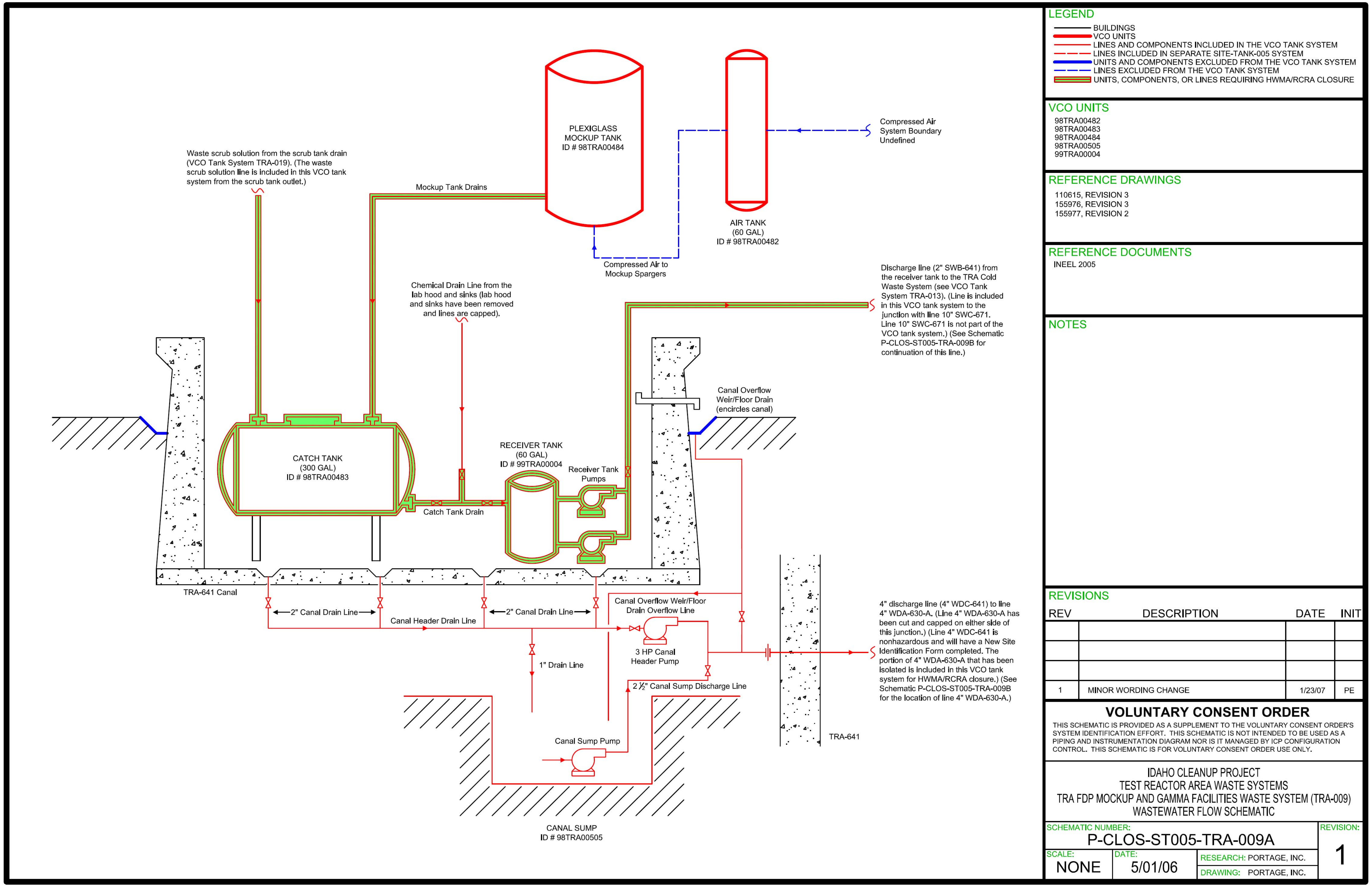

Figure 2. Schematic P-CLOS-ST005-TRA-009A. Units and components to be HWMA/RCRA closed.

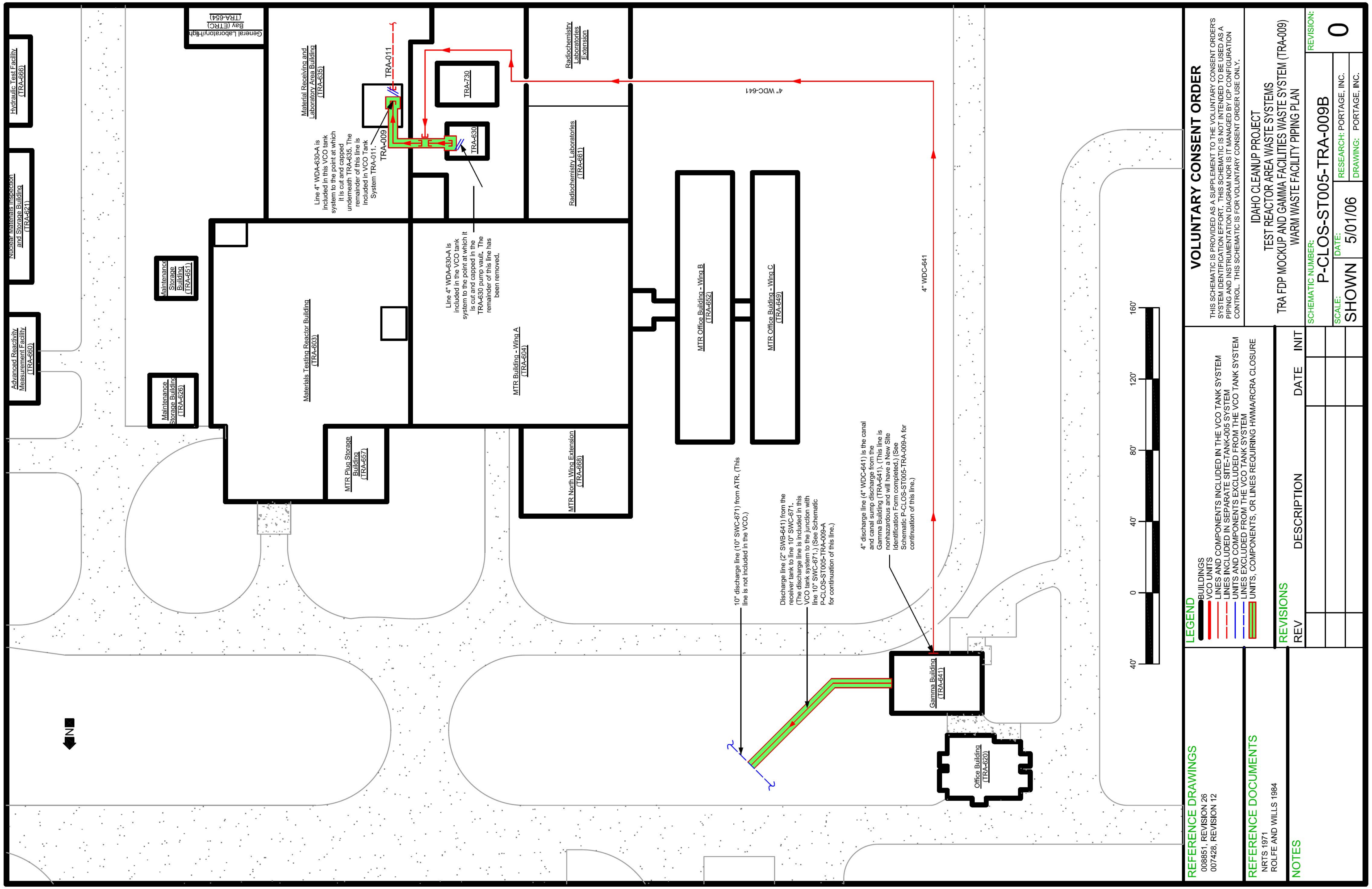

Figure 3. Schematic P-CLOS-ST005-TRA-009B. Units and components to be HWMA/RCRA closed.

3. CURRENT AND MAXIMUM HAZARDOUS WASTE INVENTORY AND CHARACTERISTICS

The catch tank (300-gal maximum capacity) and receiver tank (60-gal maximum capacity) were characterized as managing HWMA/RCRA-hazardous waste (see the characterization EDF for process knowledge, analytical data, and system boundaries related to this characterization [EDF-803]). The catch tank currently contains small quantities of residual sediment that is HWMA/RCRA hazardous for lead (D008) and also managed corrosive (D002) waste. The receiver tank currently contains small quantities of residual waste that is HWMA/RCRA hazardous for lead (D008). The following ancillary piping and equipment were also characterized as having managed HWMA/RCRA-hazardous waste:

- The catch tank discharge line to the receiver tank, Plexiglas mockup tank discharge lines to the catch tank, two receiver tank pumps, and receiver tank discharge line 2” SWB-641 managed waste that was HWMA/RCRA hazardous for lead (D008)

- The discharge line from the scrub tank to the catch tank managed waste that was HWMA/RCRA hazardous for corrosivity (D002)

- Line 4” WDA-630-A from where it is cut and capped in the TRA-630 vault to the point it is cut and capped under TRA-635 was determined to have managed waste that was HWMA/RCRA hazardous for lead (D008), cadmium (D006), chromium (D007), and mercury (D009).

4. CLOSURE PERFORMANCE STANDARDS

The following subsections describe the closure performance standards for VCO SITE-TANK-005 Tank System TRA-009 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) 265.11 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 VCO SITE-TANK-005 Tank System TRA-009 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 and system component removal.

4.1.1.1 Tank System and Waste Inventory Removal. The catch tank (98TRA00483) and receiver tank (99TRA00004) currently contain residual HWMA/RCRA-hazardous sediment.

The catch tank and receiver tank will be removed with the hazardous waste sediment remaining inside the tanks. The tanks and sediment will be transferred to a permitted treatment, storage, and disposal facility (TSDF) for treatment and/or disposal.

4.1.1.2 Tank System Isolation and System Component Removal. The hazardous waste piping associated with the tank systems will be removed from the facility. The hazardous waste systems will be isolated (i.e., piping will be plugged, capped, blind-flanged, or have other suitable methods of isolation). The isolation will be confirmed by visual inspection before completion of closure activities and confirmed by the independent, registered PE for the closure certification.

- Catch tank (98TRA00483) isolation and system component removal:

  - The drain line from the scrub tank (98TRA00488; VCO SITE-TANK-005 Tank System TRA-019) to the catch tank that carried waste scrub solution will be isolated and removed. The piping will be isolated (i.e., plugged, capped, etc.) at the scrub tank outlet at a point as near the scrub tank as technically practicable. The piping will be removed from the isolation point to the catch tank and will be transferred to a TSDF for treatment and/or disposal.

  - The drain lines from the Plexiglas mockup tank (98TRA00484; VCO SITE-TANK-005 Tank System TRA-013) are included. The 1 1/2-in. ABS line is included up to the point where it is cut and capped in the canal (the line was historically isolated at this point in the canal). The purpose of this piping is not known; however, it has conservatively been managed the same as the RCRA closure piping. The 2-in. PVC discharge line is included to the catch tank. The discharge lines will be removed and transferred to a TSDF for treatment and/or disposal. (Note: A portion of the lines were cut and removed in fall 2005 from the Plexiglas mockup tank to the top/north wall of the canal as a pre-closure activity and disposed of as hazardous waste [see footnotes a and b on page 6]. The disposition of the drain lines will be documented in the closure certification. Visual inspection verified the TRA-641 floor located where the drain lines originally connected to the Plexiglas mockup tank was free of waste-related staining; therefore, no integrity issues were identified for these portions of the drain lines.) Therefore, the floor under the Plexiglas mockup tank drain lines is not part of this closure.

  - Catch tank drain line to the receiver tank, including the valve and short section of the chemical drain line from the valve to the catch tank drain line, will be removed and transferred to a TSDF for treatment and/or disposal.

- Receiver tank (99TRA00004) isolation and system component removal:

  - Two receiver tank pumps will be removed and transferred to a TSDF for treatment and/or disposal. The portions of the pumps (e.g., electric motors) that did not contact hazardous waste may be separated and disposed of as low-level radioactive waste.

  - Line 2" SWB-641 from the receiver tank to the TRA cold waste system will be isolated (i.e., plugged, capped, etc.) from line 10" SWC-671 at a point as near 10" SWC-671 as technically practicable. The line will be decontaminated and/or removed from the receiver tank to the isolation point with line 10" SWC-671. Decontamination solution and/or removed piping will be dispositioned per Subsection 4.2. Line 10" SWC-671 is not included in this VCO tank system.

- Line 4" WDA-630-A (only the portion of the line between the TRA-630 pump vault and underneath TRA-635) is already isolated in the TRA-630 pump vault, underneath TRA-635, and from line 4" WDC-641. No further isolation is necessary.

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)].

- Tank system and waste inventory removal: Addressed under Standard 1, Subsection 4.1.1.1
- Tank system isolation and system component removal: Addressed under Standard 1, Subsection 4.1.1.2
- Decontaminate piping that will not be removed: Addressed under Standard 2, Subsection 4.1.2.1.

4.1.2.1 Decontamination Strategy. In general, components will be removed wherever practical in lieu of decontamination (Subsection 4.1.1.2). The only piping planned to remain in place is line 4" WDA-630-A from where it is cut and capped in the TRA-630 vault to the point it is cut and capped under TRA-635 and the buried portions of line 2" SWB-641. If, during closure activities, other piping is identified that cannot be removed, the same integrity evaluation and decontamination strategy will be applied.

Components will be decontaminated using common industrial practices to remove hazardous waste residuals to the extent necessary to meet the action levels. Units and components that are decontaminated to the action levels will remain in place and will exit HWMA/RCRA regulations.

An integrity evaluation will be performed on the piping requiring decontamination to ensure that the piping is intact and to minimize the potential for release during closure activities. Integrity evaluation may include external visual inspection where possible, internal video inspection, and/or process knowledge. If these evaluations cannot be made or are inconclusive, then other alternatives may be used, which are listed as follows.

- 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 a specified time period. The water is then drained from the piping and managed in accordance with a hazardous waste determination.

Following the integrity evaluation, components for which integrity has been verified will be decontaminated. Decontamination may include using dry methods (e.g., pig, plunger, scraper) and flushing or rinsing with water. Multiple rinses may be used. To demonstrate compliance with the performance standards, the components will be decontaminated and the final rinsate water will be sampled until site-specific action levels have been achieved.

Line 4" WDA-630-A is either direct-buried or embedded in concrete. Therefore, only limited external visual inspection is possible. The external portion of piping examined was in good condition with no evidence of abnormal corrosion, no evidence of leakage, and the piping had consistent wall thickness measurements.[c] The stainless steel piping has been internally visually recorded from the TRA-630 vault to the point it is isolated underneath TRA-635 and is in good condition with no evidence of defects or pitting that would indicate the piping has leaked. Additionally, during initial video inspections, standing water was present in the piping and the piping was essentially full at the low point (gravity-drain line) against the capped end under TRA-635. This water was removed and dispositioned during characterization activities. Line 4” WDC-641 was isolated from 4” WDA-630-A in 2005.[d] The 4” WDA-630-A pipe is empty with normal scaling and residual staining associated with liquid waste piping systems. Small amounts of residual liquid and particles are present within the piping; however, the residues and/or particles do not exceed 5% of the volume of any 1-ft piping length. Action levels were developed for the 4” WDA-630-A piping and are shown in Table 1. Contaminants of concern (COCs) for the 4” WDA-630-A line were developed based on previous characterization data. The COCs for line 4” WDA-630-A are 2-butanone, antimony, arsenic, barium, cadmium, chromium, cyanide, lead, mercury, nickel, trichloromethane, and zinc.

Residual liquid and solids removed from 4” WDA-630-A during sampling efforts (PLN-1984) were characterized and determined to be below the action levels in Table 1.[d] Therefore, no additional activities are required during HWMA/RCRA closure for line 4” WDA-630-A. The characterization information and comparison to the action levels will be documented in the HWMA/RCRA closure certification.

Line 2” SWB-641 will be removed where it is exposed in the TRA-641 canal. The piping that is buried underneath the TRA-641 building footprint and exterior to the facility will be integrity tested, decontaminated, and have final rinsates performed as described above. The COCs for the 2” SWB-641 line were developed based on previous characterization data. The COCs for line 2” SWB-641 are barium, beryllium, cadmium, chromium, lead, mercury, nickel, selenium, silver, thallium, vanadium, zinc, Aroclor-1248, Aroclor-1254, and Aroclor-1260. Action levels for that portion of line 2” SWB-641 remaining in place are shown in Table 2. If a section of line 2” SWB-641 does not pass the integrity evaluation and/or the concentration of COCs in the final rinsates do not meet action levels, then the section of piping will be removed and soil sampling will be performed per the HWMA/RCRA closure sampling and analysis plan (RPT-219).

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c. Quality Inspection Report: PWO-03-195-UT-1A, “Ultrasonic Thickness Inspection (lines in dig #1), May 31, 2006.

d. Project Work Order #PWO-03-195: “TRA-630 Catch Tank Excavation and VCO Work,” January 6, 2005.

Table 1. Derived action levels for VCO SITE-TANK-005 Tank System TRA-009 line 4” WDA-630-A.

COC	Action Level (mg/kg - mg/L rinsate)
2-Butanone	2.1E+01
Antimony	2.1E+01
Arsenic	1.3E+00
Barium	2.1E+01
Cadmium	6.0E–01
Chromium	3.0E+00
Cyanide	2.1E+01
Lead	3.0E+00
Mercury	1.2E–01
Nickel	2.1E+01
Trichloromethane	3.6E+00
Zinc	2.1E+01

Table 2. Derived action levels for VCO SITE-TANK-005 Tank System TRA-009 line 2” SWB-641.

COC	Action Level (mg/kg - mg/L rinsate)
Barium	1.5E+01
Beryllium	1.5E+01
Cadmium	6.0E–01
Chromium	3.0E+00
Lead	3.0E+00
Mercury	1.2E–01
Nickel	1.5E+01
Selenium	6.0E–01
Silver	3.0E+00
Thallium	1.5E+01
Vanadium	1.5E+01
Zinc	1.5E+01
Aroclor-1248	1.2E+00
Aroclor-1254	1.2E+00
Aroclor-1260	1.2E+00

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
- Verification of tank integrity: Addressed under Standard 3, Subsection 4.1.3.1
- Soils: Addressed under Standard 3, Subsection 4.1.3.2.

4.1.3.1 Verification of Tank Integrity. The catch tank (98TRA00483) is a 300-gal poly tank. The receiver tank (99TRA00004) is a 60-gal carbon steel tank. Both tanks are located inside the TRA-641 canal and have not been exposed to the environment. The tanks managed relatively small volumes of waste on a batch process basis. Based on visual inspection of the tanks, there is no evidence of leakage. The tanks are in good condition with no pitting or deterioration and no evidence of waste-related staining (on the tanks or canal floor and walls) indicating overflow or leaks.

Visual inspections performed by qualified INL Quality Assurance personnel confirmed that both the catch tank and the receiver tank had no signs of deterioration (e.g., leaks, cracks, deterioration of joints/welds). The visual inspection also applied to the piping associated with these tanks that is located inside the building (including the Plexiglas mockup drain lines located within the canal, scrub tank drain line to the catch tank, catch tank line to the receiver tank, the portion of line 2” SWB-641 inside the facility, and a portion of 2” SWB-641 in the excavation at the tie-in to line 10” SWC-671). In addition to visual inspections, ultrasonic thickness measurements were obtained on metal piping located within the canal and on the receiver tank. The results of the visual piping and tank inspections and ultrasonic thickness measurements identified three areas of concern, which are discussed below.

- An area approximately 12 in. in length on line 2” SWB-641 in the TRA-641 canal was noted to have external corrosion caused by a leak from a demineralized water line that was located above. The minimum wall thickness was measured as 0.139 in. at this location, which is 0.018 in. less than adjacent sections of the pipe. No evidence of pipe wall perforation was observed within the corroded area and no sign of a waste release was present on the canal floor (i.e., staining).

- The 1 1/2-in. ABS pipe (historically isolated piping) was removed from the Plexiglas mockup tank to the north canal wall in fall 2005. The purpose of this piping is not known; however, it has conservatively been managed the same as the RCRA closure piping. The line was disposed of as hazardous waste (see footnotes a and b on page 6). Visual inspection of the TRA-641 floor beneath the removed portion of this line was free of waste-related staining; therefore, no integrity issues were identified for this portion of the 1 1/2-in. ABS pipe.

  An inspection of the remaining portion of the 1 1/2-in. ABS pipe concluded that there was no evidence of leakage or damage. It was noted in the inspection report that the cap that had historically been installed on the lowest section of this pipe was made of a dissimilar material of construction (PVC versus ABS) than the pipe and that the cap was sealed with silicone, both of which are not appropriate choices for ABS pipe. However, approximately 0.5 gal of liquid was drained from the 1 1/2-in. ABS pipe during pre-closure activities. The fact that this cap and the associated silicone sealant held liquid confirms the integrity of the isolation technique. It was also noted in the inspection report that the seal associated with the 90° elbow in the 1 1/2-in. ABS pipe, where the line penetrated the canal wall, was not bonded. It is difficult to determine whether this was because the solvent bond failed due to cutting activities associated with disconnecting this line from the Plexiglas mockup tank and/or the historical isolation from the catch tank, or whether this elbow was never appropriately bonded. However, there were no signs of leakage from this location (no waste-related staining on the ABS pipe or on the canal wall/floor around this line).

Since there were no integrity issues associated with the 1 1/2-in. ABS pipe, no decontamination activities will be necessary for the TRA-641 floor areas near this line. However, the entire 1 1/2-in. ABS pipe segment will be removed and managed as hazardous waste.

- A gasket associated with one of the receiver tank pumps leaked a small amount of waste to the canal floor (see Figure 4). After removal of the receiver tank, the area impacted by the waste release from the gasket was identified by a small stained area (less than 1-ft^2 area) visible on the painted concrete floor of the canal (see Figure 5).

Of the three concerns identified above, only the failed pump gasket resulted in waste being released to the canal floor. Since portions of the paint in the stained area of the canal floor were found to be damaged (e.g., bare concrete is exposed), this area of the canal floor will be decontaminated using a physical extraction technology such that at least 0.24 in. of the surface layer will be removed and the surface in question, when viewed without magnification, is free of visible waste-related staining.

Figure 4. Photograph of the receiver tank (99TRA00004) and associated pump. The arrow identifies the release from the pump gasket.

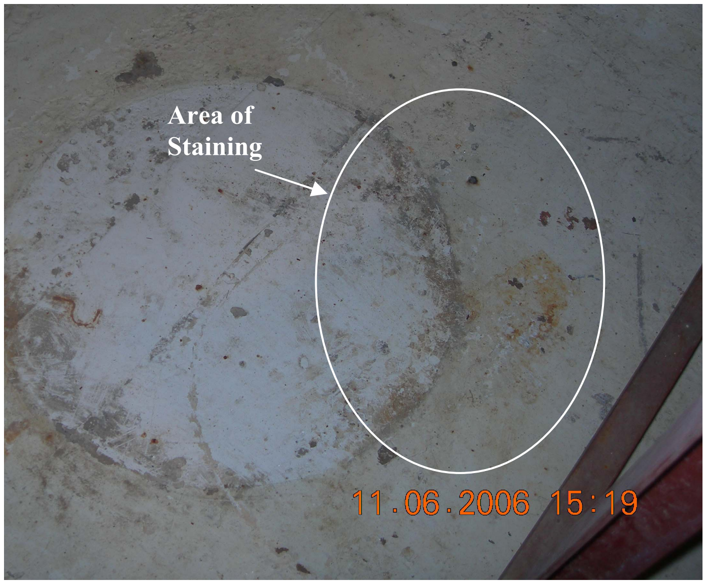

Figure 5. Photograph showing stained area associated with waste released from the failed pump gasket. Photograph was taken after receiver tank (99TRA00004) was removed.

4.1.3.2 Soils. Components for which a soil evaluation is applicable include all components that are in direct contact with soil. This includes line 2” SWB-641 from the receiver tank to the TRA cold waste system line 10” SWC-671. Line 2” SWB-641 will have an integrity evaluation performed for the portions of the piping that are direct-buried. The piping is galvanized, initial material of construction, with no record of leaks or repairs. The integrity evaluation will follow the process described in Subsection 4.1.2.1. In the event that integrity cannot be verified, soil sampling will be performed in accordance with the sampling and analysis plan for this closure (RPT-219).

If soil sampling is required, the COCs for line 2” SWB-641 closure are barium, beryllium, cadmium, chromium, lead, mercury, nickel, selenium, silver, thallium, vanadium, zinc, Aroclor-1248, Aroclor-1254, and Aroclor-1260. If other contaminants are found, they will be evaluated in the risk assessment. Analytical data will be evaluated and the soils will undergo a risk assessment for HWMA/RCRA constituents. The risk assessment methodology is presented in Appendix A. If the risk assessment for HWMA/RCRA constituents indicates soil contamination is present that poses a risk to human health (>1.0E–06), a New Site Identification (NSID) form under the Federal Facility Agreement and Consent Order (FFA/CO) (DOE-ID 1991) will be completed to allow investigation of the contaminated soil under the FFA/CO. Approval of this NSID form by the Agencies, including DEQ and the U.S. Environmental Protection Agency (EPA), is a criterion for certification of closure. However, completion of any follow-on activities for these potential new FFA/CO sites is not a criterion for certification of closure. If the NSID form is not approved by the Agencies, the closure plan will be amended in accordance with Section 7 to address the identified soil contamination. If the risk assessment for HWMA/RCRA constituents indicates that the soils do not pose a risk to human health, no further actions with regard to the soils will be taken under closure.

4.2 Waste Management

Waste generated during closure activities may include nonhazardous industrial waste, radioactive, HWMA/RCRA hazardous, and mixed low-level waste (both radioactive and HWMA/RCRA hazardous). All closure-generated wastes will undergo a hazardous waste determination in accordance with the requirements of IDAPA 58.01.05.006 (40 CFR 262.11) and will be managed per the hazardous waste determination. Table 3 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 will be provided to the independent, registered PE for closure certification and will be maintained as part of the project files.

Table 3. Anticipated waste streams and disposal pathways.

Waste Stream	Description	Anticipated Disposal Pathway
Industrial Waste	PPE, equipment not in contact with hazardous waste, and other miscellaneous wastes	Central Facilities Area landfill
Radioactive or Mixed Waste	PPE and other miscellaneous wastes	RWMC, other low-level waste disposal, or TSDF per hazardous waste determination
Hazardous or Mixed Waste	RCRA closure tanks, piping or piping contents, ancillary equipment, and concrete scabble dust removed from the facility	Permitted TSDF
Rinsate Water	Rinsate from piping decontamination	To be determined based on hazardous waste determination

PPE = Personal protective equipment.
RWMC = Radioactive Waste Management Complex.

5. CLOSURE SCHEDULE

Table 4 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 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.

Table 4. Schedule for closure of VCO SITE-TANK-005 Tank System TRA-009.

Planned Work Tasks	Completion
DEQ approval of closure plan	Day 0
Isolate 2” SWB-641 from 10” SWC-671	Day 30
Remove the receiver tank and catch tank from the canal, verify tank integrity, and scabble floor under receiver tank pump	Day 60
Remove and/or decontaminate piping	Day 80
Sampling activities complete and validated data received	Day 120
Closure-generated hazardous waste transferred to TSDF	Day 160
NSID form submittal	Day 120
NSID form approval	Day 180
Completion of closure activities and disposition of closure-generated waste	Day 180
PE and owner/operator certification submitted to DEQ[a]	Day 240

a. 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.

6. CERTIFICATION OF CLOSURE

Within 60 days of completing the closure activities, a certification of closure of VCO SITE-TANK-005 Tank System TRA-009 will be provided, in accordance with IDAPA 58.01.05.009 (40 CFR 265.115), by an independent, registered PE to the Idaho Cleanup Project operating contractor and DOE-ID. 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-009 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-009 will remain in the VCO project files in the event that this information is requested by DEQ. The tank system is not a hazardous waste disposal facility, and therefore, a “Notice in Deed” and a survey plat are not required.

7. 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, registered PE's certification.

8. 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.

9. REFERENCES

40 CFR 261, "Identification and Listing of Hazardous Waste," *Code of Federal Regulations*, Office of the Federal Register, as amended.

40 CFR 262, "Standards Applicable to Generators of Hazardous Waste," *Code of Federal Regulations*, Office of the Federal Register, as amended.

40 CFR 265, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," *Code of Federal Regulations*, Office of the Federal Register, as amended.

42 USC 6901 et seq., 1976, "Resource Conservation and Recovery Act of 1976," as amended.

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Rolfe, R. L., and E. L. Wills, 1984, *Characterization of the Materials Testing Reactor*, EG&G Idaho, Inc., WM-F1-83-016, 1984.

RPT-219, 2007, *Sampling and Analysis Plan for the HWMA/RCRA Closure of the TRA Fluorinel Dissolution Process Mockup and Gamma Facilities Waste System Voluntary Consent Order SITE-TANK-005 Tank System TRA-009*, as amended.

State of Idaho, 1983, "Hazardous Waste Management," Idaho Statute, Title 39, "Health and Safety," Chapter 44, "Hazardous Waste Management" (also known as the Hazardous Waste Management Act of 1983).

10. DRAWINGS

007428, Reference Drawing, *MTR Catch Tanks Valve and Tank Locations,* MTR-D-4015, Rev. 12, March 1993.

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110615, Reference Drawing, *Gamma Irradiation Facility Piping Layout,* Rev. 3, May 1955.

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Appendix A

HWMA/RCRA Closure Risk Assessment Methodology for Environmental Media

Appendix A

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. 1976) closure of the TRA Fluorinel Dissolution Process Mockup and Gamma Facilities Waste System (VCO SITE-TANK-005 Tank System TRA-009), at the 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, identify the potentially complete exposure routes that will be evaluated by risk assessment, and summarize 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-009, 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 one.

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 in 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.

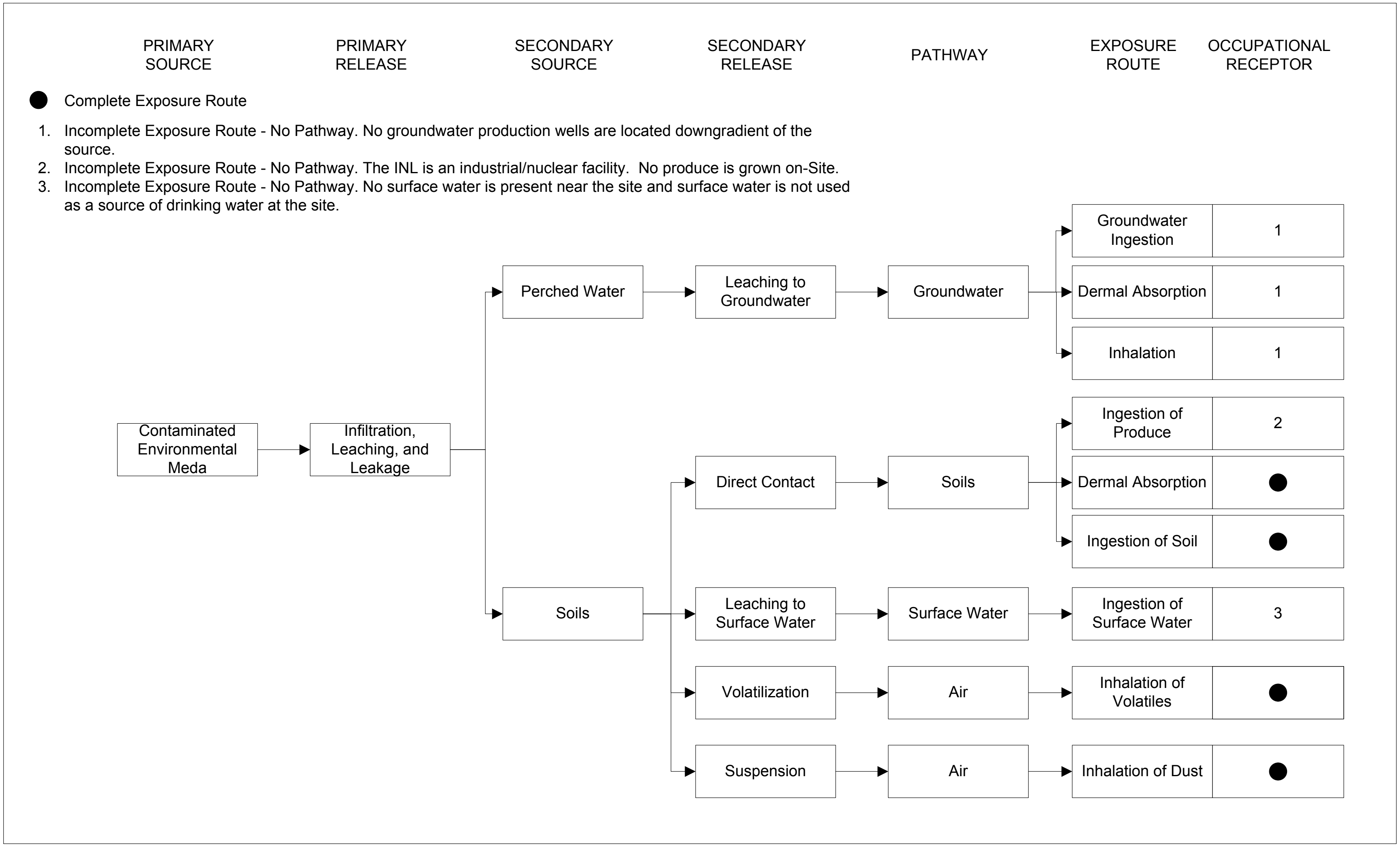

Figure A-1. HWMA/RCRA closure risk assessment conceptual site model.

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 the data quality assessment using EPA-recommended strategies, as presented in *Data Quality Assessment: Statistical Methods for Practitioners* (EPA 2006a) and *Guidance on Systematic Planning Using the Data Quality Objectives Process* (EPA 2006b)

- Contaminants for which there is no EPA-approved toxicity information (e.g., EPA's Integrated Risk Information System [IRIS] [EPA 2006c] or Region 9 PRG Table [EPA 2006d]) 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 data quality assessment 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 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.

$$C_{AIR} = CF \times R \times C_{SOIL} \quad \text{(A-1)}$$

where

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

CF = conversion factor (1.0E–09 kg/μg)

R = RTC respirable particulate matter (14 $\mu g/m^3$) (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)[e]
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.[f]

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

f. 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)
EF	=	exposure frequency (200 events/yr)[g]
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.[h]

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

h. 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)[i]

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.[j]

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

j. 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)[k]

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.[l]

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 2006c) and EPA Region 9 PRG table (EPA 2006d).

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 slope factors (SFs). Slope factors and the estimated daily intake of a compound, averaged over the 25-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 $(\mu g/m^3)^{-1}$.

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

l. 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 then 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 sections.

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.

$$RISK = INTAKE \times SF \qquad \text{(A-2)}$$

where

$RISK$ = potential lifetime excess cancer risk (unitless)

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

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

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:

$$RISK_t = \sum RISK_i \quad \text{(A-3)}$$

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:

$$HQ = \frac{INTAKE}{RfD} \quad \text{(A-4)}$$

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):

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

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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